

Turquoise Coast Development, Jurien Bay

Ardross Estates Pty Ltd

**A report by the Environmental Protection Authority under
Section 16(j) of the Environmental Protection Act 1986**

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Summary

Ardross Estates Pty Ltd (Ardross Estates) proposes to develop a land holding of 2 006 hectares for urban, recreational and tourism purposes near Jurien Bay. The site which is bound by Jurien Bay townsite to the north, the Hill River to the south, the Indian Ocean coastline to the west, and Indian Ocean Drive to the east, contains approximately 1 508 hectares of bushland.

This report provides the Environmental Protection Authority's (EPA's) advice on the environmental factors relevant to the project, to enable the preparation of a Structure Plan for the land that will facilitate environmentally sound development. As this advice is provided under Section 16(j) of the *Environmental Protection Act 1986*, there is no right of appeal.

The EPA commends Ardross Estates on its proactive approach to the incorporation of environmental planning into its overall planning for the site.

In preparing its advice, the EPA has taken into account the Environmental Report (Tingay 2000) prepared by Ardross Estates on the environmental factors relevant to the site and the proposed management of those factors; submissions from the public, organisations and government authorities on the Environmental Report; Ardross Estates' response to a summary of the submissions; further information provided by Ardross Estates, including a Conservation Strategy (Tingay 2001) and the results of a wetlands survey (ATA Environmental 2001); and the EPA's own expertise, site visits, and enquiries.

In considering the proposed development, the EPA has also taken into account that a strategic plan for the region, namely the Central Coast Regional Strategy (Western Australian Planning Commission 1996), has been prepared. The Central Coast Regional Strategy recognises the general environmental values for the region, and sets out a framework for planning and development that limits development to a hierarchy of development nodes. Jurien Bay is identified as the major regional centre for the region.

The EPA considers that the key environmental issue raised by the proposed development is the issue of clearing associated with urban development and its impact on biodiversity within a largely natural part of the coastal zone adjoining the proposed Jurien Bay Marine Park, in the West Midlands region. The West Midlands region is significant as it roughly coincides with the Lesueur Botanic District that is known for its high biodiversity values.

Having regard for the criteria in the EPA's position statement on the environmental protection of native vegetation in Western Australia (EPA 2000), the EPA has concluded that urban development may occur on portions of the site provided that the areas designated for conservation reserves in the Conservation Strategy (Tingay 2001) are retained and protected for their natural values, and that the EPA's advice on each environmental factor relevant to the development of the site is adequately incorporated into the Structure Plan and the subsequent stages of planning and development. The EPA's advice addresses both where and how development may occur to meet environmental objectives.

The EPA considers that it is imperative that a vision for the site is developed to guide this long term project, and to give long term direction to the issues of where and how development may occur. The vision should focus on the integration of development with the natural character and landscape of the region, and the pursuit of environmental sustainability. The EPA envisages the creation of "environmental living zones", being nodes of development in a natural setting.

The EPA expects that natural areas to be retained will include:

- The on-site and off-site reserves shown in Ardross Estates' Conservation Strategy (Tingay 2001). These reserves, to be set aside through the statutory planning process for the primary purpose of conservation, include:
 - * the coastline;
 - * the greater part of the vegetated portion of the beach ridge plain;
 - * a vegetated corridor adjoining the Hill River and its estuary;
 - * all wetlands other than those previously cleared in the beach ridge plain;

- * most of the Spearwood Dunes;
- * prominent landscape elements, and
- * a bushland corridor through the centre of the site of average width of at least 500 metres to include natural sequences of vegetation and typical landscape elements;
- Additional land to be set aside for the primary purpose of conservation, to be determined during the structure planning and subsequent stages of planning following more detailed site surveys and planning for coastal foreshore reserve requirements, buffers around dunes and wetlands (other than the wetlands identified in Tingay 2000), and the protection of targeted flora; and
- Additional areas to be determined during the planning process. Land in this category may include semi-natural multiple use areas serving a local open space function, and land required by management plans eg the Water Management Plan, to protect key ecosystem processes.

On the issue of how development should occur, the EPA expects that urban and tourism development will be planned to support environmental sustainability, consistent with principles, guidelines and environmental management plans developed at appropriate stages of planning and development, commencing at the structure planning phase.

As part of planning for environmental sustainability, important considerations include the efficient use of energy and water, and the conservation of resources. It is expected that the site will be planned to minimise dependence on private vehicular transport and promote a public transport system, and will incorporate the principles of walkable neighbourhoods, “greenhouse” neighbourhoods, local employment and activity centres linking with a public transport network. The subdivisional lot layout should be conducive to energy-efficient housing design and estate maintenance. For example, lots should achieve good exposure for solar energy systems.

The EPA expects that a range of environmental management plans will be prepared at appropriate stages of the planning process before development, consistent with the vision for environmental sustainability for the site, and that these plans will be subsequently implemented. Key matters requiring environmental management plans include:

- Water, including water supply, stormwater management and environmental water needs;
- Conservation reserves, including coastal, riverine and wetland areas, and other conservation corridors; and
- Wastes, including liquid and solid wastes.

With respect to future proposals for the site, the EPA expects that general urban development that complies with the advice in this report is not likely to require formal assessment in the foreseeable future. However, the EPA retains the ability under the Environmental Protection Act 1986 to assess any proposal that may have a significant impact on the environment.

1. Introduction and background

1.1 The purpose of this report

The primary purpose of this Environmental Protection Authority (EPA) report is to provide environmental advice under Section 16(j) of the *Environmental Protection Act 1986* on the key environmental factors relevant to the development of the land zoned "Special Development" south of Jurien Bay, to enable appropriate responses to the environmental factors to be incorporated into the Structure Plan and subsequent stages of planning and development for the site. Because the EPA reports publicly its advice can be seen and considered by the public, industry, State and Local Government and other stakeholders.

1.2 The project and project site

The proposed development of the 2 006 hectare "Special Development" zone is known as the Turquoise Coast Development. The land owner, Ardross Estates Pty Ltd (Ardross Estates), proposes a long-term development of this land for urban, recreational and tourism purposes.

The site is shown in Figure 1. The site extends from Jurien Bay town site to the Hill River, and from the coast to the recently constructed Indian Ocean Drive. The regional setting for the site is shown in Figure 2.

The expected stages in the development process following the provision of the EPA's advice include the preparation of an overall Structure Plan for the site, then the preparation of detailed Development Plans and subsequent subdivision applications.

The site contains approximately 1 508 hectares of bushland. The remaining 498 hectares have been cleared and are used for grazing sheep. The northern portion of the site is mostly beach ridge plain, and includes part of a large tombola or cusplate foreland. The greater part of the beach ridge plain has been cleared for agriculture but there are areas of natural vegetation on the western and south-eastern parts of the cusplate foreland, and on the eastern part of the older beach ridge plain. Coastal dunes adjoin the coastline.

The southern portion of the site comprises a series of north-trending parabolic Quindalup Dunes and an area of older limestone-based Spearwood Dunes in the east. A number of seasonal wetlands have developed in coastal dune swales. The Hill River and its estuary form the southern boundary of the site.

An outline of the project is provided in Sections 1 and 2 of Tingay (2000).

1.3 Background

Jurien Bay has been identified as the major regional centre for the Central Coast under the Central Coast Regional Strategy (Western Australian Planning Commission 1996). The Central Coast Regional Strategy identifies the northern section of the Ardross Estates properties as a key area for the urban development of Jurien Bay, and mentions that the southern section to the Hill River offers expansion potential in the longer term.

The site is the subject of a Memorandum of Understanding signed in 1997 between Ardross Estates, the Western Australian Planning Commission (WAPC) and the Dandaragan Shire Council to facilitate urban expansion and resort development at Jurien Bay.

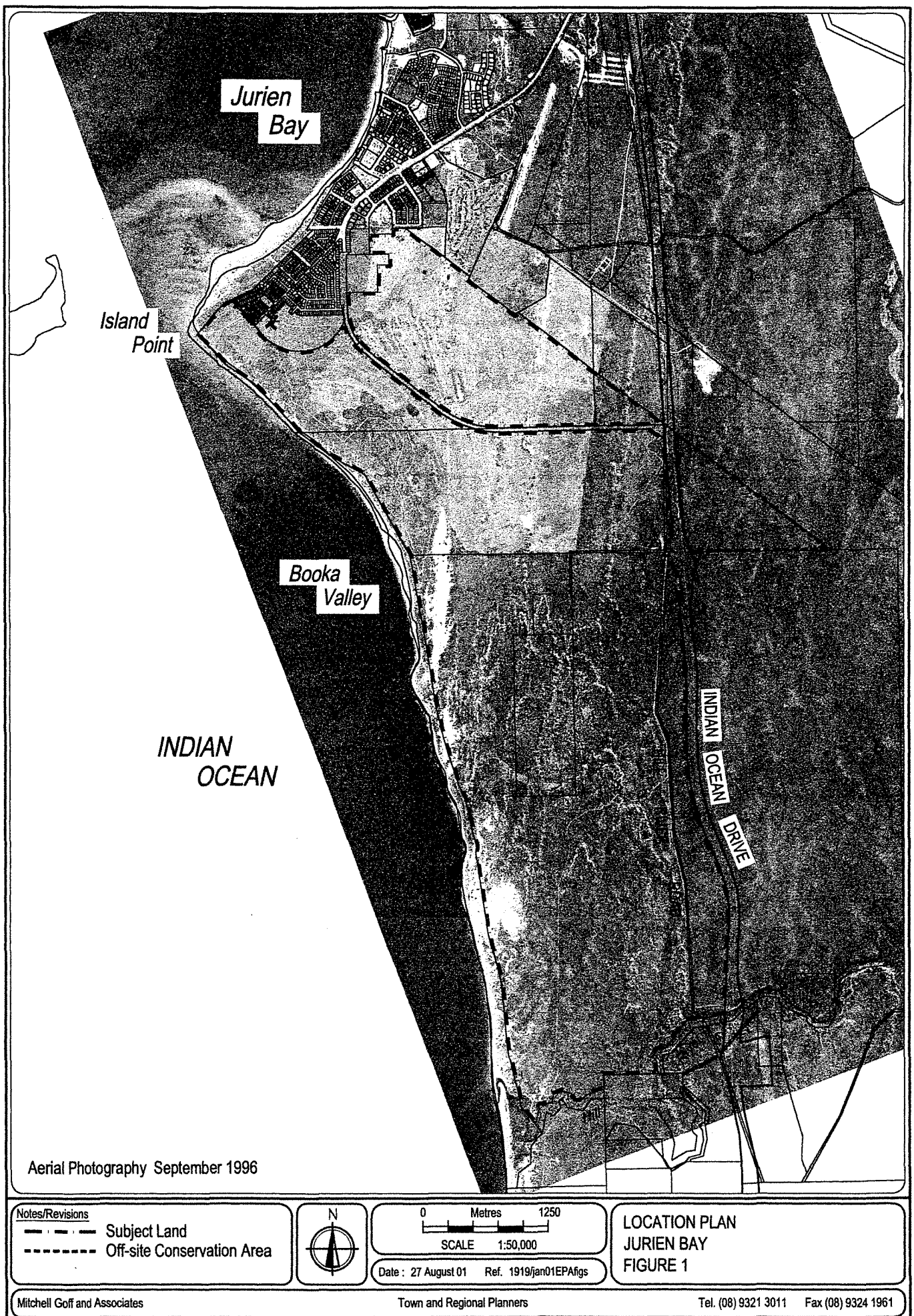


Figure 1. Location of site.

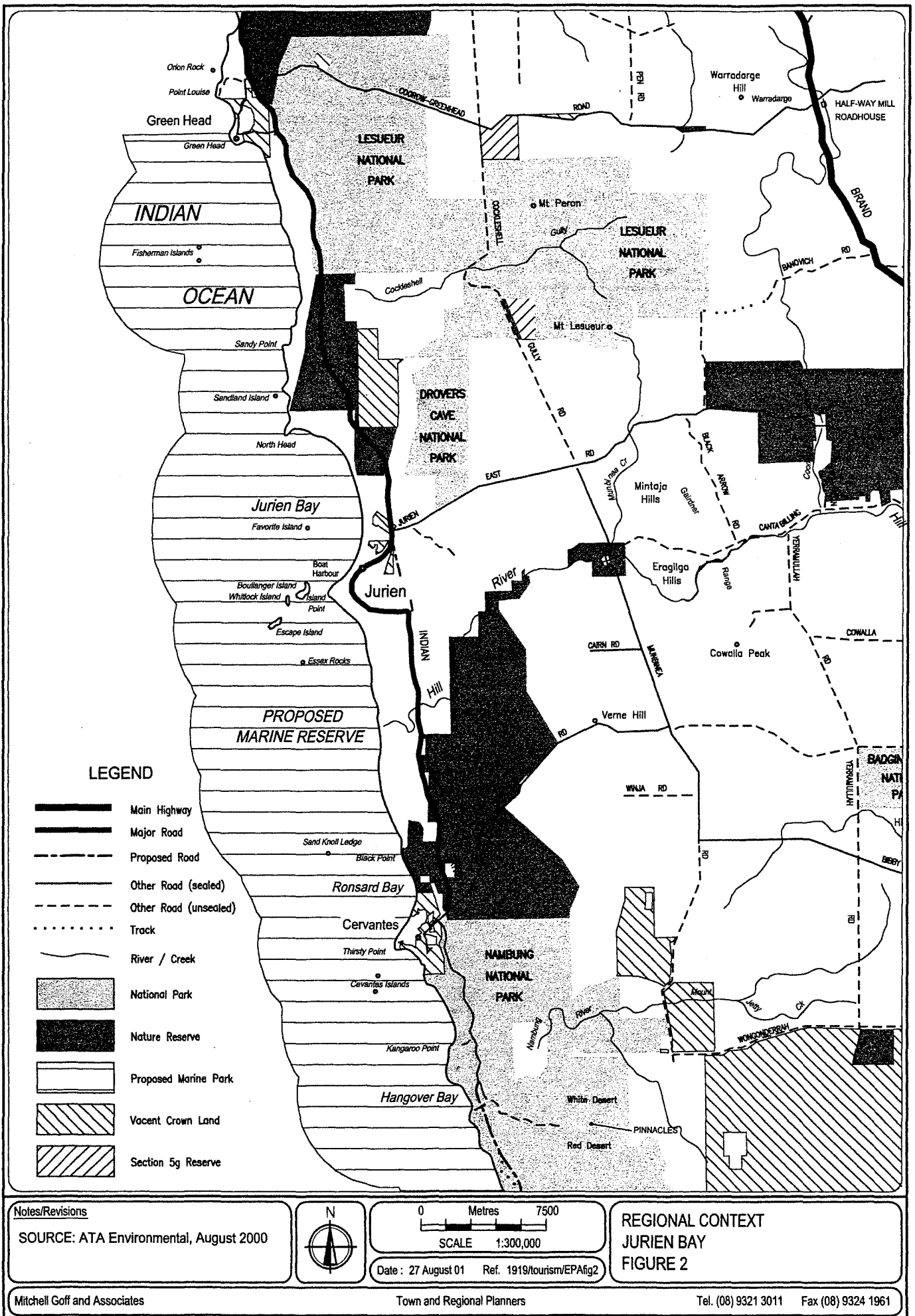


Figure 2. Regional context.

The EPA was not able to formally assess Amendment No. 13 to the Shire of Dandaragan Town Planning Scheme No. 6 that rezoned the site to "Special Development". This is because Amendment No. 13 was initiated before the promulgation of the changes to the *Environmental Protection Act 1986* in 1996 which allow the EPA to undertake environmental impact assessment of scheme amendments.

Ardross Estates has participated cooperatively in the EPA's consideration of the proposed development to ensure environmental scrutiny at the earliest stages and to highlight significant environmental values.

1.4 The role of the EPA

The EPA considers that it is timely to provide Section 16 advice before the preparation of a Structure Plan for the site, as the proposed development involves the clearing of coastal bushland and the introduction of an urban population and services that may result in significant environmental impacts.

It should be noted that advice issued by the EPA under Section 16 of the *Environmental Protection Act 1986* does not constitute a formal assessment or approval by the EPA. The purpose of the advice is to provide independent guidance on environmental issues to the land owner and government agencies at a stage when formal assessment by the EPA under Part IV of the *Environmental Protection Act 1986* is not possible. There is no right of appeal against Section 16 advice.

Providing that the advice is followed, it is likely that proposals for the site of a general urban nature would not require formal assessment under Part IV of the *Environmental Protection Act 1986*. Specific proposals such as a marina, aquaculture development, water extraction or waste water treatment may require referral to the EPA under Section 38, and assessment, depending on the particular characteristics of the proposal.

1.5 The procedures leading to the EPA's advice

The EPA has provided advice on the proposed Turquoise Coast Development after completion of the procedures below:

- Preparation by Ardross Estates of an Environmental Report (Tingay 2000) on the preliminary environmental factors considered relevant to the project, and the proposed management of those factors;
- Release of the Environmental Report (ER) for public comment for 8 weeks between 28 August 2000 and 23 October 2000 (ten submissions were received – one from an individual, three from conservation organisations and six from government departments);
- Response by Ardross Estates on a summary of the submissions;
- Preparation of draft advice by the EPA and the Department of Environmental Protection (DEP) to Ardross Estates recommending inter alia the preparation of a Conservation Strategy for the site;
- Preparation of a Conservation Strategy (Tingay 2001) and commissioning of a wetland survey (ATA Environmental 2001) by Ardross Estates, and modification to the proposed conservation areas shown in the ER; and
- Consideration by the EPA of the information in the ER; submissions from the public, organisations and government authorities on the ER; Ardross Estates' response to a summary of the submissions; further information provided by Ardross Estates, including the Conservation Strategy; and the EPA's own expertise, site visits, and enquiries.

1.6 Sections of this report

Section 2 discusses the environmental issues considered by the EPA to be relevant to the structure planning stage of the Turquoise Coast Development. The future role of the EPA with respect to the development of the site is discussed in Section 3. Section 4 provides other EPA advice and Section 5 sets out the EPA's conclusions.

Appendix 1 lists references, while Appendices 2 and 3 contain a list of submitters and a summary of their submissions. Ardross Estates' response to the submissions is in Appendix 4. Appendix 5 contains the Strategy for Nature Conservation and Biodiversity prepared for Ardross Estates (Tingay 2001).

2. Environmental issues

The EPA has decided to provide advice on the following environmental issues in relation to the proposed urban development, known as the Turquoise Coast Development:

- (a) Nature conservation and biodiversity;
- (b) Declared rare and priority flora, and other significant flora;
- (c) Hill River and estuary;
- (d) Wetlands;
- (e) Coastline;
- (f) Beach ridge plain;
- (g) Landform and landscape;
- (h) Ground and surface water;
- (i) Solid and liquid waste disposal;
- (j) Marine environment;
- (k) Enhanced greenhouse effect; and
- (l) Environmental sustainability.

The above issues were identified from the EPA's consideration and review of the environmental factors discussed in the Environmental Report on the proposed Turquoise Coast development (ATA Environmental 2000) and the submissions received, in conjunction with the project characteristics.

The EPA considers that the key environmental issue raised by the proposed development is the issue of clearing for urban development and the effects of clearing on nature conservation and biodiversity in a locality of environmental significance. As this issue is identified as the key issue and interrelates with all the other factors above, this issue is addressed first and at greater length.

The EPA recognises that the site of the Turquoise Coast Development is of particular environmental significance as it is located within a largely natural section of coastline adjoining the proposed Jurien Bay Marine Park, in the West Midlands region. The West Midlands region is significant as it roughly coincides with the Lesueur Botanic District (Griffin 1998) that is known for its high biodiversity values.

The EPA is prepared to consider the development of the site as urban expansion into the site is generally consistent with the Central Coast Regional Strategy (WAPC 1996). The draft Central Coast Regional Strategy was reviewed by the EPA (EPA 1994). The EPA considered that it provided a basis for commencing studies required for sound environmental planning of the region. Under the Central Coast Regional Strategy, Jurien is to be promoted as the regional centre for the Central Coast.

In providing advice, EPA has kept in mind the following key principles:

- To promote environmental sustainability;
- To conserve Western Australia's biological diversity;
- To prevent adverse effects on interdependent elements of natural systems;
- To make decisions in a cautious way where there is lack of certainty about potential impacts and cumulative effects on the environment; and
- To prevent pollution.

The EPA has also kept in mind the main issues identified in “state of the environment” reporting for Western Australia (Government of Western Australia 1998) and the need to protect the community’s “social surroundings” as they relate to the environment.

Taking into account the above, the EPA does not believe that conventional urban development in the style of Perth metropolitan urbanisation is appropriate for the site. As discussed in this report, the EPA prefers the concept of nodes of development within a natural setting incorporating the principles of environmental sustainability.

A description of the environmental factors considered by the EPA and the EPA’s advice on the protection and management of these factors, in relation to the development of a Structure Plan and subsequent planning proposals for the site, is contained in Sections 2.1 to 2.12. For each factor, the EPA describes potentially significant aspects of the factor, a summary of submissions from the public and government agencies, the land owner’s commitments to managing the factor, the EPA’s objectives, and the EPA’s advice.

2.1 Nature conservation and biodiversity

The Environmental Report (Tingay 2000) prepared for Ardross Estates and more particularly the Conservation Strategy (Tingay 2001), have identified major conservation measures for the subject site including the identification of portions of the site to be excluded from development and set aside for conservation purposes.

This section of the EPA’s report addresses the issue of biodiversity protection and nature conservation, and assesses the proposed conservation measures with respect to the protection of biodiversity and nature conservation for the site. The section begins with a discussion on the issue of biodiversity protection and the EPA’s position on the clearing of native vegetation.

Strategic context

The project envisages the clearing and development of land for urban and tourism purposes. Development areas are to be surrounded by a network of conservation reserves, and will include internal public open space areas.

It is well recognised that broad scale land clearing has had a critical effect on biological diversity and ecosystem processes. These impacts have been documented in reports by both the State Government and Commonwealth Government (Government of Western Australia 1998 and Commonwealth of Australia 1996).

Significant policy initiatives have been developed to address the issue of the protection of biodiversity at both Commonwealth and State Government levels. The National Strategy for the Conservation of Australia’s Biological Diversity (Commonwealth of Australia 1996) commits the Commonwealth and each State Government to:

“arresting and reversing the decline of remnant native vegetation”; and

“avoiding or limiting any further broad-scale clearance of native vegetation, consistent with ecologically sustainable management and bio-regional planning, to those instances where regional biological diversity objectives are not compromised” (Commonwealth of Australia 1996).

The Western Australian Government, in its election policy statement, has specifically committed to:

- declare a moratorium on clearing and drainage until the relevant catchment management plans are in place;
- review and amend the environmental impact assessment process to ensure the protection of biodiversity and ecological integrity on a regional scale; and
- encourage the management of remnant native vegetation, including rehabilitation and fencing, with an emphasis on the long-term maintenance of nature conservation values in each sub-catchment.

The EPA considers that protection of biodiversity is one of Western Australia's highest priority environmental issues. Land clearing is associated not only with the loss of biodiversity but also with a range of other significant environmental issues, such as enhanced greenhouse effect, salinisation, eutrophication, loss of fringing vegetation, erosion, and degradation and contamination of the marine environment.

Because of the extensive clearing of land which has occurred in the south west region of the State for agriculture, the EPA has set down its view on land clearing in a Position Statement entitled "Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area" (EPA 2000). While the Position Statement was prepared primarily in relation to agricultural land clearing, it also outlines the EPA's position more generally in relation to the protection of vegetation.

The proposed development is in the "agricultural area" defined in the EPA's Position Statement. The EPA has indicated that for clearing to be considered environmentally acceptable in this area, the following key criteria would need to be satisfied:

- The proposed land use addresses alternative mechanisms for protecting biodiversity. The EPA would like to see an overall environmental benefit as a result of the project.
- The area proposed for clearing is relatively small, depending on the scale over which significant biodiversity changes occur in the particular area, including the extent of vegetation in the surrounding area.
- The project is consistent with the principles of the National Strategy for the Conservation of Australia's Biological Diversity.
- It is demonstrated that all reasonable steps have been taken to avoid disturbing native vegetation.
- No known species of plant or animal, or community of plants or animals, will become extinct as a result of the project.
- The risks to threatened species do not exceed acceptable levels.
- No vegetation type will be taken below 30% of the pre-clearing extent of the vegetation type.
- There is a comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area.
- If the project area is large, the project area itself will include a comprehensive and adequate network of conservation areas and linking corridors, and the integrity and biodiversity of these areas will be secure.
- Land degradation including aquatic environments and threatening processes on-site and off-site will not be exacerbated.

(From Sections 4.2 and 4.3 EPA 2000)

In considering the extent of clearing on this site, the EPA is mindful that the property is already zoned for urban development and that a Memorandum of Understanding has been entered into to facilitate development for urban and other purposes. This report is therefore not focussed on whether clearing can occur, but rather to what extent it may occur, and the identification of the environmental values that should be protected.

Regional and local context

The 2 006 hectare Turquoise Coast development site lies on the Swan Coastal Plain adjoining the Indian Ocean, and contains two major surface geology systems namely the Quindalup Dunes and the Spearwood Dunes (Trudgen 1966). Approximately 498 hectares of the site have previously been cleared, and the native flora in this area has been almost entirely replaced by exotic species (Trudgen 1996). The remaining 1 508 hectares generally comprises bushland, exposed sand and tracks.

The site is in the West Midlands region which is known for its high biodiversity values including mega diverse flora, and rapid replacement of species (EPA 2000), and for species at their southern or northern limit (Burbidge, Hopper and van Leeuwen 1990). However, it is the Eneabba-Mt Lesueur area that is known for its extremely rich flora rather than the coastal area (Burbidge, Hopper and van Leeuwen 1990).

The conservation reserves in the vicinity of the subject land are shown on Figure 2.

Biological surveys of the site

The site has been the subject of a four day flora and vegetation survey undertaken for Ardross Estates by botanist Malcolm Trudgen. Trudgen identified 15 vegetation units on the site, relating to geomorphologic elements of the Quindalup and Spearwood Dunes (Trudgen 1996). The vegetation units identified by Trudgen are shown in Figure 3.

Key vegetation and flora identified by Trudgen (1996) comprise:

- the beach ridge plain vegetation;
- the vegetation of the seasonal wetlands;
- the vegetation of the Hill River estuary and channel;
- the vegetation of the lower sandy slopes of the Spearwood Dunes next to the boundary of the Quindalup Dunes; and
- seven species located on the site that are uncommon, poorly known, restricted in distribution or are at the end of their range.

A fauna survey of the site was undertaken for Ardross Estates over two days and involved opportunistic observations and active searching by ATA Environmental (Tingay 2000). Fauna studies of other sites in the locality are also referred to in the Environmental Report (Tingay 2000). These comprise a fauna survey of the Indian Ocean Drive alignment (ecologia 1997) and two fauna surveys near Jurien Bay. The Environmental Report (Tingay 2000) concludes that two or three species of Priority 4 vertebrate species may be present in small numbers. The Little Bittern (*Ixobrychus minutus*) and the Water Rat (*Hydromys chrysogaster*) may be present near the Hill River, and the Western Brush Wallaby (*Macropus irma*) may be found throughout the site in small numbers.

Studies of the conservation status of the vegetation of the region

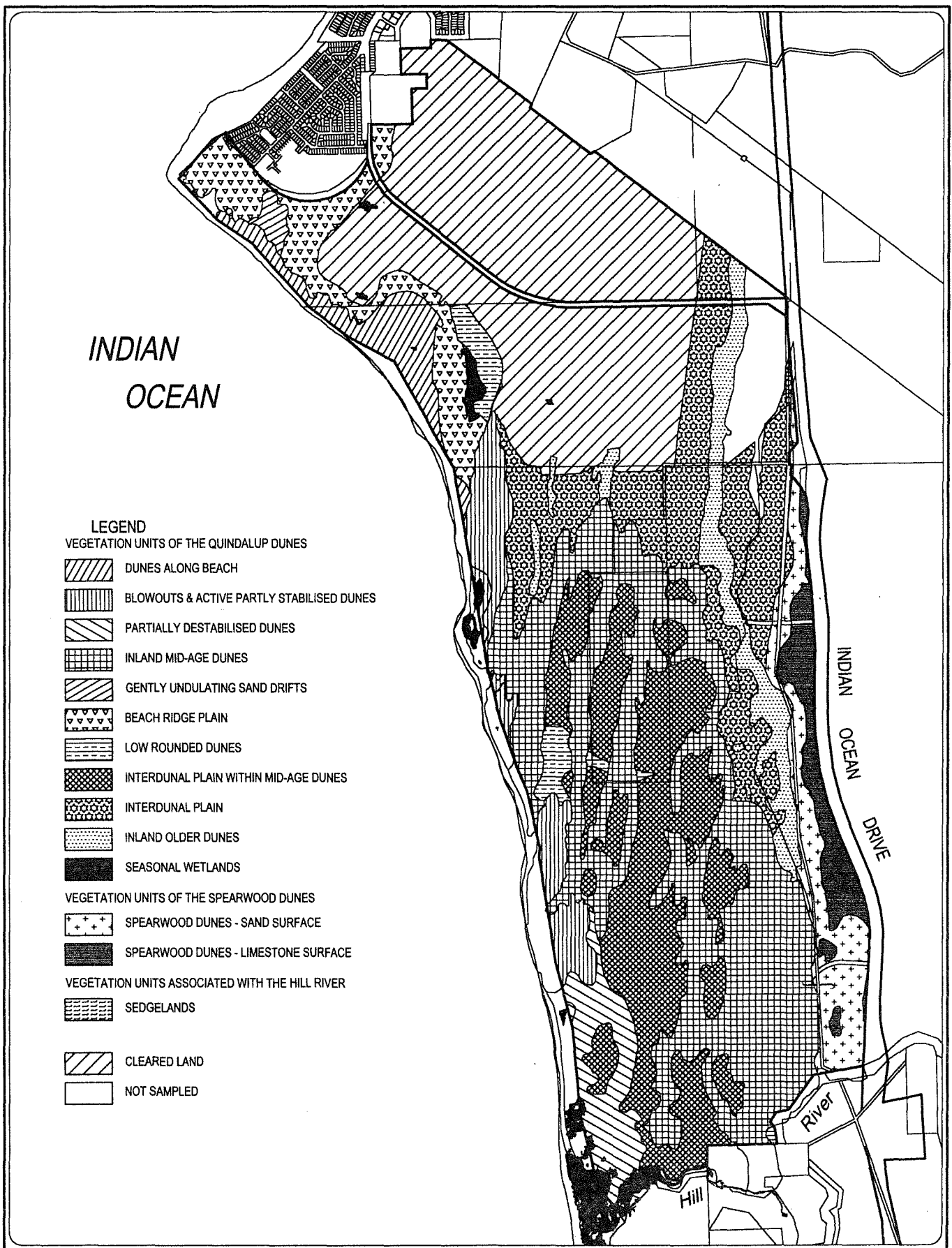
This section describes analyses of the conservation status of regional vegetation units as mapped and described by Beard (1979) and the Department of Conservation and Land Management (CALM), and surveys undertaken by Griffin (1993).

Beard Vegetation Types

The Western Australian vegetation types as described and mapped at a scale of 1:250 000 by Beard (1979) have been used in analyses by the Department of Environmental Protection (DEP) of the status of the vegetation of the West Midlands area. Three of the vegetation types mapped by Beard occur on the site, as shown in Figure 4. These are the types "*Shrublands; scrub-heath*", "*Mosaic: Shrublands; Acacia lasiocarpa and Melaleuca acerosa heath / Shrublands; Acacia rostellifera and Melaleuca cardiophylla thicker*" and "*Bare areas; drift sand*".

The DEP studies found that native vegetation persists over 80% of the original extent of the mapping unit known as "*Shrublands; scrub-heath*", and persists over 81% of the mapping unit known as "*Mosaic: Shrublands; Acacia lasiocarpa and Melaleuca acerosa heath / Shrublands; Acacia rostellifera and Melaleuca cardiophylla thicker*". For the vegetation type "*Bare areas; drift sand*" the DEP studies found that 100% of the original extent of vegetation remains. (See Table 1.)

As also shown in Table 1, the vegetation on the site contributes between 0.1% and 1.6% of the vegetation remaining in each of the above three Beard vegetation types in Western Australia.



<p>Notes/Revisions</p> <p>SOURCE: ATA Environmental, August 2000</p>	<p>N</p>	<p>0 Metres 1000</p> <p>SCALE 1:40,000</p>	<p>VEGETATION UNITS & WETLANDS</p> <p>JURIEN BAY</p> <p>FIGURE 3</p>
<p>Date : 27 August 01 Ref. 1919/EPA-Fig3veg</p>		<p>Mitchell Goff and Associates Town and Regional Planners Tel. (08) 9321 3011 Fax (08) 9324 1961</p>	

Figure 3 . Vegetation units and wetlands

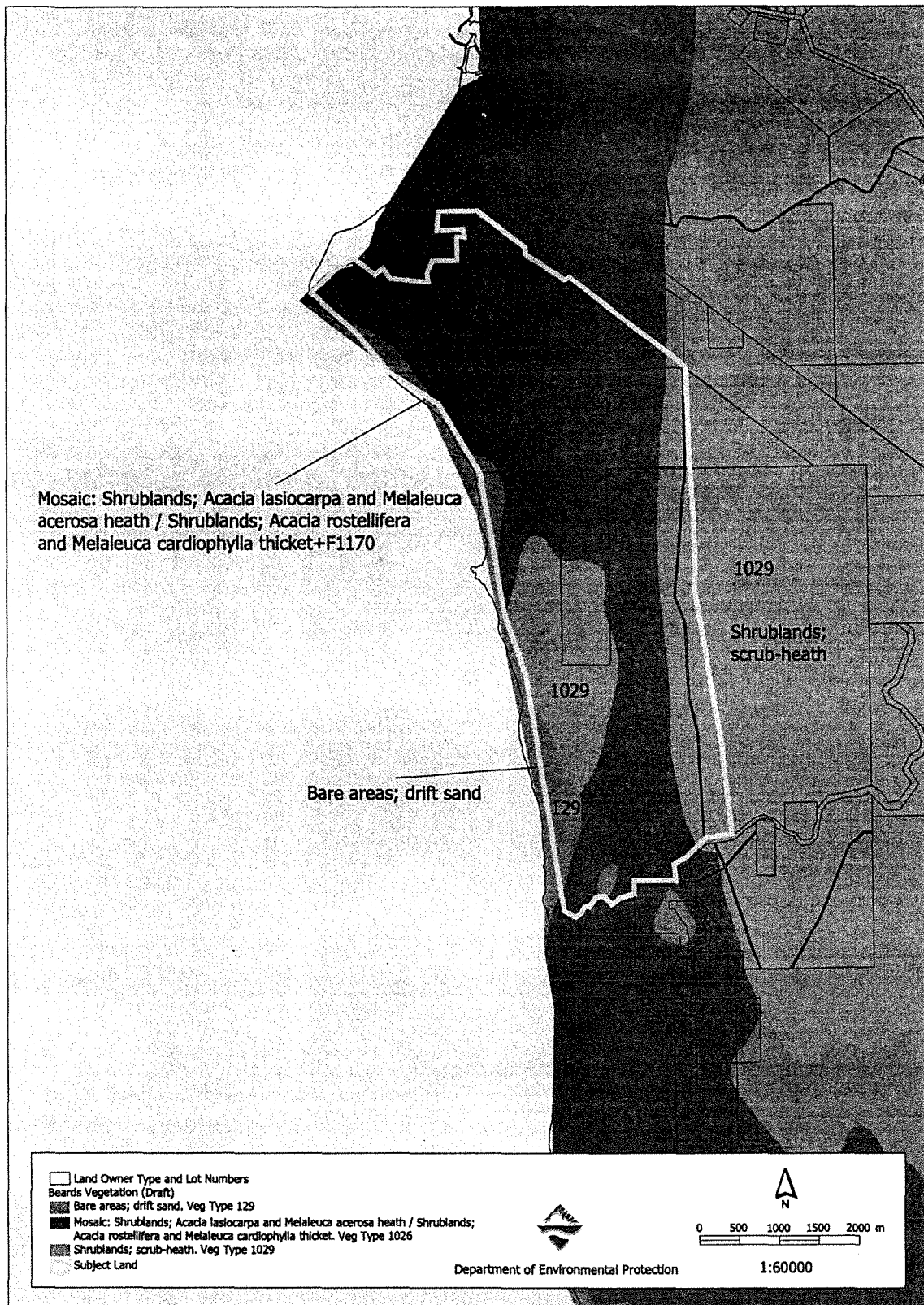


Figure 4: Beards Vegetation Types

The conservation status of each of the Beard vegetation types has been assessed by Angus Hopkins (Hopkins 1996). Hopkins established that 45.1% of the original extent of the Beard vegetation type “*Mosaic: Shrublands; Acacia lasiocarpa and Melaleuca acerosa heath / Shrublands; Acacia rostellifera and Melaleuca cardiophylla thicket*” remains in secure CALM reserves. The corresponding figures for the vegetation types “*Shrublands; scrub-heath*” and “*Bare areas; drift sand*” are 17.1% and 52.9% respectively, as shown in Table 1 below.

Table 1 – Conservation status of the Beard vegetation types on the site

<i>Beard vegetation type</i>	<i>Original area of vegetation type in Western Australia</i>	<i>Area of native vegetation remaining in the vegetation type in 1996 (area of vegetation remaining as a percentage of the original extent of the vegetation type)</i>	<i>Area of all CALM conservation reserves in the vegetation type (area of conservation reserves as a percentage of the original extent of the vegetation type)</i>	<i>Area of vegetation type in National Parks, Nature Reserves, and Conservation Parks (area of National Parks etc as a percentage of the original extent of the vegetation type)</i>	<i>Area of native vegetation remaining on the property within the Beard vegetation type</i>	<i>The area of native vegetation on the property as a percentage of the area of native vegetation remaining in the vegetation type</i>
Shrublands; scrub-heath	59 951 ha	47 961 ha (80%)	17 624 ha (29.4%)	10 273 ha (17.1%)	567 ha	1.1%
Mosaic: shrublands; Acacia lasiocarpa and Melaleuca acerosa heath/ Shrublands; Acacia rostellifera and Melaleuca cardiophylla thicket	64 596 ha	52 323 ha (81%)	32 805 ha (50.8%)	29 114 ha (45.1%)	836 ha	1.6%
Bare areas; drift sand	83 522 ha	83 522 ha (100%)	45 300 ha (54.2%)	44 193 ha (52.9%)	107 ha	0.1%

Data derived from DEP studies and Hopkins (1996). Location of vegetation types shown on Figure 4.

Vegetation mapping of the West Midlands by CALM

The Beard mapping units provide a means for making comparisons on a State-wide basis. However, they are not ideal for more detailed analyses since they have been developed from information that is more limited than is available today.

Recently CALM has mapped the vegetation subsystems of the West Midlands. The mapping by CALM is part of a joint study of the vegetation subsystems of the West Midlands area by the DEP and CALM. The study is not complete at the date of publication of this report. However, interim information is available for the vegetation subsystems on the site, as shown in Table 2. It is noted that the vegetation subsystems at this stage are numbered, but have not yet been described. The location of the subsystems is shown in Figure 5.

The information in Table 2 shows that native vegetation remains on 74% of mapping unit no. 4 (the vegetation subsystem that adjoins the coast between Jurien and Lancelin) and that native vegetation remains on 95% of mapping unit no. 6b (a subsystem over portion of the Spearwood Dune system).

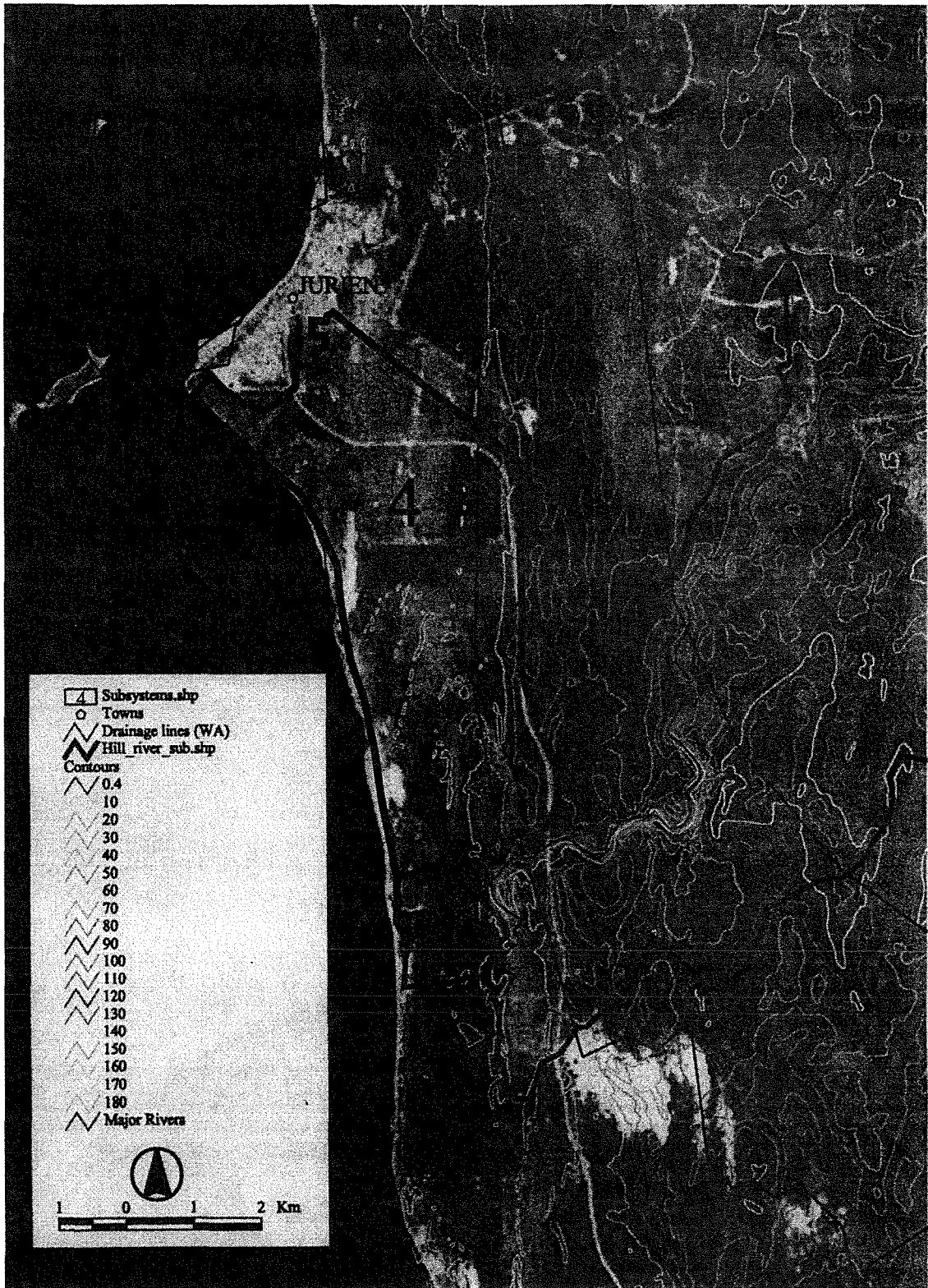


Figure 5 . CALM vegetation subsystems.

The DEP studies indicate that 51% of mapping unit no. 4 is in conservation reserves, and that the corresponding figure for mapping unit no. 6b is 41%.

The vegetation on the site contributes between 2% and 4% of the vegetation remaining in these vegetation subsystems in the West Midlands region (See Table 2).

Table 2 – Conservation status of the vegetation subsystems of the West Midlands on the site (interim findings)

<i>Vegetation subsystem</i>	<i>Total area of vegetation subsystem within the West Midlands study area</i>	<i>Area of native vegetation remaining in the vegetation subsystem (area of vegetation remaining as a percentage of the total area of the vegetation subsystem)</i>	<i>Area of the vegetation subsystem in conservation reserves (area of conservation reserves as a percentage of the total area of the vegetation subsystem)</i>	<i>Area of native vegetation cover remaining on the property in the subsystem</i>	<i>For each vegetation subsystem, the remaining native vegetation on the site as a percentage of the total vegetation remaining in the subsystem</i>
4 (subsystem adjoining the coast – Jurien to Lancelin)	64 313 ha	47 899 ha (74%)	32 894 ha (51%)	1 200 ha	2%
6b (subsystem over portion of Spearwood Dune system)	7 509 ha	7 162 ha (95%)	3 081 ha (41%)	300 ha	4%

Data derived from DEP studies and CALM mapping of the vegetation subsystems of the West Midlands. Location of vegetation subsystems shown on Figure 5.

Griffin's studies of the flora of the Quindalup Dunes

The flora of the Quindalup Dunes and conservation priorities for the Quindalup Dunes have been described by Edward Griffin (Griffin 1993). Most of the site falls within the Quindalup Dunes system, in Griffin's sector V4 "North of Jurien Bay to Lancelin". Griffin's recommendations for this sector relevant to the subject land were:

- The northern part of the Jurien beach ridge plain should be protected in a reserve which would allow for the study of the Holocene depositional history; and
- Land should be acquired to ensure the protection of the Hill River mouth and immediate surrounds.

Griffin advised in 2000 (Griffin 2000) that the vegetation of the Quindalup Dunes shows a strong relationship to landforms, and that in his view most of the landforms of the site are likely to be well conserved in Crown reserves. Those portions of the site that are likely to be poorly conserved are the mouth of the Hill River and the beach ridge plain on which Jurien sits.

Submissions

Comments from the public, conservation groups and government agencies on the Environmental Report, relevant to the issue of nature conservation and biodiversity, are summarised below.

Public and conservation group submissions on the Environmental Report

- The flora and fauna studies are inadequate. Without these studies it is impossible to determine with any degree of confidence the impact of the Turquoise Coast Development on the biodiversity of the area.

- This is a large development that involves the loss of a large amount of native vegetation and will degrade the biodiversity and conservation value of the area.
- Further loss of native vegetation in Western Australia is unacceptable.
- The biodiversity of the Central Coast Region is one of the highest in Australia and is significant on a global scale. Few pristine areas remain particularly close to Perth. An extensive reserve system is not a reason for a large scale urban development such as the Turquoise Coast Development.
- It is important to have conservation outside of reserves - local conservation.
- The mixture of Quindalup and Spearwood vegetation, the Hill River, the estuary and the coast means complex interactions between these systems. They are also fragile. It will be difficult to manage and maintain the natural condition of the systems once development proceeds, even under the proposed reserve scheme.
- The project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected. The reserves proposed by the landowner should be enlarged, more conservation areas should be added, and these should be linked with corridors of conserved land. It is not enough to say there is a lot of land in conservation reserves in the region.
- The impact of introduced weeds must be considered. Coastal vegetation is easily invaded by some garden plants. Fertiliser drift and watering of gardens will increase weed invasion and growth.
- In order to further protect the reserves it would be best if only recreational zones were placed next to the reserves.
- The proposed development is too large, both in the context of the projected population growth for Jurien Bay, and its impact on biodiversity.
- The biggest unanswered question is the justification for such a large development. There needs to be a thorough examination to substantiate the need and demand for a development on the large scale proposed.
- The Environmental Report has ignored the potential for cumulative effects in the region as a result of the development.
- If the EPA allows a development of this size on natural land in the Central Coast Region it will set a precedent for development in the area.

Government agency submissions on the Environmental Report

- The Commissioner for Soil and Land Conservation has no objections on land degradation grounds to the proposal.
- The Ministry for Planning (MfP) advises that the Western Australian Planning Commission (WAPC) has entered into a Memorandum of Understanding with Ardross Estates to facilitate and guide the development of the land, and that the environmental issues of concern to the Ministry include provision of an adequate foreshore reserve along the coast and the Hill River, protection of any significant wetlands and flora and fauna, landscape amenity issues, provision for a full range of recreation opportunities, and public access to the coast and river.
- CALM informs that the northern cleared area supports significant weed infestation, and recommends that the proponent develop a strategy as soon as practical to control Patterson's Curse that represents a significant threat to areas of remnant vegetation to be retained.

Land owner Commitments

To address the issue of the nature conservation and the protection of biodiversity, the landowner has committed to a range of environmental management measures to apply to future development plans for the site. The commitments made by the land owner in the Environmental

Report (Tingay 2000) and the land owner's response to submissions have been amplified in the land owner's Conservation Strategy (Tingay 2001). The modified commitments that address the protection of biodiversity, flora and fauna, are summarised below:

- establish conservation reserves on the site to protect the key environmental features, including the coastline, the Hill River and its estuary, wetlands, a vegetated portion of the beach ridge plain at Island Point, and the lower slopes of the Spearwood dunes (see Figures 6 and 7);
- establish conservation reserves on the site to protect a transept of vegetation and landform types (the proposed transept forms an east-west corridor roughly through the centre of the site as shown on Figures 6 and 7);
- cede for conservation purposes an 86 hectare lot owned by Ardross Estates Pty Ltd (this lot is on the east side of the development site as shown in Figure 6);
- prepare Management Plans for the above reserves;
- retain additional vegetation and fauna habitat in multi-purpose public open space reserves;
- liaise with CALM regarding the major neighbouring reserves and proposed Marine Park to ensure that population growth in the region can be managed without detriment to the environmental values of CALM reserves;
- consult with CALM, as is occurring at the time of publication of this report, to determine CALM's requirements for protection of flora priority species and species of interest; carry out targeted flora surveys, and subsequently cede land to the satisfaction of CALM if significant species are identified; and
- incorporate a series of environmental management measures in all future development plans to ensure ongoing environmental protection as the population expands (these measures to include best management practices of water sensitive urban design to minimise the pollution of sensitive environments and prevent adverse impacts on the hydrology of wetlands and the Hill River).

EPA objectives and discussion

The EPA's environmental objectives for this issue are to:

- maintain biological diversity;
- manage clearing consistent with the criteria in the EPA's position statement on the clearing of native vegetation in Western Australia (EPA 2000); and
- maintain the natural character of significant environmental areas.

In considering the proposed development and its potential impacts on nature conservation and biodiversity, the EPA has had particular regard to the following matters:

- The landowner has prepared a Conservation Strategy for the site and committed to implementing it. The Conservation Strategy for the site is considered to provide a sound basis for a comprehensive, adequate and secure network of conservation areas and linking corridors on the site, to protect biodiversity and other natural values. The vegetation that is likely to be cleared is relatively well retained in the region, both in conservation reserves and on other land.
- A range of mechanisms are proposed by the landowner to protect biodiversity. As preferred by the EPA, the landowner proposes to implement both on-site and off-site conservation measures. The proposed off-site conservation measure comprises the ceding for conservation purposes of 86 ha of adjoining land. The Conservation Strategy proposes that nearly all of the Spearwood Dunes vegetation and at least 27% of the remaining remnant vegetation on the site will be retained in the core conservation areas. Overall, the core conservation areas on the site cover an area equivalent to 34% of the vegetated portion of the site. The on-site and off-site core conservation areas cover an area equivalent to 40 % of the vegetated portion of the site.

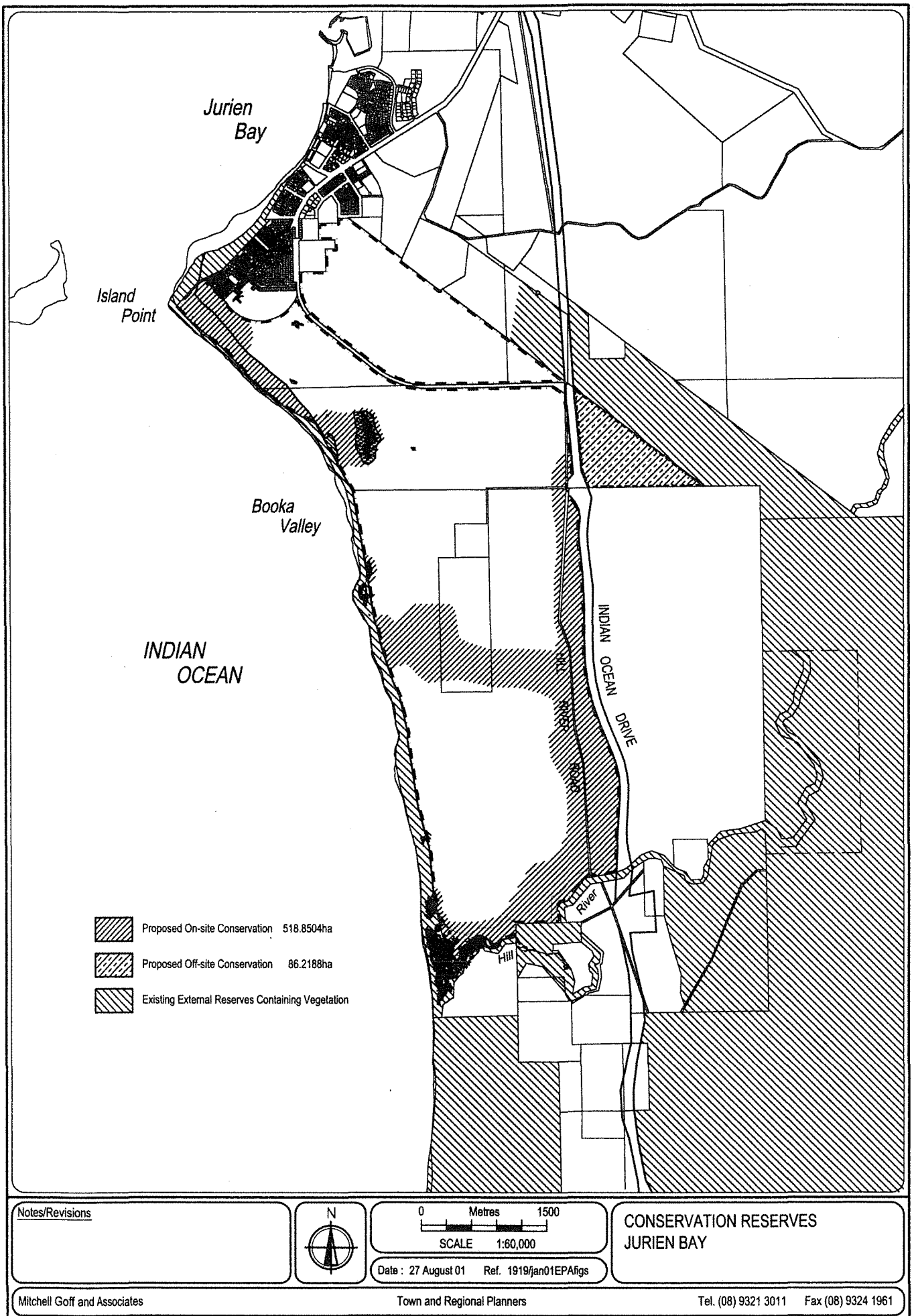


Figure 6 . Proposed on-site and off-site conservation reserves.

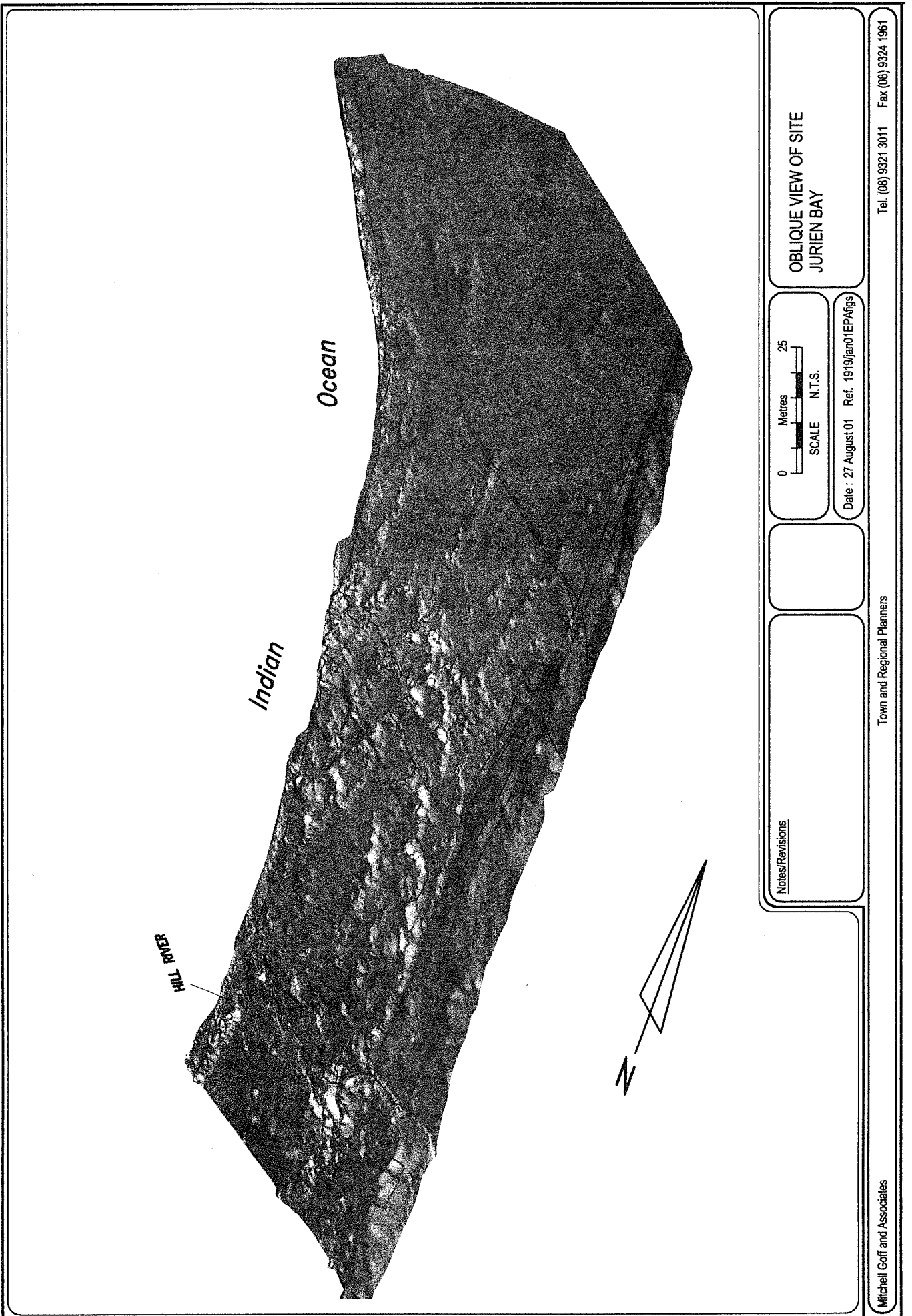


Figure 7 . Oblique view of conservation reserves, showing topography.

- Studies of the main vegetation types of the West Midlands coastal region as discussed in the section above on “Studies of the conservation status of the vegetation of the region” show that at least 74% of the native vegetation in each mapping unit remains.
- Development of the site will not take any main vegetation type below the threshold level of 30% of the pre-clearing extent of the vegetation type.
- The major vegetation types on the site as described in this report are relatively well represented in secure reserves in the region.
- Studies to date indicate that no known species of plant or animal will become extinct as a consequence of the development and the risks to threatened species are considered to be manageable (see Section 2.2). Further surveys are currently being organised in conjunction with CALM to ensure that significant species are identified and protected, if present.
- Studies to date indicate that it is unlikely that any community of indigenous plants or animals will cease to exist as a result of the project.
- The development of the site has the support of the State planning and local government agencies. Jurien has been identified for expansion and the facilitation of major commercial and tourism development, as the major regional centre of the Central Coast in the Central Coast Regional Strategy (WAPC 1996).
- The Government agencies that commented on the project, including the Water and Rivers Commission (WRC), the Ministry for Planning, the Water Corporation, the Shire of Dandaragan and CALM did not oppose it. Some agencies mentioned the need for appropriate environmental management of the project.
- CALM has commented in a letter to the DEP dated 17 September 2001 that the proposed off-site conservation reserve does not appear to have any unique nature conservation values and that the vegetation of the area is currently well represented in conservation reserves. However, it is representative of the vegetation in the vicinity, and would have increased value if the linkage through the stock route to existing conservation reserves is realised.
- The Commissioner for Soil and Land Conservation raised no objections to clearing on land degradation grounds.
- The land owner proposes a range of management measures to prevent land degradation, and the EPA provides some additional advice in this report.
- The landowner has committed to substantially more conservation measures than is conventionally the case for urban development.

The EPA concludes that the clearing of some of the remnant vegetation on the site is acceptable providing that the land owner’s commitments and the EPA’s advice on the issue of nature conservation and biodiversity as described under the next heading are implemented.

With respect to the issue of how much clearing and disturbance of the natural environment is acceptable, a key consideration is the general environmental significance of the area.

The EPA considers that the area has high environmental significance taking into account:

- The development site adjoins the coastline and the proposed Jurien Bay Marine Park, and retains large areas of native vegetation; and
- The site is in the West Midlands area which is well known for its natural environment and biodiversity.

The EPA is of the view that this long term project for a natural coastal area not far from Perth requires the setting of a vision for coastal development, and the detailing of processes to ensure that the vision is implemented.

The EPA encourages a long term vision for the development that is clearly focussed on retaining the natural attributes of the site and integrating with them. The EPA envisages a vision that seeks to achieve a high quality “environmental living zone” with development occurring in nodes in a natural setting.

The EPA considers that its objectives for the issue of nature conservation and biodiversity can be met provided that the advice below is followed.

EPA advice

(a) The EPA considers that Ardross Estates’ Strategy for Nature Conservation and Biodiversity (Tingay 2001) provides an appropriate basis for the retention of natural areas, and supports the Strategy to the extent that the Strategy ensures:

- Significant and scarce habitats and vegetation on the site will be protected , notably:
 - ❖ the coastline (see also the EPA’s advice in Section 2.5);
 - ❖ the beach ridge plain (see also the EPA’s advice in Section 2.6);
 - ❖ the Hill River, the Hill River estuary and adjoining buffer (see the EPA’s advice in Section 2.3);
 - ❖ wetlands and adjoining buffers (see the EPA’s advice in Section 2.4); and
 - ❖ a portion of the vegetation of the lower Spearwood Dunes within a bushland reserve of sufficient dimensions to ensure its long term survival;
- Key landscape elements, and typical landscape and vegetation elements, will be protected, as itemised in the EPA’s advice in Section 2.7 point (d) and generally identified or referred to in the Conservation Strategy;
- Targeted flora studies will be undertaken to the requirements of CALM, and any areas recommended by CALM to be set aside for the protection of significant species will be ceded for conservation purposes;
- Bushland corridors that link the above areas on the site with adjoining off-site bushland areas, and include natural sequences of vegetation and landforms, will be reserved. In this regard, the EPA supports the east-west corridor through roughly the centre of the site, provided that the corridor is at least 500 metres wide in average width, with all parts of the corridor to be at least 400 metres wide;
- Additional natural and semi-natural areas will be retained through the detailed planning process. Open space areas in this category may include some recreational open space that retains bushland; semi-natural areas required by management plans, such as the Water Management Plan (see Section 2.8) to protect key ecosystem processes; and, following more detailed planning studies, additional coastal foreshore reserve and wetland buffer areas, and buffer areas around any dunes that are to be retained to accommodate any sand blow that may affect residential amenity, and movements, if any, of those dunes;
- Off-site conservation measures will be implemented. See point (b) below;
- Environmental management plans that describe procedures to minimise disturbance in the long term to key remnant vegetation on and adjoining the site will be prepared, then implemented, at appropriate stages in the development process;
- Schedules will be developed, and subsequently implemented, for the collection of baseline environmental data and the monitoring of ecosystems;
- Periodic review of appropriate elements of the Conservation Strategy will occur, to ensure that environmental objectives continue to be met as development occurs on the site and incrementally in the Central Coast Region; and

- (b) An important component of the Strategy for Nature Conservation and Biodiversity is the identification of off-site conservation measures. The EPA agrees that the ceding of the 86 hectare site on the eastern side of Indian Ocean Drive fulfils the requirement for off-site conservation measures, taking into account the proposed on-site conservation measures.
- (c) The EPA recommends that at the initial stages of planning for the site a long term vision is developed that focuses on integration with the natural attributes of the site and environmental sustainability. Development of the site is expected to occur in accordance with development policies or guidelines that ensure that the overall vision is progressed.
- (d) The portion of land to be cleared prior to each stage of development should not exceed the expected short term demand for land.
- (e) The EPA notes that some access and infrastructure will be required through conservation areas in the Turquoise Coast Development. The EPA advises that these should be carefully located to minimise environmental impacts, and should be minimised as far as practical.
- (f) The EPA's expectations regarding the timing of the implementation of conservation measures, and the future role of the EPA as development proceeds, are provided in Section 3 "Future Role of the EPA".

2.2 Declared rare and priority flora, and other significant flora

Context

The flora and vegetation survey of the site (Trudgen 1996) did not find any rare flora. However, some priority flora and other flora of interest were observed.

Three priority species, and four other species of interest because they are uncommon, poorly known or restricted in distribution or are at the end of their range, were identified by Trudgen (1996).

Trudgen (1996) considered that it is likely that more priority or declared rare flora species from the CALM list than he actually recorded for the study area are likely to occur in it. He considered that "the flora list presented only records some 60% of the native angiosperm flora of the study area".

The State's *Wildlife Conservation Act 1950* and the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* contain provisions to protect significant flora.

For the best conservation outcome, the protection of significant flora species should be addressed well before development proposals become constrained by detailed planning.

Submissions

Submissions made during the public comment period for the Environmental Report, on the issue of significant flora, are summarised below:

Public and conservation group submissions on the Environmental Report

- More work is needed to ensure rare flora is identified and protected.

Government agency submissions on the Environmental Report

- CALM confirmed that it is prepared to work with the developer, and that it prefers that areas where there may be species of interest are identified at the earliest possible stage.

Land owner commitments

The land owner is liaising with CALM to identify flora species that may occur on the properties, based on regional distribution and other information, and which would warrant conservation measures if present.

The developer has committed to carry out further flora survey work to determine whether any of these flora species are present on the properties. The land owner proposed that the timing and methods used in these surveys will be determined by the land owner in consultation with CALM.

The land owner has committed to protect by reservation in the Structure Plan any populations of flora that are considered by CALM to be significant. Management plans for the conservation of these plant populations also will be prepared by the developer in consultation with CALM.

EPA objectives

The EPA's objectives for this factor are:

- To protect declared rare and priority flora consistent with the provisions of the *Wildlife Conservation Act 1950* and the *Environment Protection and Biodiversity Act 1999*; and
- To protect other flora of conservation significance.

EPA Advice

The EPA endorses the initiatives that the land owner is making in consultation with CALM with respect to significant flora, to the extent that the initiatives are consistent with the following:

- Targeted flora survey work to determine whether significant flora species are present on the properties will be carried out. The timing and methods used in these surveys will be to the satisfaction of CALM.
- Areas with populations of flora that are considered by CALM to be significant will be protected by reservation for conservation purposes. These areas should preferably be shown in the Structure Plan, or alternatively an adequate process to protect these areas should be described at the structure planning stage and then pursued. The areas that may need to be set aside for the protection of significant flora would be additional to the areas shown in the Conservation Strategy (Tingay 2001) if they are located outside the nominated conservation areas.
- Management plans for significant plant populations will be prepared by the land owner in consultation with CALM, before ground disturbing works near the populations occur. The management plans will be subsequently implemented.

The EPA considers that its objectives for declared rare and priority flora and other significant flora, can be met provided that its advice above is followed.

2.3 Hill River and estuary

Context

WRC considers that the Hill River is significant as the last relatively pristine river in the Mid West area. Griffin (1993) and others have identified the Hill River and estuary and immediate surrounds as a priority for conservation in the locality. In addition to ecological, scientific and educational values, the riverine and estuarine environments have visual amenity and recreation values.

The portion of the catchment of the Hill River within the site is restricted to land less than a kilometre from the Hill River, and in places the catchment on the property is substantially narrower.

As part of the process to determine a foreshore reserve, the land owner has completed a flood study identifying the extent of the floodplain associated with a 1 in 100 year flood event. According to JDA (2000), the floodplain for the 1 in 100 year flood event on the property is up to 600 m wide, but in places is quite narrow.

Appropriate river setbacks and management are required, as urban development has the potential to impact directly and indirectly on water quality and water regimes, sediment loads, fringing vegetation and fauna, and social values such as visual amenity and recreational usage.

Submissions

Submissions made during the public comment period on the issue of the Hill River and estuary are summarised below:

Public and conservation group submissions on the Environmental Report

- Modifications to the environment of the Hill River and estuary are opposed.
- The proposed buffers are inadequate.
- More studies are required to identify interactions between coastal processes, wetlands and the Hill River.
- The floodplain should be left as is and not used for parks and recreation use.

Government agency submissions on the Environmental Report

- WRC is satisfied that a foreshore boundary consistent with that shown in the Environmental Report is adequate. Details such as pathways will need to be assessed separately through a comprehensive foreshore management plan.

Land owner commitments

The land owner has worked closely with WRC to establish a Hill River foreshore and estuary reserve that is acceptable to WRC, taking into account site specific biophysical characteristics, including floodway requirements, vegetation and landform considerations.

In addressing the overall issue of conservation for the site, and subsequent to the release of the Environmental Report, the land owner has committed to pursuing a Conservation Strategy that sets aside not only the land required by the WRC for foreshore protection, but also a more extensive area that incorporates the total floodplain associated with a 1 in 100 year flood event.

EPA objectives

The EPA's objective for this factor is to maintain the integrity, functions and environmental values of rivers and their estuaries.

EPA Advice

The EPA supports the work done to identify land for conservation adjoining the Hill River, and the proposed conservation measures, and expects implementation of the following advice:

- The Conservation Strategy will provide for a bushland corridor reserve adjoining Hill River that:
 - * is in all places at least as wide as that agreed by WRC;
 - * will incorporate the total floodplain associated with a 1 in 100 year flood event; and
 - * links with on-site and potential off-site open space networks, through links with the coastal foreshore to the west, and the north-south corridor on the eastern side of the site that adjoins Indian Ocean Drive;
- A Hill River Bushland Management Plan will be prepared before development occurs, to protect the riverine and estuarine environments and natural processes. This should be to the satisfaction of all relevant authorities. Some limited passive recreation facilities may be provided in the foreshore area agreed by the WRC, but other facilities should be outside that boundary. Areas with different management priorities should be identified in the Hill River Bushland Management Plan.

- Protection of the water regime (including water quality, water quantity and seasonal flow) supporting the Hill River will be addressed in the overall Water Management Plan for the site (see Section 2.8). Further, the detailed drainage plans for the adjoining stages of development and the Hill River Bushland Management Plan should provide more detailed prescriptions for protection of the Hill River water regime.

Taking into account the advice of WRC and the landowner's commitments, the EPA considers that its objectives for the protection of the Hill River and estuary can be met provided that its advice is implemented.

2.4 Wetlands

Context

Two wetlands were identified on the site in the Environmental Report (Tingay 2000), and a further 16 natural wetlands were identified in supplementary survey work reported in ATA Environmental (2001). Seven of the wetlands are in the Quindalup Dunes near the coast, six are near the Hill River estuary, and five are in the beach ridge plain in the northern portion of the site. Of the five in the beach ridge plain, three have previously been cleared and are reported to be in poor condition. The location of the wetlands is shown in Figure 3.

The wetlands of the Jurien Bay area have been studied previously as part of an evaluation of wetlands in the System 5 area (V & C Semeniuk Research Group 1994).

The System 5 study identified a number of consanguineous wetland suites in the coastal plain between Lancelin and Dongara. Although the wetlands on the site were not identified in the System 5 study, they are considered by ATA Environmental (2000) to be part of the Jurien Suite. ATA Environmental (2000) advises that "the System 5 wetland study lists the Jurien Suite wetlands as an unusual wetland type located in a coastal dune setting and containing habitat for unusual plant associations." Wetlands are not common in this part of the Quindalup Dunes, thus those that are present are of enhanced conservation significance, and should generally be protected.

Submissions

Submissions made during the public comment period on the issue of the Hill River and estuary are summarised below:

Public and conservation group submissions on the Environmental Report

- More studies to delineate wetlands, their buffers and midge control distances, and to identify interactions between natural processes, should be carried out.
- Recreation may adversely affect wetland processes. Access to wetlands should be minimised.
- Use of groundwater may adversely impact on wetland hydrology.
- The large wetland in the northern part of the site should be reserved for conservation purposes only.
- The reserve around the above wetland should be increased in size/extended to the coastal reserve.

Land owner commitments

Subsequent to the release of the Environmental Report, the land owner commissioned a further study to identify wetlands on the site. The study is reported in ATA Environmental (2001). The land owner has committed to protecting 15 of the 18 natural wetlands identified on the site together with buffers around the wetlands, within reserves, as part of the Conservation Strategy (Tingay 2001). The three wetlands on the beach ridge plain that are not designated for protection are reported to be in poor condition from past clearing and agricultural activities.

The land owner has committed to preparing management plans for reserves to be coordinated with planning at the local level, and a Water Management Plan is to be prepared.

EPA objectives

The EPA's objectives for this factor are:

- To maintain the integrity, functions and environmental values of wetlands; and
- To ensure the quality, quantity, seasonal variation and rate of flow of surface and groundwater is maintained to prevent adverse impacts on indigenous wetland vegetation and other aspects of wetland ecosystems.

EPA Advice

- (a) The EPA supports the inclusion of all the wetlands in the network of reserves shown in the Conservation Strategy.
- (b) The EPA accepts that the environmental values of three of the wetlands that are on the beach ridge plain have been severely reduced by historic clearing and agricultural use.
- (c) Buffers associated with the wetlands also require reservation, and protection. The EPA agrees that the buffer around the large wetland in the northern part of the property should not be less than the buffer shown in the Environmental Report. The wetland buffers elsewhere are to be based on detailed site studies and reflect the latest methodology for wetland buffer determination, at the time of reservation.
- (d) The primary objective of the portion of the open space reserve that incorporates each wetland and its buffer should be conservation of the natural attributes and functions of the wetland. The buffer should not perform an urban drainage function. Passive recreational use and minor complementary facilities within the buffer may be acceptable. Other recreational facilities should be outside the buffer.
- (e) Management plans for the wetland areas and their buffers, and for urban water management near the wetlands, should be prepared before development, and implemented.

It is considered that the EPA's objectives for wetlands may be met provided there is satisfactory implementation of its advice.

2.5 Coastline

Context

The site has a coastline adjoining the Indian Ocean between Jurien Bay and the Hill River that is approximately 9 kilometres in length.

All of Western Australia's coastline is considered to have significance. The draft "Coastal Zone Management Policy for Western Australia" (WAPC 2001) seeks the retention of as much of Western Australia's regional coastline as possible in a natural and healthy condition.

The northern end of the coastline on the property forms part of a large tombola (cusped foreland). It is significant as one of the largest tombolas on the west coast.

The mouth of the Hill River is of particular conservation significance, as discussed in Section 2.3.

The values of the coastline include its proximity to the proposed Jurien Bay Marine Park. The Indicative Management Plan for the Jurien Bay Marine Park (CALM 2000) recommends that the Marine Park includes strips of adjacent coastal Crown land.

The coastline is in a natural state of flux. MP Rogers and Associates undertook studies of coastline movements for the land owner and reported on these in 1999 (MP Rogers & Associates 1999). It was found that:

- The northern third (approximately) of the coastline of the site (south of Island Point) is receding. The rate of recession drops from around 1.5 m per year at Island Point to 0 m per year roughly a third of the way down the site. These figures compare with Tinley (1992) that refer to 1984 estimates of a recession rate of 1.9 m per year for the southwest facing side of Island Point;
- The central portion is accreting from 0 m per year roughly a third of the way down the site, to 1.5 m per year at Booka Valley. South of Booka Valley the rate of accretion drops; and
- The southern third (approximately) of the coastline of the site is receding.

The coastline is sandy and prone to storm damage, as, it is understood, has occurred at Booka Valley.

The coastline forms part of the seascape from the proposed Marine Park, provides vantage points for panoramic views into and out of the site, and forms part of the view from inland vantage points.

The State Government has committed to introduce an environmental protection policy for the coastal zone, and this is expected to progress this year. A statement of planning policy currently known as the State Coastal Planning Policy is in preparation. Matters addressed by the draft statement of planning policy include the determination of foreshore reserves.

Submissions

Submissions made on the issue of the coastline are summarised below:

Public and conservation group submissions on the Environmental Report

- Urban development may significantly impact on the marine and coastal environment.
- Detailed management plans should address relevant recommendations from the Dandaragan Coastal Plan.
- The Turquoise Coast Engineering Study does not address a sufficiently long period of time.
- The proposed coastal reserves are inadequate and require more site investigation.

Government agency comments on the Environmental Report

- The Ministry for Planning has given conditional support for the foreshore alignment.
- CALM submits that as coastal development plans are further advanced, the coastal foreshore reserve alignment and width at the proposed resort and aquaculture sites will need to be further examined. The requirements for coastal recreation and rehabilitation should also be investigated and the subject of detailed reports at the subsequent structure planning stages. Development conditions should be set to ensure these issues are properly addressed.

Government agency comments following revision of the proposed setback to accommodate physical coastal processes

- The Department of Transport has accepted the revised proposals for coastal setbacks subject to some changes to accommodate physical coastal processes, as shown in the Conservation Strategy Appendix 1.

Land owner commitments

The land owner's Environmental Report proposes a coastal foreshore reserve based on a study by MP Rogers and Associates of shoreline movements, and proposes that a foreshore management plan will be prepared.

Figure 11 in the Environmental Report shows a line referred to as the "Proposed Foreshore Reserve". The line was subsequently reviewed by the land owner and the coastal engineering division of the Department of Transport and modified in the northern third of the site, by some additions. The Conservation Strategy indicates that this line, which is based on coastal engineering factors, represents the minimum extent of any eventual reserve for protection of the coastline. The line is considered adequate to accommodate the following physical processes:

- Long term shoreline movements for 100 years;
- The one in one hundred year storm event and a sequence of storm events; and
- Allowance for global sea level rise.

The Conservation Strategy informs that the final foreshore boundary may in places be wider than shown to satisfy the full range of coastal reserve planning criteria to be determined through the detailed planning process.

EPA objectives

The EPA's objective for this factor is to maintain the integrity, functions and environmental values of the coastline.

EPA Advice

- (a) The EPA expects that the final coastal foreshore will be, in all places, of sufficient width to accommodate:
- The following physical coastal processes – long term shoreline movements, absorption of the impact of a sequel of severe storm events, allowance for global sea level rise, and allowance for the maintenance of natural coastal processes;
 - Maintenance of coastal ecological systems and processes (eg sustainable habitat for coastal flora and fauna) in the long term; and
 - Coastal landscape and coastal features that have value for social, cultural and economic reasons, including visual amenity, tourism, recreation and cultural heritage.

It is expected that the foreshore will be wider, in places, than shown in the figures in the Conservation Strategy and Ardross Estates' Environmental Report, to ensure, into the long term, that the foreshore reserve can accommodate physical and ecological processes, as well as providing for human amenity and culture. The boundary of the foreshore reserve should also reflect practical, aesthetic and natural lines. It should not unduly dissect dune landforms. In places, the foreshore may need to be increased to include entire dunes. It is noted that the Department of Transport advice of 15 June 2001 relates setback lines to the line of established vegetation or the toe of the erosion scarp at the time of subdivision and notes that this line may be in a different place to the present line should development not occur in some places for many years.

At this stage it is expected that the final coastal reserve will be determined through the planning process, taking into account the evolving State Coastal Planning Policy.

- (b) The coastal foreshore reserve is expected to link with other areas or corridors of open space both on the property, as shown in the Conservation Strategy, and adjoining the property, as part of an overall open space network for the locality; and
- (c) A Coastal Foreshore Management Plan should be prepared before clearing and development near the coastline occurs, to the satisfaction of the relevant authorities.

It is considered that the EPA's objectives for the coastline may be met provided there is satisfactory implementation of its advice.

2.6 Beach ridge plain

Context

Two beach ridge plains occur on the site. The newer one has formed the cusped foreland on which Jurien Bay townsite and vegetated areas at Island Point are located. This plain is referred to as Plain A in the Environmental Report. The older beach ridge plain is largely cleared and is to the east and southeast of Jurien Bay townsite. The older beach ridge plain is referred to as Plain B in the Environmental Report.

The cusped foreland at Jurien is the largest in the Central Coast and one of the largest in Western Australia. It has been recognised internationally as an area of scientific significance (DPUD not dated).

E.A. Griffin in his studies of the flora of the Quindalup Dunes (Griffin 1993) recommended that "the northern part of the Jurien beach ridge plain should be protected in a reserve which would allow for the study of Holocene depositional history."

Trudgen (1996) also recommended that a vegetated portion of the beach ridge plain be retained.

Submissions

Submissions made on the issue of the beach ridge plain are summarised below.

Public and conservation group submissions on the Environmental Report

- Erosion may occur between vegetation removal and building on the beach ridge plain.
- The beach ridge plain reserve should be extended south to incorporate part of Plain B and the large wetland.

Land owner commitments

Under the Memorandum of Understanding between Ardross Estates, the WAPC and the Shire of Dandaragan, the company has undertaken to protect a representative sample of the beach ridge plain landform at Island Point within a reserve or reserves. Following discussions with the EPA, Ardross Estates proposes to designate a reserve in the Structure Plan that is larger than the reserve shown in the Environmental Report. The proposed reserve is shown in Figure 6.

EPA objectives

The EPA's objectives for this factor are to maintain the environmental, scientific, cultural and recreational values of significant land forms (beach ridge plain).

EPA advice

- (a) The EPA endorses the inclusion of most of the vegetated portion of the beach ridge plain in the north west corner of the site, in a reserve for conservation purposes, and expects that it will be no less in size than the proposed reserve shown in the Conservation Strategy (Tingay 2001).
- (b) As for all conservation reserves, a Management Plan for the beach ridge plain reserve should be prepared before clearing and development near the proposed reserve occurs, to the satisfaction of the relevant authorities. The Management Plan should be subsequently implemented in accordance with the specifications in the Plan.

The EPA considers that its objectives for the beach ridge plain landform can be met provided that its advice is implemented.

2.7 Landform and landscape

Context

The EPA considers that landforms and landscape are potentially significant for their environmental, scientific, cultural, economic and recreational values, and for their integral role in the functioning of ecosystems and natural processes. Development in harmony with the natural landforms and landscape can enhance some social, cultural and economic values.

However, coastal urban development is typically associated with clearing, reshaping sand dunes and considerable change to the character and uniqueness of a site.

The EPA further considers that the maintenance of natural character through the protection of landform and landscape is of particular importance in areas of high environmental significance.

The EPA considers that in areas of environmental significance, as in the subject case, the concept of environmental living zones and development that retains a sense of the natural environment, should be pursued where urban development is required to fulfil regional planning objectives.

The liveability of a development may be enhanced by the natural environment in that the natural environment contributes a unique character that cannot be replicated. The landforms, vegetation, fauna, and climate in combination produce the unique character of the site. As fewer areas retain their natural qualities, the significance of retaining the natural areas that are left, increases.

It is considered that the opportunities for urban development on the site may depend largely on the natural environmental attractions of the area.

The EPA notes that parts of the northern sector, and most of the southern sector of the site, retain natural vegetation and natural landforms. The landforms of the site include beaches, foredunes, parabolic and nested parabolic dunes, relict foredune plain (beach ridge plain), active parabolic dune lobes, deflation basins with either a sand floor or limestone pavement, and limestone landforms (Gozzard 1985). It is noted that all of the landforms on and near the site contribute to its character.

Vistas of the natural environment, both coastal and land based, are gained from a range of locations both near and on the site. Views into and out of the site need to be considered. "Sensitive" views include views into the property from Indian Ocean Drive.

The draft Coastal Zone Management Policy for Western Australia (WAPC 2001) recommends that where residential development occurs on the coast, it should be concentrated in nodes, and that new linear development should be avoided.

Submissions

Submissions made on the issue of landscape, landforms and visual amenity are summarised below.

Public and conservation group submissions on the Environmental Report

- A large portion of the development site will be visible from Indian Ocean Drive. The design of the development alongside Indian Ocean Drive must maintain the visual amenity of the area and avoid creating a visual landscape that is out of context with the surrounding environment.
- A buffer adjacent to Indian Ocean Drive should hide the development from motorists.
- There will be a loss of high value landscapes.
- One of the main attractions of the Central Coast Region is that it has "wide open space" and "low levels of development". The Structure Plan must incorporate the natural surroundings of the area into the development.
- The design of the Turquoise Coast Development must maintain visual amenity and avoid suburban style, and the style of many existing coastal urban developments.

- There is the opportunity to create a unique style for the proposed development that would also fit local environmental conditions.

Government agency comments on the Environmental Report

- CALM recommends that utility services particularly power be underground to minimise impacts on the visual amenity of the proposed development.

Land owner commitments

Subsequent to the public review period the land owner has prepared a Conservation Strategy and committed to its implementation. The Conservation Strategy proposes coastal foreshore reserves, an extensive vegetation belt adjacent to most of Indian Ocean Drive, extended reserves along the Hill River to incorporate flood plain areas as well as flood ways and adjacent dune systems, a vegetated corridor through the centre of the site, and, in addition, reservation of the area of the tallest and steepest dunes on the site which are to the south of Booka Valley.

The land owner proposes that development adjacent to the reserves will be in accordance with approved Development Plans, and that development of facilities within the reserves will be in accordance with Management Plans for the reserves.

EPA objectives

The EPA's objectives for the protection of landscape and landform are to:

- Maintain the environmental, scientific, cultural, recreational, economic and aesthetic values of natural landforms and landscapes; and
- Ensure that the natural visual amenity of significant environmental areas is not unduly affected by the development.

EPA advice

Taking into account the environmental significance of the locality, the EPA's advice on landform and landscape is as follows:

- (a) The EPA expects that natural areas and natural character will be retained and managed through the implementation of on-site and off-site conservation measures as outlined in the EPA's advice in Section 2.1. Key areas to be protected from point of view of landform and landscape are summarised in (d) below;
- (b) The EPA urges that during all stages of the planning process, planning of the urban fabric will integrate with the natural landscape and landforms, and with planning for the overall open space network for the site. The EPA recommends that further investigations are carried out during the planning process, to address visual amenity and opportunities for urban design to relate to the natural landscape and landforms.
- (c) The EPA expects development to occur in accordance with development policies or guidelines that ensure that an overall vision for coastal development is maintained in the long term. The EPA envisages that the vision should be clearly focussed on the natural setting and on maintaining a sense of an "environmental living zone" with development to occur in nodes such that the site retains an overall sense of natural landform and setting. Development should allow the retention of the natural character and characteristic landforms as far as practical, and particularly where vistas are experienced.
- (d) Development of the site should provide for the retention of the key landscape and landform elements and representative portions of all landforms and vegetated landscapes, on the site. These elements are considered to include:
 - The coastline and its foreshore, including some coastal dunes;
 - The vegetated portion of the cusped headland at Island Point;
 - The Hill River valley and the Hill River estuary;

- Wetlands and their buffers;
- A landscape protection zone generally adjoining Indian Ocean Drive;
- Prominent dunes in the south east of the site;
- Bushland corridors that enable some natural sequences of vegetation types and landforms to be retained; and
- Additional portions of a range of landform and vegetation types in local open space.

The EPA considers that its objectives can be met provided that there is satisfactory implementation of its advice.

2.8 Ground and surface water

Context

Urban development has the potential to significantly impact on the hydrological regimes and water quality that are critical for the Hill River, the proposed Marine Park, wetlands, and conservation areas and ecosystem maintenance generally.

Many urban activities and constructions have the potential to impact on the quality and quantity of ground and surface water. Nutrients, toxicants, pathogens, litter and sediment may affect the quality of urban stormwater. Sources of pollutants include commercial, residential and industrial land uses, transportation, effluent disposal, and fertiliser and pesticide use in gardens and parks. Abstraction of groundwater has the potential to adversely affect groundwater levels.

The Water Corporation is examining options for water supply and waste water treatment and disposal. Any eventual proposal that may have a potentially significant impact on the environment would require referral to the EPA for the EPA to set the level of assessment.

At the time of publication of the EPA's advice, it is expected that a water supply will be provided from an off-site source.

The site is to be sewerred.

The principles for environmental sustainability include wise use of resources, such as fresh water.

Submissions

Submissions made on the issue of ground and surface water are summarised below.

Public and conservation group submissions on the Environmental Report

- Plans for the management of water must be open to public review and formal assessment.
- Poor plans could have a significant effect on a number of significant environs.
- Data needs to be collected on the current water quality.
- No approvals should be given until the proponent can demonstrate adequate management.

Government agency comments on the Environmental Report

- The Water Corporation is to prepare the Water Management Plan. This Plan will address stormwater drainage and nutrient management, and water supply.
- The Water Corporation advises that in undertaking investigations for water source areas, sites have been nominated on land not contained within the Environmental Report. When investigations are completed, the Water Corporation will be applying for the necessary statutory approvals.

Land owner commitments

The developer has committed to the preparation of a Water Management Plan in co-operation with the Water Corporation, the Water and Rivers Commission, the DEP and the Office of Water Regulation.

EPA objectives

The EPA's objectives for the protection of ground and surface water are to maintain the quality and quantity of surface water and groundwater, and flow regimes, to ensure that existing and potential uses, including ecosystem maintenance, are protected.

EPA advice

- (a) The EPA expects the Water Management Plan to integrate with land use planning to ensure a good environmental outcome. For this project, the Water Management Plan is expected to address both a water supply to meet urban needs, and the disposal of water that is surplus to urban needs.

A primary objective of the Water Management Plan should be to demonstrate that development will occur without adversely affecting the hydrological regime of the Hill River system, wetlands, conservation areas, the proposed Jurien Bay Marine Park, ecological processes generally, and the water regime that supports other existing and potential beneficial uses of the groundwater and surface water resource.

If the Water Management Plan is developed in stages, the EPA expects that the first report will support the Structure Plan for the site. This report should describe the overall objectives of the Water Management Plan, and the process that will ensure that, at full development of the site, the objectives and criteria for protection of the beneficial uses of the groundwater and surface water resource will be met.

At the structure planning stage, the EPA expects that the Water Management Plan will identify the location of any major facilities required for stormwater management and water supply (if on-site), and any multi purpose corridors to be used for stormwater. The elements of the stormwater system should integrate with the open space system where appropriate. With respect to stormwater management, the Water Management Plan report that accompanies the proposed Structure Plan for the site should describe the key elements of the proposed system and provide sufficient information to demonstrate that at full development the stormwater management system will be capable of achieving environmental objectives.

The use of Water Sensitive Urban Design principles is strongly supported, including, where possible, at-source treatment and infiltration of stormwater, and the use of treatment trains that are ecologically sound.

At the structure planning stage, the likely source or sources for the water supply and approval processes for water supply, should be described.

- (b) The Water Management Plan should be implemented in accordance with the specifications in the Plan.
- (c) It is recommended that the brief for a comprehensive Water Management Plan be prepared to the satisfaction of the relevant authorities. These would include the WRC, Water Corporation, EPA, the Shire of Dandaragan and CALM. If the Water Management Plan is prepared in stages, the timing and detail required in each report should be agreed by the relevant authorities.

The brief should include the following requirements (this is not necessarily an exhaustive list of requirements and will depend on the input from other agencies):

1. Develop the objectives and criteria for hydrological changes and export of nutrients and other pollutants, associated with the development of the site.

2. Develop an overall strategy for the management of landuse and water to ensure that the developed objectives, criteria and targets can be met. Identify all potential activities that may impact on water that may arise from the development of the site.
3. Undertake surface and groundwater analyses, modelling and investigations which demonstrate that the overall strategy is likely to ensure that the objectives, criteria and targets can be met.
4. In addressing urban water needs, propose the method of water supply, sources, distribution and management arrangements. If the supply is off-site discuss water supply options and the process that will be followed to gain approval for the use of the water supply. Address the promotion of efficient water use, and the use of on-site bores for non-potable uses.
5. Include an assessment of the quality and quantity of water needed by the ecosystems on and off the site that may be affected by the water resource of the site, and the periods during which those ecosystems will need that water, including any actions or restrictions needed to protect the water resource and the environment, and how these should be implemented.
6. Include an assessment as to whether the taking or use of water from the resource will have detrimental effect on the quantity and quality of water that is available from any other nearby water resource.
7. Assess the capacity of the resource to meet the demands for water on a continuing basis and make proposals for regular monitoring of the capacity of the resource to meet those demands.
8. Recommend strategies and responsibilities for surface and groundwater monitoring pre-development; and for monitoring, maintenance and, if necessary, remedial action (contingency planning), post-development.
9. Describe opportunities for use and reuse, detention and treatment of water emanating from the study area.
10. Describe management strategies and the most relevant best management practices for water pollutant and nutrient management. Recommend management measures that minimise recurrent maintenance whilst ensuring an ecologically responsible outcome. The Water Management Plan should address a range of mechanisms that will lead to manageable levels of nutrients and other pollutants in groundwater and surface water.
11. Outline procedures for the stages in implementation and management, and include review procedures for the Water Management Strategy.

The EPA considers that its objectives for ground and surface water can be met provided that its advice is followed.

2.9 Solid and liquid waste disposal

Context

Solid and liquid waste disposal has the potential to affect either directly or indirectly the ecology of natural environments both on and adjoining the site, and the amenity of residential and other land uses. Solid waste is associated with the production of methane, a greenhouse gas.

The principles of environmental sustainability include waste minimisation, reuse and recycling.

The Shire of Dandaragan has commissioned a comprehensive waste management review for the municipality.

Submissions

Submissions made on the issue of solid and liquid waste disposal are summarised below.

Public and conservation group submissions on the Environmental Report

- Plans for the management of waste must be open to public review and formal assessment.
- Poor plans could have a significant effect on a number of significant environs.
- It is unacceptable to merely rely on the local government by-laws to regulate the disposal and treatment of wastes. A waste management plan should be produced. The control of airborne pollutants must be accounted for.

Government agency comments on the Environmental Report

- The Water Corporation advises that in undertaking investigations for such facilities as a wastewater treatment plant, sites have been nominated on land not contained within the Environmental Report. When investigations are completed, the Water Corporation will be applying for the necessary statutory approvals.
- CALM is concerned about the potential impact of the disposal of waste products on the proposed Jurien Bay Marine Park, particularly as Jurien Bay and its adjacent lagoons are poorly flushed embayments.

Land owner commitments

The Environmental Report proposes that solid and liquid waste will be managed as follows:

“The development will be deep sewerred. Collection and disposal of solid wastes will be the responsibility of the Local Authority. Industrial wastes generated by light industry will be regulated by specific planning provisions.”

EPA objectives

The EPA's objectives for solid and liquid wastes are to:

- ensure that solid and liquid wastes are disposed of without causing adverse impacts on the environment; and
- promote the reduction of the quantity of waste, and the recycling of waste.

EPA advice

- (a) At the structure planning stage, it should be shown that there are practical locations and methods for sewage disposal and solid waste disposal, for the proposed urban development, that are environmentally sound. Any waste disposal sites that the development may require, either on or off the site, should be located and managed to avoid significant impacts on the natural environment and on the health and amenity of the community.

Before development, the options and broad procedures for achieving environmentally sustainable management of liquid and solid wastes produced by the development, should be identified, including a system for waste reduction, reuse and recycling. It is expected that this step would need to interrelate with any waste management strategy for the general region.

- (b) Before development occurs, the Water Management Plan should identify potential wastes that may end up in the ground or surface water systems, and provide prevention and management measures.

The EPA considers that its objectives for solid and liquid waste disposal can be met provided that its advice is followed.

2.10 Marine environment

Context

The site adjoins the proposed Jurien Bay Marine Park. Proposed Marine Park zonings near the property are the General Use Zone, Sanctuary Zone, Special Purpose (Shore Based Activities) Zone, Special Purpose (Scientific Reference) Zone, Special Purpose (Aquaculture) Zone and the Special Purpose (Puerulus) Zone (CALM 2000).

The values of the proposed Jurien Bay Marine Park are listed in Section 7 of the "Indicative Management Plan for the Proposed Jurien Bay Marine Park" (CALM 2000). They comprise ecological, social and economic values.

Urban development has the potential to affect the values of the proposed Jurien Bay Marine Park, through increased recreational and tourism use of the coastal landforms; increased recreational and tourism use of the marine waters; coastal development (eg groynes and other structures associated with urban development); urban stormwater disposal; effluent disposal; and other activities and landuses.

The Marine Park is expected to provide recreational, visual, tourism, scientific research, educational and other social and economic opportunities to the occupants and visitors of the proposed urban development.

CALM will prepare a Management Plan for the Marine Park.

The EPA notes that the project considered in this report does not include a marina. Any eventual proposal for a marina that may have a potentially significant impact on the environment would require referral to the EPA for the EPA to set the level of assessment.

Submissions

Submissions on the issue of the marine environment are summarised below.

Public and conservation group submissions on the Environmental Report

- The Central Coast Region is currently self-sustaining. The livelihood of the region depends on a pristine and clean environment, particularly the rock lobster industry. The biodiversity of the marine environment is high and in pristine condition. The development will impact on this.
- A marina is associated with structures that may cause erosion and alter natural processes, and with marine pollution from leakages and oil spills. Boating moorings will contribute to destruction of seagrasses and biodiversity. A marina would not be justified. There is one already in Jurien Bay.

Government agency comments on the Environmental Report

- CALM recommends that the proponent should acknowledge the need for value-threat analyses for activities arising from the development to be developed in advance of structure plans with emphasis given to the management of ecological and social values described in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000.
- CALM recommends that the proponent should acknowledge the need for strategies in sympathy with those specified in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000 to ensure that the park's values are not compromised as a result of future development.
- CALM recommends that management measures relating to any potential impacts that may arise specifically as a result of proposed development should be resourced fully by the proponent under some agreed arrangement with CALM.

- The report provides no specific information on likely loadings and disposal of waste products to the marine environment. If the disposal of liquid wastes to the marine environment either directly via outfalls or indirectly via groundwater discharge is pursued, there will need to be careful evaluation and maintenance of very stringent water quality criteria as outlined in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000. This is due to the well-established problems that nutrient enrichment from wastewater inputs can have in oligotrophic lagoonal environments subjected to weak flushing as in Jurien Bay and its adjacent lagoons.

Land owner commitments

The land owner is engaged in an ongoing process of consultation with CALM to provide CALM with information on the Turquoise Coast development and to ensure that the development is consistent with the purposes of the Park.

EPA objectives

The EPA's objectives for the marine environment are to:

- ensure that the environmental values of the proposed Marine Park are not compromised; and
- maintain the abundance, biodiversity, productivity and geographic distribution of marine flora and fauna.

EPA advice

- (a) At the structure planning stage, a process should be described to identify:
 - potential impacts on the proposed Marine Park arising from the development;
 - appropriate studies that should be undertaken in consultation with CALM; and
 - procedures for ensuring that development occurs in a way that is consistent with the purposes of the Park.
- (b) The EPA's advice on ground and surface water, the coastline, landform and landscape, and solid and liquid waste disposal is also relevant to protection of the proposed Marine Park.

The EPA considers that its objectives for this factor can be met provided that its advice is followed.

2.11 Enhanced greenhouse effect

Context

The State of the Environment Reference Group for Western Australia had provided the issue of enhanced greenhouse effect with an environmental status rating of four out of five. "Five" indicates the highest priority for government and community action (Government of Western Australia 1998).

Human-induced greenhouse gas emissions are associated with a rise in world temperatures, an increase in extreme weather events, a rise in sea levels and a direct biological effect on plants through increased carbon dioxide. The principal greenhouse gases are water vapour, carbon dioxide, methane and nitrous oxide, as well as some manufactured gases such as chlorofluorocarbons and some of their replacements. Carbon dioxide is the main greenhouse gas emitted in Australia.

Greenhouse gas sources include the generation of electricity from burning fossil fuels, transportation, industry, agriculture, waste and the clearing of land.

Australian households are responsible, either directly or indirectly, for the generation of 56 % of Australia's energy-related greenhouse gas emissions (Australian Bureau of Statistics 2001).

Potential measures to control greenhouse gas emissions that can be adopted during the development of new urban areas include minimising the clearing of land, and designing urban areas on “urban village” or “greenhouse village” principles that integrate land use planning with community formation and transport planning. “Urban village” principles include designing for reduced car use eg by providing jobs near residences, and designing housing to reduce the need for heating and cooling systems and lighting.

The National Greenhouse Strategy encourages the retention of native vegetation as a carbon sink.

There were no submissions on the issue of the enhanced greenhouse effect.

The Memorandum of Understanding between the land owner, the Shire of Dandaragan and the WAPC requires planning to incorporate innovative, energy efficient and ecologically sustainable forms of development, and the creation of viable communities with high degrees of self sufficiency in terms of employment and social infrastructure development. Provision will be made for public transport with activity centres to be located in a public transport network wherever possible (Ardross Estates 1997).

EPA objectives

The EPA’s objective for this factor is to minimise greenhouse gas emissions as low as reasonably practical.

EPA advice

- (a) It is recommended that at each stage in the planning approval process, including the structure planning stage, that the layout and management of development should aim to minimise the production of greenhouse gases, for example through the use of “urban village” or “greenhouse village” design principles that promote reduced car use, public transport, activity nodes, the provision of jobs near residences, and lot layout such that housing can optimally utilise solar energy and natural light.
- (b) Advice on the retention of vegetation is provided in the sections on Nature Conservation and Biodiversity, and Landform and Landscape.
- (c) The EPA urges that each stage of development is subject to a greenhouse audit to estimate the likely greenhouse gas implications, and that greenhouse-friendly practices are adopted as opportunities are identified.

The EPA considers that its objectives for this factor can be met provided that its advice is followed.

2.12 Environmental sustainability

Context

Sustainable development is usually considered to have three main facets – environmental, economic and social. The EPA’s primary area of interest is the first mentioned facet. Environmental sustainability incorporates the principles of ecologically sustainable development.

Ecologically sustainable development is defined in the “National Strategy for Ecologically Sustainable Development” (Commonwealth of Australia 1992) as “using, conserving and enhancing the community’s resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased”.

Ecologically sustainable development may be viewed as having two main interrelated thrusts:

- To protect biological diversity and maintain essential ecological processes and life-support systems; and

- To enhance individual and community well-being and welfare by, in the present time, following a path of economic development that safeguards the natural resource base and hence welfare of future generations.

The EPA is developing a position statement on the broad issue of environmental sustainability.

At this stage, important considerations for urban development include:

- Reducing impacts on natural ecosystems and ecological processes;
- Protecting biodiversity;
- Wisely using natural resources, particularly those that are non-renewable, scarce or required in large quantities eg fresh water and energy from fossil fuels;
- Minimising greenhouse gas emissions;
- Reducing waste;
- Recycling and otherwise dealing with liquid and solid wastes using environmentally appropriate technology in appropriate locations;
- Using energy efficiently and encouraging the use of renewable energy eg solar and wind energy to replace energy from fossil fuels;
- Designing urban development to minimise the use of energy in infrastructure, transport, housing etc;
- Designing urban development for accessibility to the range of services and community, cultural and recreational facilities that will support a vibrant community;
- Maintaining the amenity, health and safety of the community by managing exposure to unacceptable noise, dust and pollution generally;
- Inspiring community commitment to sustainable development and caring for the local surroundings; and
- Heeding the precautionary principle (lack of scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation).

Plans and procedures agreed at the structure planning stage and the subsequent stages of urban design and development can influence the ability of urban developments to be environmentally sustainable. They also have the potential to set the scene for complementary actions taken outside the planning process to promote sustainable development.

Submissions

Submissions on the issue of sustainable development are summarised below.

Public and conservation group submissions on the Environmental Report

- The documentation provided does not demonstrate that this development will be ecologically sustainable.
- The development will compromise the sustainability of the area.
- Should the development proceed it should be based on environmentally sensitive planning, with design, management and buildings that would be environmentally sustainable.
- The development should be energy and water efficient; use solar power; retain native vegetation within lower density lots; build housing that matches well with the environment; use responsible waste management, and so on.
- In designing new buildings it is highly recommended that Ardross Estates consult with a number of sustainability architects.
- It is hoped that the ecovillage concept will be used extensively.
- The grazed land should be developed as higher density housing.

Land owner commitments

The Memorandum of Understanding between Ardross Estates and the planning authorities requires the development to occur in a sustainable manner with planning consideration to be given to the incorporation of innovative, energy efficient and ecologically sustainable forms of development. Provision is to be made for public transport; the development should be designed to limit the need for personal car trips; and activity centres are to be located in a proposed public transport network where possible.

EPA objectives

The EPA's objective for this factor is to promote environmental sustainability consistent with the principles in the National Strategy for Ecologically Sustainable Development (Commonwealth of Australia 1992).

EPA advice

(a) The EPA expects that the documentation supporting the Structure Plan and subsequent applications for approval (as relevant) will consider what can be done to promote environmental sustainability, and will demonstrate an appropriate response in terms of the following:

- Ensuring the healthy functioning of key ecological processes and key areas of natural ecosystems;
- Protecting biodiversity;
- Limiting greenhouse gas and other air quality emissions;
- Reducing the use of materials and energy in infrastructure, transport, communities, services, housing etc compared with conventional development, and promote the use of renewable energy and recycled materials;
- Managing wastes through minimising the production of waste and promoting recycling, and ensuring environmentally acceptable locations are available to process wastes from the development;
- Reducing the demand for fresh water, compared with conventional development, and promote the reuse of water;
- Protecting the community from pollution and adverse amenity impacts; and
- Promoting a vision for environmentally sensitive development, and the development of a community ethos that supports sustainable development and caring for the local environment.

The EPA expects that the documentation supporting the Structure Plan will outline a vision for environmentally sensitive development and environmental sustainability with respect to the site, and the opportunities and the process for promoting this vision at subsequent stages of planning and development. This process should then be implemented. The EPA recommends the development of urban design guidelines at appropriate stages of planning, to progress the vision for environmentally sensitive and sustainable development on the site.

- (b) Compliance with the EPA's overall advice will contribute to sustainable development of the site.
- (c) The objective in the Memorandum of Understanding to incorporate innovative, energy efficient and ecologically sustainable forms of development is strongly supported. In this regard, the development should where possible incorporate the principles of walkable neighbourhoods, "greenhouse" neighbourhoods, local employment and activity centres linking with a public transport network. The site should be planned to minimise dependence on private vehicular transport and to promote a public transport system. The

subdivisional lot layout should be conducive to energy-efficient housing design and estate maintenance. For example, lots should achieve good exposure for solar energy systems.

- (d) The EPA urges that particular care is taken by the planning authorities and the developer to ensure that the initial urban constructions reflect the site-specific vision for environmentally sensitive development. The EPA recognises that the initial housing, tourism developments, estate design and stormwater drainage management systems, and activity/community nodes can to a large extent set the tone for, and inspire, subsequent development.
- (e) It is noted that local models for sustainable development and for the assessment of the sustainability of settlements have yet to be developed. As appropriate models and strategies are developed these should be adopted and implemented through the ongoing development of the site.

The EPA considers that its objectives for sustainable development can be progressed provided that its advice is followed.

3. Future role of the EPA – Turquoise Coast Development

The EPA has prepared the advice in this report to enable the preparation of a Structure Plan for the site that will facilitate environmentally sound development and enable the EPA's objectives for the environmental factors relevant to the development of the site, to be met.

The advice in this EPA report does not constitute a formal assessment or approval by the EPA. The purpose of the advice is to provide independent guidance on the environmental issues to the land owner and government agencies at a stage when formal assessment by the EPA under Part IV of the *Environmental Protection Act 1986* is not possible.

The EPA expects that any proposal for general urban development that complies with the EPA's advice is not likely to require formal assessment in the foreseeable future. However, the EPA retains the ability to assess any proposal or scheme that may have a significant impact on the environment that is referred to the EPA pursuant to Division 1 and Division 3 of the *Environmental Protection Act 1986*.

Referral to the EPA of a subdivision or development proposal that may have a significant impact on the environment, is a statutory obligation imposed on decision-making authorities under the *Environmental Protection Act 1986* where the proposal is not "a proposal under an assessed scheme". It is noted that the amendment that imposed the "Special Development" zoning on the site is not an assessed scheme.

While a proposal for the site of a general urban nature may not require formal assessment if the EPA's advice is adopted, a proposal such as a marina, aquaculture development, water extraction or waste water treatment, may of course require referral to the EPA and subsequent assessment, if the proposal raises significant environmental issues.

In view of the evolving nature of knowledge on environmental issues and on effective management techniques to control impacts on the environment, the advice given in this report may eventually require review, in relation to those portions of the site not developed.

The extent to which the EPA's advice may require revision or cease to apply, will depend on future events and findings, including legislative changes, the state of environmental knowledge, and the development of environmental policies and priorities. In the absence of the development of new legislation and significant new environmental findings, the review of the advice on the Turquoise Coast Development is not expected within 10 years.

To ensure that a good environmental outcome is achieved, the EPA envisages that the process below, or an alternative process accepted by the EPA, will be pursued:

- The Structure Plan and accompanying documentation will be referred to the EPA for advice. The EPA expects that the Structure Plan will be accompanied by an explanation of how the EPA's advice has been applied, and particularly:

- * Sufficient information on water management issues to demonstrate that the strategic land requirements for urban water management indicated on the Structure Plan are satisfactory, and that a satisfactory process will be followed to address water management in the subsequent stages of planning;
 - * The results of the targeted flora survey and demonstration that the findings will be adequately incorporated in subsequent stages of planning;
 - * Greater definition of the boundaries of conservation and bushland open space reserves (and/or a description of the process to be followed to ensure that the extent of the proposed reserves meets environmental objectives); and
 - * Demonstration that the full range of environmental considerations have been and will continue to be adequately addressed during the planning and development process, and that the advice in this report has been considered; and
 - * Details on how and when reserves will be secured for the primary purpose of conservation. Unless an acceptable alternative is pursued, the EPA expects that the ceding of the off-site conservation reserve, and the ceding of the core conservation areas on the site, will occur before or concurrent with the first stage of subdivision.
- The EPA will advise should it consider that the review of the recommendations in this report is needed. At the time of publication of this report, it is not envisaged that this would occur within 10 years unless legislative changes or significant new information is available or major policy changes occur. Ultimately, however, it is the prerogative of the EPA of the day to decide when proposals and schemes require assessment, and when further advice should be provided.

4. Other advice - urban development in bushland

The EPA considers that the issue of the retention of bushland is a significant issue for urban development.

The EPA prefers that urban development areas, particularly where bushland areas remain, should arise from overall comprehensive strategic planning for entire regions, that takes into account the most appropriate locations for different land uses, to achieve the overall goals of sustainable development.

Where urban development is required to fulfil regional planning objectives, it is expected that an adequate and integrated system of natural areas will be retained to ensure healthy ecological functioning, to meet human needs and demands, and to protect biodiversity, in the long term.

The EPA's view is that to ensure environmental sustainability, urban development must increasingly focus on integration with the natural environment, and not exceed the ability of the environment to accommodate disturbance.

Experience indicates that unless adequate areas of open space are set aside at the commencement of development, a Bush Forever type exercise may ultimately be required.

However, this is not the most effective or efficient way to achieve the community's overall conservation goals.

The EPA considers that it is essential that adequate areas are identified for reservation through the initial stages of planning, to meet long term sustainability goals.

In areas of high environmental significance, such as in the case of the Turquoise Coast Development, where urban development is required to fulfil regional planning objectives, the EPA encourages the pursuit of a vision of "environmental living zones" within a natural setting.

5. Conclusions

The EPA has concluded that urban development on the site is acceptable provided that the EPA's advice as summarised below is incorporated into the Structure Plan and subsequent stages of planning. The EPA's advice addresses both where and how development may occur to satisfy environmental objectives.

The EPA considers that it is imperative that a vision for the site is developed to guide this long term project, and to give long term direction to the issues of where and how development may occur. The vision should focus on the integration of development with the natural character and landscape of the region, and the pursuit of environmental sustainability. The EPA envisages the creation of "environmental living zones", being nodes of development in a natural setting.

The EPA expects that natural areas to be retained will include:

- The on-site and off-site reserves shown in Ardross Estates' Conservation Strategy (Tingay 2001). These reserves, to be set aside through the statutory planning process for the primary purpose of conservation, include:
 - * the coastline;
 - * the greater part of the vegetated portion of the beach ridge plain;
 - * a vegetated corridor adjoining the Hill River and its estuary;
 - * all wetlands other than those previously cleared in the beach ridge plain;
 - * most of the Spearwood Dunes;
 - * prominent landscape elements, and
 - * a bushland corridor through the centre of the site of average width of at least 500 metres to include natural sequences of vegetation and typical landscape elements;
- Additional land to be set aside for the primary purpose of conservation, to be determined during the structure planning and subsequent stages of planning following more detailed site surveys and planning for coastal foreshore reserve requirements, buffers around dunes and wetlands (other than the wetlands identified in Tingay 2000), and the protection of targeted flora; and
- Additional areas to be determined during the planning process. Land in this category may include semi-natural multiple use areas serving a local open space function, and land required by management plans eg the Water Management Plan, to protect key ecosystem processes.

On the issue of how development should occur, the EPA expects that urban and tourism development will be planned to support environmental sustainability, consistent with principles, guidelines and environmental management plans developed at appropriate stages of planning and development, commencing at the structure planning phase.

As part of planning for environmental sustainability, important considerations include the efficient use of energy and water, and the conservation of resources. It is expected that the site will be planned to minimise dependence on private vehicular transport and promote a public transport system, and will incorporate the principles of walkable neighbourhoods, "greenhouse" neighbourhoods, local employment and activity centres linking with a public transport network. The subdivisional lot layout should be conducive to energy-efficient housing design and estate maintenance. For example, lots should achieve good exposure for solar energy systems.

The EPA expects that a range of environmental management plans will be prepared at appropriate stages of the planning process before development, consistent with the vision for environmental sustainability for the site, and that these plans will be subsequently implemented. Key matters requiring environmental management plans include:

- Water, including water supply, stormwater management and environmental water needs;
- Conservation reserves, including coastal, riverine and wetland areas, and other conservation corridors; and

- Wastes, including liquid and solid wastes.

With respect to future proposals for the site, the EPA expects that general urban development that complies with the advice in this report is not likely to require formal assessment in the foreseeable future. However, the EPA retains the ability under the Environmental Protection Act 1986 to assess any proposal that may have a significant impact on the environment.

Appendix 1

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Appendix 2

List of submitters

Individual:

Miss Julianna Priskin

Organisations:

Conservation Council of Western Australia
Australian Marine Conservation Society Inc
Wildflower Society of Western Australia (Inc.)

Government Organisations:

Department of Conservation and Land Management
Water Corporation
Agriculture Western Australia
Water and Rivers Commission
Shire of Dandaragan
Ministry for Planning

Appendix 3

Summary of Submissions

TURQUOISE COAST DEVELOPMENT, JURIEN
SUMMARY OF ISSUES RAISED IN SUBMISSIONS

Issues in italics below are duplicated under each relevant heading.

1 BIODIVERSITY/ECOSYSTEMS/VEGETATION

2

- 1.1 The flora and fauna studies are inadequate (also see below). Without these studies it is impossible to determine with any degree of confidence the impact of the Turquoise Coast Development on the biodiversity of the area.
- 1.2 This is a large development (2006 ha) that involves the loss of a large amount of native vegetation and will degrade the biodiversity and conservation value of the area.
- 1.3 Further loss of native vegetation in Western Australia is unacceptable.
- 1.4 There will be a loss of up to 2006 ha of vegetation, so how can there be “no impact” on the conservation of vegetation in the region, as stated repeatedly in the Environmental Report?
- 1.5 The proposed development will effect the local environment as well as surrounding areas.
- 1.6 The biodiversity of the Central Coast Region is one of the highest in Australia and is significant on a global scale. Few pristine areas remain particularly close to Perth. An extensive reserve system is not a reason for a large scale urban development such as the Turquoise Coast Development.
- 1.7 It is important to have conservation outside of reserves - local conservation. It is not enough to say there is a lot of land in conservation reserves in the region.
- 1.8 Given that the development occurs in a region that is a biodiversity hotspot on a world scale, the highest environmental criteria on a world scale should be applied to the development.
- 1.9 The report comments that more than 20% of the original vegetation remains in the Shire of Dandaragan. However, the distribution and proportion of vegetation that will remain after the development needs to be determined.
- 1.10 The report mentions that between Lancelin and Dongara 76% of the land is vegetated. Yet a lot of this land is highly disturbed by 4WD tracks and other impacts and is subject to possible developments, such as at Grey, Wedge and North Head.
- 1.11 The mixture of Quindalup and Spearwood vegetation, the Hill River, the estuary and the coast means complex interactions between these systems. They are also fragile. It will be difficult to manage and maintain the natural condition of the systems once development proceeds, even under the proposed reserve scheme.
- 1.12 The vegetation survey is insufficient in that it was completed in one season and only during 5 days in 1996. A survey over at least two seasons is needed to identify species missed in the first survey.
- 1.13 The vegetation should be investigated at the specific time of the year when there is the maximum level of flowering.
- 1.14 The vegetation and flora report upon which the conclusions made in Section 3.2 are based does not provide sufficient information to draw these conclusions.
- 1.15 To comply with the EPA Preliminary Position Statement No. 2 that “the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity is secure and protected”, it is necessary for a number of conservation areas to be incorporated into the development. These additional areas as well as the existing reserves would then have to be linked by corridors of conserved land.
- 1.16 It is good to see that the development includes plans to reserve vegetated areas, but the proposed reserves on the site do not go far enough to protect the landscape, flora and fauna. More reserves need to be established, and existing ones enlarged.

- 1.17 There are a number of vegetation communities on the property. Each is locally significant and each type should be preserved rather than just preserving bushland where it is convenient to the plans.
- 1.18 The reserves in the development should be connected by corridors of reserved land which would have to be wider than 200 m.
- 1.19 Section 2.2 references are made to several reserves that are not indicated or present in either Figure 1 or Figure 2. This makes it hard to conceptualise the proximity of these reserves to the development.
- 1.20 The vegetation left as conservation reserves within the development will be impacted on. Residential development will cause impacts such as the spread of weeds, disease and feral animals. Coastal vegetation is easily invaded by garden plants such as daisies, geraniums and creepers. Fertiliser drift and watering of gardens will increase weed invasion and growth.
- 1.21 Buffer zones between the development and all reserves are inadequate and should be expanded to afford maximum protection for the reserves.
- 1.22 It is at the boundary between reserves and developed land that there is a great probability of damage occurring to the reserves. In order to further protect the reserves it would be best if only recreational zones were placed next to the reserves.
- 1.23 Designated open space areas should retain a significant amount of natural bushland.
- 1.24 The report stated that much of the vegetation on the properties is in good condition. It is considered that limited development in the area is the reason the vegetation is in such good condition.

Government Authority Submissions

- 1.25 The Commissioner for Soil and Land Conservation has no objections on land degradation grounds to the proposal. There is an error on page 16 of the Environmental Report in that the Memorandum of Understanding for the protection of native vegetation applies to all proposals in rural zoned land regardless of whether there is 20% native vegetation remaining on the property or within the shire. Therefore any proposed land clearing greater than one ha will require notification. In this case, that should be an administrative exercise, as the proposal is already being assessed.

See also 18.9.

2 DECLARED RARE AND PRIORITY FLORA

- 2.1 More work is needed to ensure rare flora is identified.

Government Authority Submissions

- 2.2 The Department of Conservation and Land Management (CALM) is prepared to work with the developer during the preparation of a Structure Plan on the issue of the impact on the conservation status of flora from the proposed development. Nevertheless, it may better ensure the conservation of flora and also the proponent's development interests to identify the areas where potential exists for impediments to the proposal at the earliest possible stage, in consultation with CALM.

3 WEED CONTROL

- 3.1 The impact of introduced species into the area must be considered, including environmental weeds. By-laws must be put in place to prevent the potential spread of weeds.

Government Authority Submissions

- 3.1 The northern cleared section of the subject land supports significant weed infestation. CALM strongly recommends that the proponent develops a strategy as soon as is practicable for control of the highly invasive weed Patterson's Curse that represents a significant threat to surrounding conservation land and to areas of remnant vegetation that the proponent has indicated will be protected in the future.

4 FAUNA

- 4.1 The conclusions made in Section 3.3 are questioned. The data used to draw these conclusions is not substantial enough to sustain the claims that the regional fauna can be adequately conserved in the existing and proposed reserves.
- 4.2 Of the fauna survey studies referenced only two have any real validity in respect to the Turquoise Coast Development. The combination of these two surveys does not provide enough information about the fauna present within the area.
- 4.3 It has previously been shown that the contemporary status of fauna in an area cannot be determined remotely from old records.
- 4.4 There is clearly a need to perform a comprehensive fauna survey that includes data recorded at a variety of points throughout the year, including a focused study of the seasonal wetlands.
- 4.5 Before the development can go any further an extensive fauna survey of the entire area proposed for development should be conducted.
- 4.6 The impact of introduced species into the area must be considered. By-laws must be put in place to prevent the keeping of cats and dogs which would have a negative influence on the environment.
- 4.7 *The Hill River Delta is an important breeding habitat for several bird species and should be protected.*
- 4.8 *The different vegetation around the wetlands provides habitat for fauna. The area should be increased in size and recreation access minimised.*

5 WETLANDS

- 5.1 *It is recommended that a more comprehensive study be completed to identify interactions between coastal processes, wetlands and the Hill River.*
- 5.2 The claim that there will be “no impact” on the wetlands from development is unsubstantiated.
- 5.3 Recreation around the wetlands will affect wetland processes by increasing soil disturbance, creation of tracks, increased weed invasion, and so on.
- 5.4 Recreation access to the wetlands should be minimised.
- 5.5 Use of ground water (eg to irrigate grassed reserves in the development) and inappropriate management of stormwater and urban runoff is likely to impact on wetland hydrology.
- 5.6 How do the report writers know there will be “no change to the present hydrology of the wetland areas” when they only “suspect” there are wetlands in the site?
- 5.7 The larger wetland is a saline wetland containing atypical vegetation and is thus significant. The larger wetland should be reserved for conservation purposes only. It is important to provide it with protection commensurate with its significance.
- 5.8 The boundary of the larger wetland has not been defined since Trudgen identified it in 1996 at a time of year when it was not inundated. The boundary should be confirmed at a time of the year when the wetland is inundated.
- 5.9 The Environmental Report does not adequately delineate wetland boundaries. A survey of wetlands should be conducted at a time of the year when the area is waterlogged to determine the real boundaries.
- 5.10 Buffers should be determined once the wetlands are clearly delineated.
- 5.11 Buffers for the larger wetland of 50 - 100 metres are inadequate to protect the wetland from the effects of development. The setback should be at least 100 m.

- 5.12 The proposed setback for the wetland does not meet EPA and WAPC guidelines that stipulate midge control distances need to be at least 500 m.
- 5.13 *The Beach Ridge Plain Reserve should be extended south to incorporate part of Plain B and the larger wetland to provide greater protection for the larger wetland and incorporate some of the flora of Plain B that has not yet been cleared.*
- 5.14 The coastal reserve should be extended to include the larger wetland.
- 5.15 *The different vegetation around the wetlands provides habitat for fauna. The area should be increased in size and recreation access minimised.*

6 THE HILL RIVER

- 6.1 This development means that all three rivers in the Central Coast Region that meet the sea will be modified by urban development and for this reason the development is opposed.
- 6.2 *It is recommended that a more comprehensive study be completed to identify interactions between coastal processes, wetlands and the Hill River.*
- 6.3 There will be loss of high value landscape with modification of the river landscape.
- 6.4 *The Hill River Delta is an important breeding habitat for several bird species and should be protected.*
- 6.5 The buffer zones proposed in the report are inadequate to protect the riverine environments.
- 6.6 The floodplain should be left as is and not allocated for parks and recreation use.
- 6.7 The recreation facilities including walk trails shown in Appendix 5 near the Hill River are likely to contribute to erosion, soil disturbance, proliferation of weeds, disturbance of bird breeding habitats, litter, and more tracks. There needs to be a setback area from the river before walkways are developed.
- 6.8 The proposed buffer zone along the Hill River should be extended to the north by an additional 150 metres to adequately protect the lower reaches of the Hill River.

Government Authority Submissions

- 6.9 The Hill River and its estuary are a rarity in terms of its river classification and condition. The estuary area is in particularly good condition.
- 6.10 The Water and Rivers Commission (WRC) supports the foreshore boundary alignment shown on plan 1919/00 02 ENV amended 12 May 2000. This support does not include the pathways which will need to be assessed separately through a comprehensive foreshore management plan.

7 COASTAL AND MARINE ENVIRONMENT

- 7.1 Urban developments can cause significant changes to natural processes both in marine and coastal environments. Any development on the coast will have an impact on beaches, fragile foredunes and ridges, and the marine environment. Impacts occur from construction and later from trampling and general use.
- 7.2 It is not correct to say there will be "no impact" on coastal processes, the marine environment or beaches.
- 7.3 The Central Coast Region is currently self-sustaining. The livelihood of the region depends on a pristine and clean environment, particularly for the rock lobster industry. The biodiversity of the marine environment is high and in pristine condition. The development will impact on this.
- 7.4 The clean and natural standard of the coast and marine environments will be lowered by the development.
- 7.5 A marina is associated with structures that may cause erosion and alter natural processes, and with marine pollution from leakages and oil spills. Boating moorings will contribute to destruction of seagrasses and biodiversity.

- 7.6 Jurien Bay has a marina. The report has not justified the need for a similar structure.
- 7.7 The Environmental Report notes that the Dandaragan Coastal Plan did not make recommendations for the Turquoise Coast area. The Report should note that that was because the brief excluded the section for the Turquoise Coast Development.
- 7.8 It is expected that detailed management plans would be prepared by Ardross for that section of the coast. Recommendations from the Dandaragan Coastal Plan that are applicable to the coastal areas of the Turquoise Coast Development are at Attachment 1.
- 7.9 *It is recommended that a more comprehensive study be completed to identify interactions between coastal processes, wetlands and the Hill River.*
- 7.10 When considering long-term processes such as shoreline movements for there to be a meaningful study of these phenomena a very large period of time must be examined. Understandably, such a study could not be performed in the case of the area between the Hill River and Jurien Bay. Therefore the Turquoise Coast Engineering Study (1999) must be viewed with the knowledge that the processes effecting the coastline might have only occurred relatively recently.
- 7.11 The proposed coastal setbacks and foreshore reserves are inadequate to provide reasonable protection of the coastline.
- 7.12 As noted by MP Rogers and Associates (1999) in the area labelled Sector 1 in Figure 11 there has been a significant level of erosion. In this area the foreshore reserve should be at least 250 m wide.
- 7.13 If the Beach Ridge Plain Reserve is extended into Plain B to include the larger wetland (referred to above), the coastline in Sector 1 will be adequately protected.
- 7.14 Since it is not known whether accretion in the northern part of Sector 2 is a relatively recent change that will continue, the foreshore reserve should be greater than 150 m in order to account for any changes in the coastal processes and extreme storm events.
- 7.15 For the southern region of Sector 2 where the coastline has been relatively stable a foreshore reserve greater than 200 m wide should be established.
- 7.16 The piece of land approximately 800 m north of the division between Sector 2 and Sector 3 that extends further into the ocean than the rest of the coastline should be part of a wider section of the foreshore reserve. This has already been identified in Figure 11 as a necessary action due to the probable greater occurrence of erosion at this site.
- 7.17 The proposed foreshore reserves in Sector 3 should have a minimum width of 200 m.
- 7.18 Foreshore reserve widths must take into account in addition to coastal processes and extreme storm events, erosion of soil and adequate vegetation. This is difficult to estimate from aerial photographs and requires an on site examination.
- 7.19 The coastal setbacks as detailed in Figures 11A-C do not meet present coastal policy recommendations for Western Australia (WAPC 1996). In order to accommodate wind, wave and water erosion and to allow space for public amenities it is recommended that the foreshore reserve distance be widened in the following sectors:
- Sector 2 (Figure 11B):
- widen foreshore reserve boundary to include the wetland, together with an additional 100 metres on the eastern side to protect the wetland. This would widen the foreshore reserve to 500 metres in the southern part of the wetland.
 - widen the foreshore reserve for the area highlighted as Booka Valley by another 100 metres as this is a designated district beach and it erodes regularly.
- Sector 3 (Figure 11C):
- widen the northern section of Sector 3 by an additional 50 metres.
- 7.20 At Sector 2, the fragile and most likely to erode area, near the wetland, there is only a 60 metre setback.

- 7.21 With the increase in population, higher levels of tourism and greater boating in the area there will be a larger strain placed upon the islands. This would further stretch the resources of CALM and cause greater damage to the islands.

Government Authority Submissions

- 7.22 General referencing to the marine reserve planning process for the proposed Jurien Bay Marine Park requires correction. The Environmental Report incorrectly refers to the NPNCA rather than the MPRA.
- 7.23 The State Government's policy document on marine conservation New Horizons - the Way Ahead in Marine Conservation and Management 1998 should be referred to.
- 7.24 Figure 13 incorrectly shows the proposed Jurien Bay Marine Park boundary. The current proposed marine park area is shown in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000.
- 7.25 CALM recommends that the proponent should acknowledge the need for value-threat analyses for activities arising from the development to be developed in advance of structure plans with emphasis given to the management of ecological and social values described in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000.
- 7.26 CALM recommends that the proponent should acknowledge the need for strategies in sympathy with those specified in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000 to ensure that the park's values are not compromised as a result of future development.
- 7.27 CALM recommends that management measures relating to any potential impacts that may arise specifically as a result of proposed development should be resourced fully by the proponent under some agreed arrangement with CALM.
- 7.28 The report provides no specific information on likely loadings and disposal of waste products to the marine environment. If the disposal of liquid wastes to the marine environment either directly via outfalls or indirectly via groundwater discharge is pursued, there will need to be careful evaluation and maintenance of very stringent water quality criteria as outlined in the Indicative Management Plan for the Proposed Jurien Bay Marine Park 2000. This is due to the well-established problems that nutrient enrichment from wastewater inputs can have in oligotrophic lagoonal environments subjected to weak flushing as in Jurien Bay and its adjacent lagoons.
- 7.29 The Ministry for Planning (MfP) considers that the coastal issues relating to the marine environment, the beach and dunes, coastal erosion, potential sea level rise and the definition of the foreshore reserves, have been adequately dealt with at a broad level in the Environmental Report. The Ministry has given conditional endorsement to the coastal foreshore reserve alignment as presented by Ardross Estates.

As coastal development plans are further advanced the coastal foreshore reserve alignment and width at the proposed resort and aquaculture sites will need to be further examined. The requirements for coastal recreation and rehabilitation will also be investigated and the subject of detailed reports at the subsequent structure planning stages. Development conditions will be set to ensure these issues are properly addressed.

8 BEACH RIDGE PLAIN

- 8.1 The Report mentions that there will be development on the beach ridge plain. This may cause erosion between vegetation removal and building stages.
- 8.2 *The Beach Ridge Plain Reserve should be extended south to incorporate part of Plain B and the larger wetland to provide greater protection for the larger wetland and incorporate some of the flora of Plain B that has not yet been cleared.*

9 WATER MANAGEMENT

- 9.1 Plans for the management of water must be open to public review and formal assessment.
- 9.2 *These plans should have been available as part of the Public Review of the Environmental Report. Only when the plans have been created can any decision be made on their environmental impact.*

- 9.3 Poor plans could have a significant effect on a number of different environs including the wetlands, the Hill River, the Indian Ocean and groundwater below the development. From the readings recorded at the bores it can be deduced that the groundwater flows towards the Hill River which in turn would lead to contamination of the local coastal waters.
- 9.4 When addressing the management of groundwater it is not sufficient to ensure that it does not rise significantly. More detailed commitment is required.
- 9.5 The bores labelled O and R in Figure 8 have negative readings recorded for the water level. These readings may warrant additional bores around this area.
- 9.6 Data needs to be collected on the current surface water quality before any water management plan can be designed.
- 9.7 No approvals should be given until the proponent can demonstrate adequate management.

Government Authority Submissions

- 9.8 The Water and Rivers Commission is the regulatory authority responsible for the issuing of a license for the extraction of groundwater rather than the Water Corporation as referred to on page 37 of the Environmental Report.
- 9.9 To clarify the statement on page 37 of the Environmental Report, Ardross Estates has appointed the Water Corporation as the preferred water, wastewater and drainage supplier.
- 9.10 To clarify the statement on page 38 of the Environmental Report, it will be the Water Corporation who will be undertaking the preparation of the Water Management Plan which will include a Drainage and Nutrient Management Plan and a Strategic Drainage Scheme Review as a basis for the detailed design of the drainage system. In undertaking the Drainage and Nutrient Management Plan the Water Corporation in association with Ardross Estates will ensure that land uses are appropriately located to safeguard the quantity and quality of groundwater.
- 9.11 *In undertaking investigations for water source areas as well as the siting of facilities associated with the proposed development, such as a Wastewater Treatment Plant, sites have been nominated on land not contained within the Environmental Report. When investigations are completed the Water Corporation will be applying for the necessary statutory approvals from the relevant authorities.*

10 WASTE MANAGEMENT

- 10.1 Plans for the management of waste must be open to public review and formal assessment.
- 10.2 These plans should have been available as part of the Public Review of the Environmental Report. Only when the plans have been created can any decision be made on their environmental impact.
- 10.3 Poor plans could have a significant effect on a number of different environs including the wetlands, the Hill River, the Indian Ocean and groundwater below the development. From the readings recorded at the bores it can be deduced that the groundwater flows towards the Hill River which in turn would lead to contamination of the local coastal waters.
- 10.4 It is unacceptable to merely rely on the local government by-laws to regulate the disposal and treatment of wastes. A waste management plan should be produced to take into account the by-laws and unique environmental context. An important feature of the plan would be an enforceable method of controlling nitrogen and phosphorus loading into the marine environment. Also, the control of airborne pollutants must be accounted for.

Government Authority Submissions

- 10.5 *In undertaking investigations for water source areas as well as the siting of facilities associated with the proposed development, such as a Wastewater Treatment Plan, sites have been nominated on land not contained within the Environmental Report. When investigations are completed the Water Corporation will be applying for the necessary statutory approvals from the relevant authorities.*

11 VISUAL AMENITY

- 11.1 While it is noted in Section 5.1.1 that the Turquoise Coast Development will be visible from Indian Ocean Drive, there are no proposed methods of sustaining the visual amenity of this area.
- 11.2 The development is adjacent to Indian Ocean Drive for approximately 6 km. This combined with the fact the vegetation in the area which is not very tall will not hinder the visibility from the road means that a large area of the Turquoise Coast Development will be visible to motorists. The design of the portion of the development alongside Indian Ocean Drive must clearly take into account the need to maintain the visual amenity of the area and avoid creating a visual landscape that is out of context with the surrounding environment.
- 11.3 The proposed development would be detrimental to the visual amenity of the area.
- 11.4 Housing will be visible from the road as soon as you reach the Hill River.
- 11.5 The buffer adjacent to Indian Ocean Drive should be widened to at least 500 metres to hide the development from motorists. The buffer zone should be screened with taller plants, particularly local indigenous shrubs.
- 11.6 There needs to be a very large buffer (500 m to 1 km) between the development and Indian Ocean Drive to hide it from the road.
- 11.7 There will be loss of high value landscapes with loss of up to 2006 ha of vegetation.
- 11.8 The issue of the visual amenity value of the design of the buildings of the Turquoise Coast Development is essential to the planning of the development.
- 11.9 It would be disastrous if the development were to be built in such a manner that it resembled the many existing coastal urban developments.
- 11.10 "Suburban style" development would be detrimental.
- 11.11 One of the main attractions of the Central Coast Region is that it has "wide open space" and "low levels of development" (Priskin, 1999).
- 11.12 The Structure Plan must be designed to incorporate the natural surroundings of the area into the development with an abundance of low density houses and limited medium density housing.
- 11.13 The report states that as the public do not use the land, "the visual amenity of the area is therefore limited". Yet people on the beach and along Indian Ocean Drive can see the land.
- 11.14 It is hoped that Ardross Estates will create a development that is visually appealing.
- 11.15 Should the development proceed there is a good opportunity to create a unique architectural style for the proposed development that would also fit local environmental conditions.
- Government authority submissions**
- 11.16 CALM recommends that serious consideration should be given to underground supply of utility services particularly power, to minimise impacts on the visual amenity of the proposed development.

See also 18.9.

12 PUBLIC USE OF SITE

- 12.1 The report says that there is little public use of Ardross Estate yet provides no data on this. Was a survey of numbers of users of the site conducted? Was the Jurien community consulted? The area used to be a shack area and thus was used a lot.

13 TOURISM

- 13.1 Several large scale tourism developments are proposed. There are sufficient plans in Jurien Bay already for these purposes as well as in other coastal towns in the Central Coast Region.
- 13.2 It is recommended that any tourism facilities on the subject land consider the environmental features of the Central Coast Region.

14 RECREATION

- 14.1 The proposed site of the public beach at Booka Valley is inappropriate. Just to the east of the proposed beach site is an area of land that has already experienced a great loss of vegetation. If the Booka Valley beach does go ahead there will be an even greater loss of vegetation particularly the thin strip of vegetation adjoining the beach. Loss of vegetation in this area would result in a very high level of soil erosion that places the long term viability of a public beach at this site into doubt.

See also 18.9.

15 MARICULTURE

- 15.1 The approximate area set aside for the potential mariculture industry should be delineated more clearly.
- 15.2 Further planning of the development must include some form of buffer zone between the area for mariculture and the residential area. The mariculture area should not be in proximity to the Hill River.

16 JUSTIFICATION AND SCALE OF DEVELOPMENT

- 16.1 The proposed development is too large, both in the context of the projected population growth for Jurien Bay, and its impact on biodiversity. The Environmental Report does not provide sufficient justification to develop such an extensive area.
- 16.2 There needs to be a thorough examination to substantiate the need and demand for a development on such a large scale as proposed.
- 16.3 We are concerned that this huge area of land will be prepared for residential development and never reach its projected potential.
- 16.4 Does the Jurien Bay Townsite have the resources and job opportunities to cater for the greatly increased population that will result from this development?
- 16.5 Much of the coast south of the Perth Metropolitan Region is fully developed and this has affected the quality of the natural environment as well as its visual amenity. There is no need to repeat this ribbon development along the northern coast.
- 16.6 After examination of the Environmental Report, the biggest unanswered question is the justification for such a large development. Without proper justification this project can not proceed as outlined in the EPA Preliminary Position Statement No. 2 on the Environmental Protection of Native Vegetation in Western Australia. The Environmental Report does not provide any evidence on how it meets the requirements of the position statement by providing a "social good".
- 16.7 It is difficult to believe that the town of Jurien Bay would expand to the point where it would be necessary to build a 2006 ha development. The average annual population growth of Jurien Bay is below 5%.
- 16.8 What must be clearly defined is the most likely population that the Turquoise Coast Development will be required to provide for.
- 16.9 When making a decision about the suitable scale of the Turquoise Coast Development attention should be paid to the Shire of Dandaragan's plans for the area, particularly the Coastal Plan. The success of the recreational development areas outlined in the Coastal Plan will indicate the viability of the tourism industry in the area and should be used to determine the appropriate level of expansion of Jurien Bay.

- 16.10 The comment on page 6 of the Environmental Report that the southern section of the Hill River offers unlimited expansion potential in the longer term is disturbing. This section of the Dandaragan coast is fragile and unstable.
- 16.11 It is recommended that the size of the proposed development is reduced in spatial extent leaving more natural open space towards the southern section of the land.
- 16.12 While there is a need to diversify facilities in the Region as tourism grows, there are sufficient plans in Jurien Bay already as well as in other coastal towns in the Central Coast Region.

17 ENVIRONMENTAL PLANNING/ECOLOGICAL SUSTAINABILITY

- 17.1 The documentation provided does not demonstrate that this development will be ecologically sustainable.
- 17.2 The development will compromise the sustainability of the area.
- 17.3 Should the development proceed it should be based on environmentally sensitive planning, with design, management, and buildings that would be ecologically/environmentally sustainable.
- 17.4 The development should be energy and water efficient/use solar power/retain native vegetation within lower density lots/ build housing that matches well with the environment/ use responsible waste management, and so on.
- 17.5 In designing new buildings it is highly recommended that Ardross Estates consult with a number of sustainable architects such as Gary Baverstock.
- 17.6 It is hoped that the ecovillage concept will be used extensively when designing the Turquoise Coast Development.
- 17.7 The grazed land should be developed as higher density housing.

18 GENERAL

- 18.1 The Environmental Report has ignored the potential for cumulative effects in the region as a result of the development. This should be considered in some detail.
- 18.2 It is recommended that the EPA apply the most stringent environmental criteria to this development should it proceed.
- 18.3 If the EPA allows a development of this size on natural land in the Central Coast Region it will set a precedent for development in the area.
- 18.4 Any further submissions from Ardross estates relating to this development should be open to public review and formally assessed. A supplement to the Environmental Report that would include more comprehensive information on several topics including flora and fauna studies might be required.
- 18.5 The argument in the Report that the environmental impacts of the development on the environment would be minimised often relies on means as yet unknown.
- 18.6 The phrase "no impacts" is used far too frequently and often incorrectly. This is very noticeable in Table S1. The project will have substantial environmental impacts given its extent.

Government authority submissions

- 18.7 The Shire of Dandaragan has endorsed the Environmental Report prepared by Ardross Estates and has been supportive of the overall development.
- 18.8 The Western Australian Planning Commission (WAPC) has entered into a Memorandum of Understanding with Ardross Estates to facilitate and guide the development of the land.

18.9 Ministry for Planning (MfP) advise that the environmental issues of concern to the Ministry are provision of adequate coastal and Hill River foreshore reserves, protection of significant wetlands and flora and fauna, landscape amenity issues and provision for a full range of recreation opportunities and public access to appropriate areas along the coast and river. Also, protection of groundwater resources and marine and surface water resources are of concern, and the Environmental Planning Branch at MfP would support other agency comments in relation to these and other issues. The open space, landscape amenity and recreation issues have been addressed to an acceptable level of detail at this stage in the development process and will be further investigated and incorporated into plans during the structure planning phases. Culture and heritage issue seem to have been adequately dealt with.

Appendix 4

Strategy for Nature Conservation and Biodiversity – Turquoise Coast Development – Jurien Bay for Ardross Estates Pty Ltd

Prepared by Dr Alan Tingay and Mitchell Goff & Associates

October 2001

STRATEGY FOR NATURE CONSERVATION
AND BIODIVERSITY – TURQUOISE COAST
DEVELOPMENT – JURIEN BAY

for ARDROSS ESTATES PTY LTD

OCTOBER 2001

Prepared by:

DR ALAN
TINGAY and

MITCHELL
GOFF &
ASSOCIATES

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Strategy for Nature Conservation and Biodiversity – Turquoise Coast Development – Jurien Bay

1. INTRODUCTION

In order that an urban and tourism project on approximately 2000 ha of land on the coast at Jurien Bay can be planned and coordinated within appropriate environmental guidelines, the proponents, Ardross Estates Pty Ltd, sought advice from the Environmental Protection Authority (EPA) under Section 16 of the Environmental Protection Act. This resulted in the preparation of an Environmental Report (Dr Alan Tingay & ATA Environmental, August 2000) which was advertised for public input resulting in the Department of Environmental Protection (DEP) preparing draft recommendations to the EPA.

These draft recommendations include the preparation of a Strategy for Nature Conservation and Biodiversity. This strategy therefore addresses this issue.

It is understood that the EPA is mindful of achieving preservation of areas of existing vegetated land both within and outside the project area as a contribution to nature conservation and biodiversity.

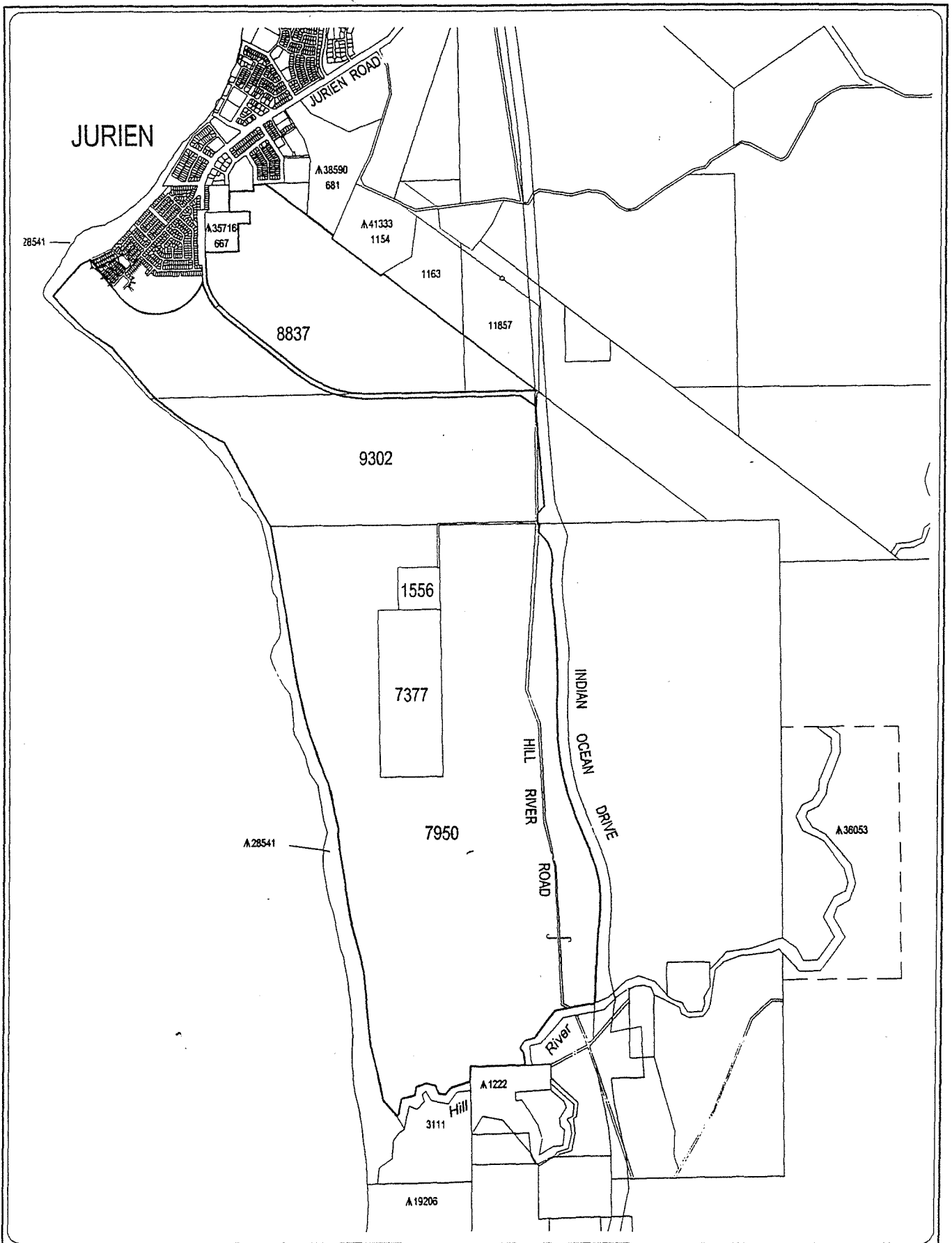
Amongst the key elements listed by the DEP in relation to the strategy are the following.

- ◆ Protection of significant and scarce habitats and vegetation on the site, notably:
 - the coastline;
 - the beach ridge plain;
 - the Hill River and its estuary;

- wetlands; and
 - portion of the vegetation of the lower Spearwood Dunes within a bushland reserve of sufficient dimensions to ensure the long term survival of the lower Spearwood Dunes vegetation;
-
- ◆ protection of key landscape elements;
 - ◆ retention of natural or semi-natural areas as required by management plans to protect key ecosystem processes;
 - ◆ inclusion of bushland corridors that link the above areas on the site with adjoining off-site bushland areas and include natural sequences of vegetation;
 - ◆ the development of a schedule for the preparation of Management Plans that described procedures to minimise disturbance in the long term to key remnant vegetation on and adjoining the site;
 - ◆ the development of schedules for the collection of baseline environmental data and the monitoring of ecosystems;
 - ◆ taking into account the likely long term timeframe for the development of the site, provision for periodic review of the conservation strategy to ensure that environmental objectives continue to be met as development occurs on the site and incrementally in the Central Coast Region; and
 - ◆ the EPA expects that development would occur in nodes such that the site retains an overall sense of natural landform and setting. In this regard, as part of the on-site conservation measures, greater areas should be excluded from development than occurs in conventional urban development.

2. STUDY AREA

The study area totalling approximately 2,006 ha is shown on **Figure 1 – Locality Map**. This figure also shows existing cadastral boundaries including those of public reserves.



Notes/Revisions



0 Metres 1250

SCALE 1:50000

Date: 25 June 2001 Ref. 1919/Jan2001base

LOCATION PLAN
JURIEN BAY
figure 1

Figure 2 overlays the study area onto an aerial photograph, showing the portion of the site which is cleared and the portion retaining vegetation. In total, some 1,508 ha is vegetated and 498 ha cleared. Apart from coastal dune systems, the vegetated portion of the study area generally occupies the southern two thirds (approximately) of the site.

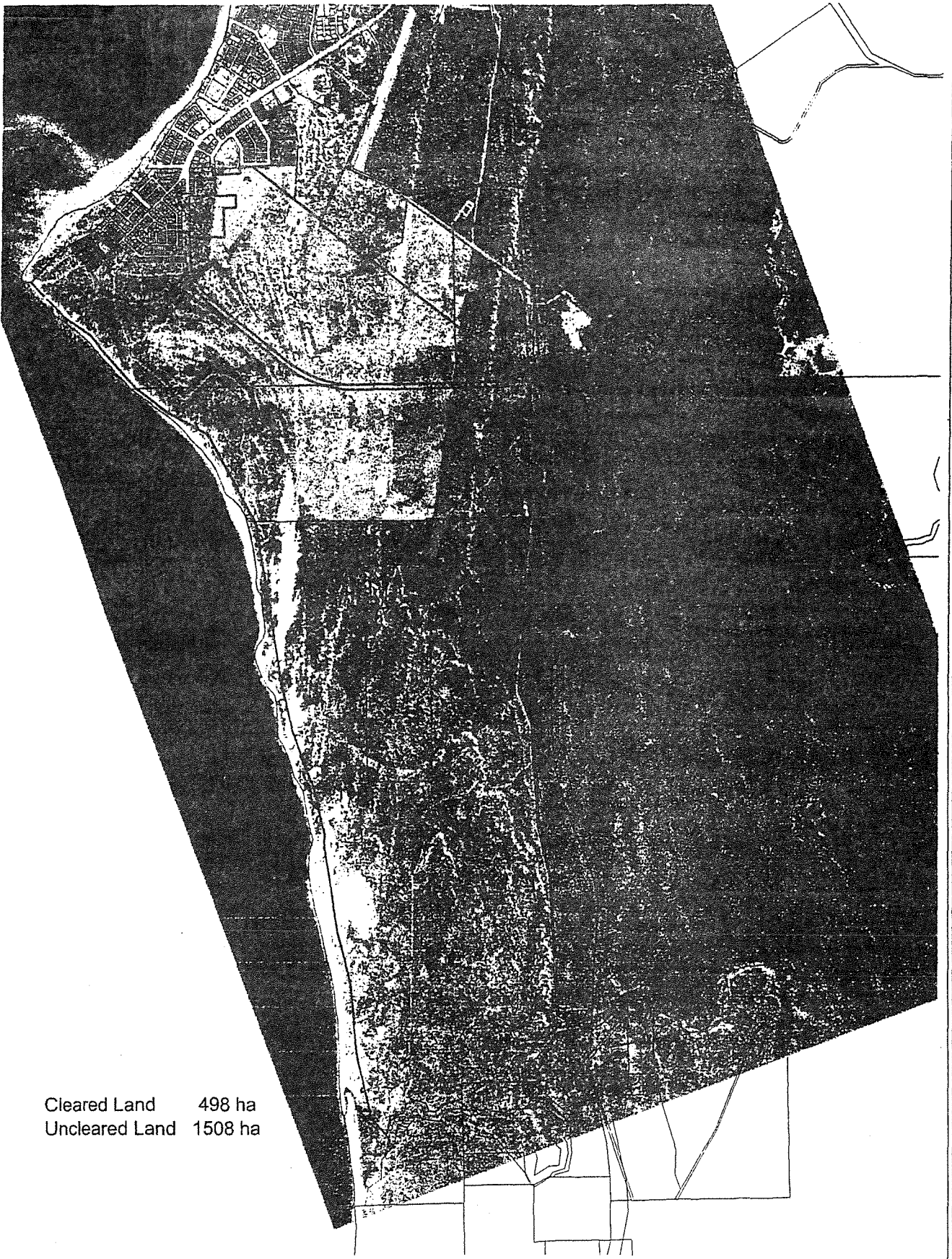
3. THE STRATEGY

Figure 3 shows the proposed reserves comprising the Strategy for Conservation and Biodiversity. These proposed reserves comprise approximately 519 ha on-site and 86 ha off-site. The total of 605 ha represents 40.1% of the 1,508 ha of vegetated land within the project area.

Figure 4 shows the proposed on-site reserves draped over a computer generated model of the site. The site is viewed from the north-east and the vertical exaggeration is 5 times.

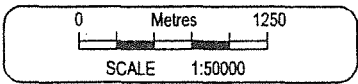
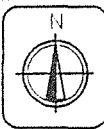
In summary, the proposed reserves comprising this strategy include ocean foreshores, a representative sample of the beach ridge plain at Island Point, an extensive foreshore reserve following the course of the Hill River, a central east-west belt breaking the development area into nodes and protecting a west to east vegetation sequence and dune systems including parabolic dunes in the east west belt and a dune ridge towards the south-east, a belt of vegetation along Indian Ocean Drive as well as an off-site reserve creating a linkage through to the large Beekeepers Reserve to the east.

In addition, it is anticipated that further retention of vegetation will be achieved in the Structure Plan through allocation of public open space.



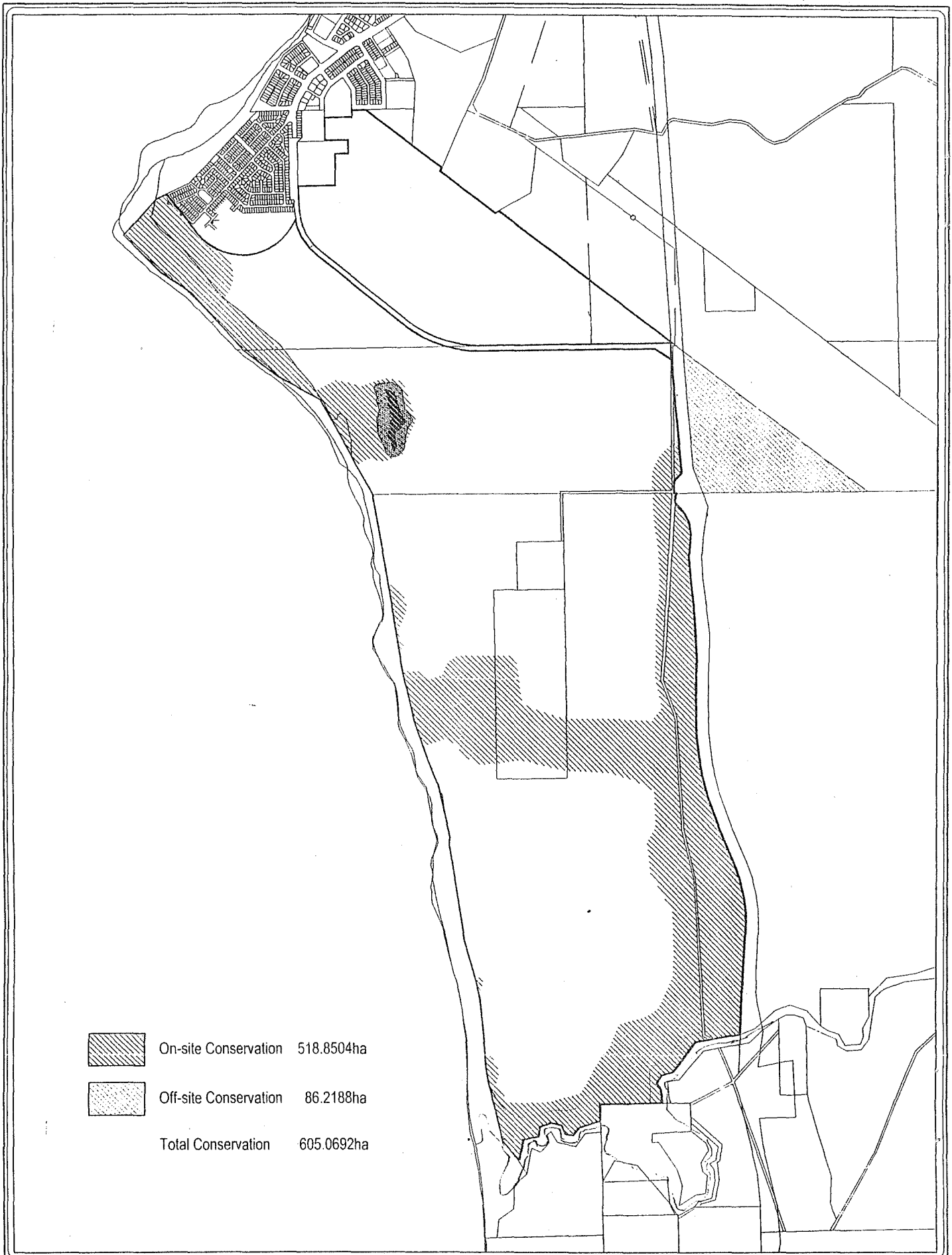
Cleared Land 498 ha
 Uncleared Land 1508 ha

Notes/Revisions

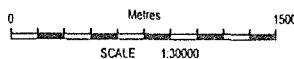


Date : 25 June 2001 Ref. 1919/jan2001base

VEGETATION PLAN
 JURIEN BAY
 figure 2



Notes/Revisions

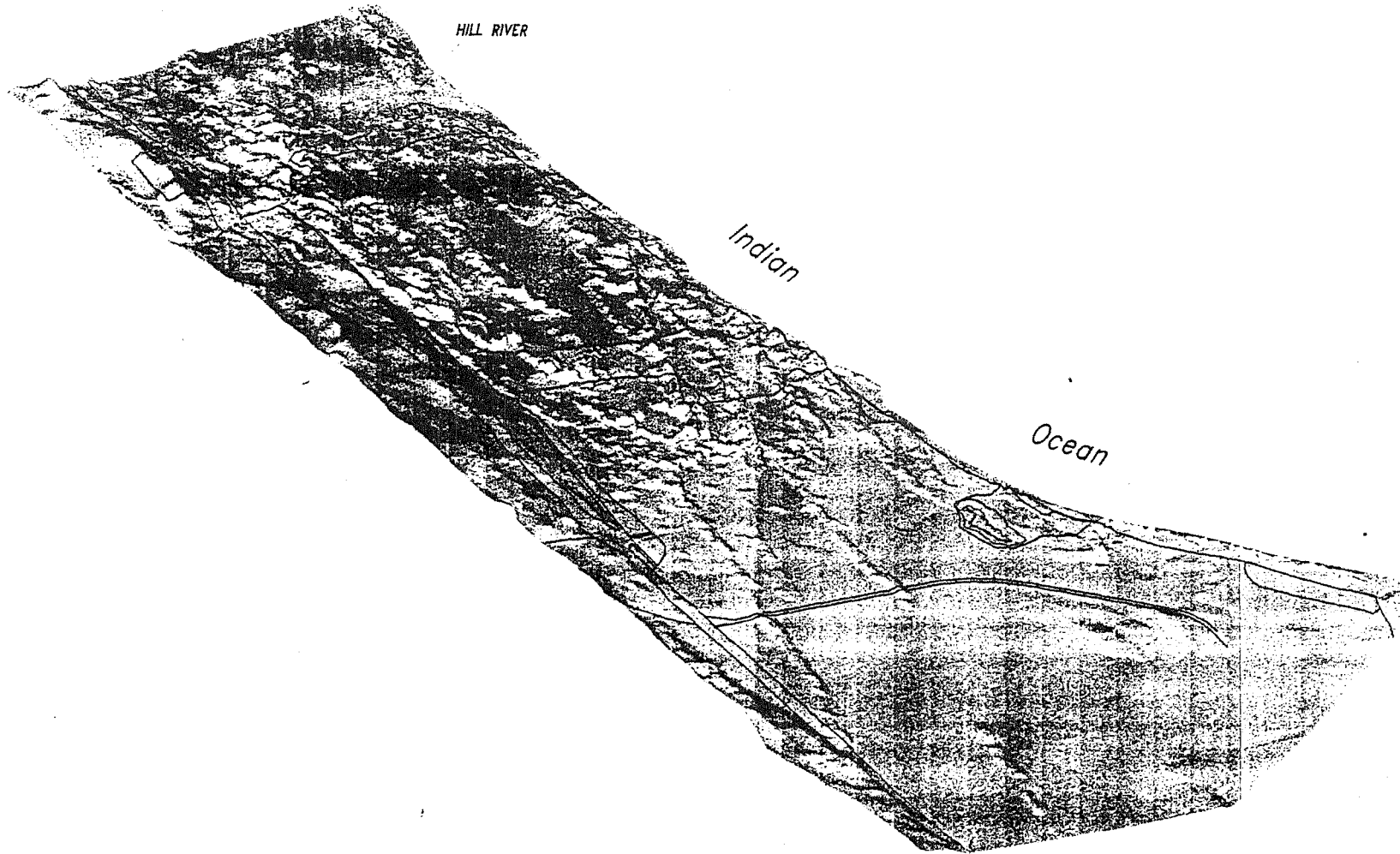


Date: 14 August 01

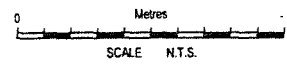
Ref No. 1919/Jan2001base

ON SITE & OFF SITE CONSERVATION RESERVES

Figure 3



Notes/Revisions



Date: 14 August 2001 Ref No. 1919Jan2001base

OBLIQUE VIEW OF SITE
5 TIMES VERTICAL EXAGGERATION
Figure 4

The developer has committed to carry out further flora survey(s) to determine whether any targeted flora species are present on the properties. The timing and methods used in these surveys will be determined by the developer in consultation with CALM.

The developer has committed to protect by reservation in the Structure Plan any populations of flora that are considered by CALM to be significant. Management plans for the conservation of these plant populations also will be prepared by the developer in consultation with CALM.

The relationship of the proposal to key elements listed by the DEP follows.

4. PROTECTION OF SIGNIFICANT AND SCARCE HABITATS ON THE SITE

4.1 The Coastline

The environmental report of August 2000 proposes a foreshore reserve line based on coastal engineering factors as a minimum reserve for protection of the coastline.

The proposed foreshore reserve has been reviewed by the proponents and by the coastal engineering division of the Department of Transport and modified accordingly. This strategy incorporates the modifications recommended by the Department of Transport in accordance with their advice dated 15th June 2001 to M P Rogers & Associates, included here as **Appendix 1**.

The final foreshore boundary may in places be wider than shown to satisfy the full range of coastal reserve planning criteria to be determined through the detailed planning process.

4.2 The Beach Ridge Plain

The landform of the project site is described in the environmental report of August 2000. That description identifies Jurien Bay's location on a beach ridge plain with a second plain existing to the south and east of the first. In general, the vegetation on the second beach ridge plain has been removed and the area substantially modified.

A portion of the first plain however (Plain A) retains vegetation and is proposed to be set aside as a reserve, providing a representative sample and a geological resource. The proposed reserve extends south-east to a location where a more recent coastal dune overlies the beach ridge plain forming a natural boundary.

4.3 The Hill River and its Estuary

A riparian reserve for the protection of the Hill River has been established in consultation with the Water and Rivers Commission. This process included the completion of a flood study identifying the extent of the floodplain associated with a 1 in 100 year flood event.

The riparian reserve takes into account floodway requirements, vegetation and landform considerations. The proposed reserve incorporates the total floodplain associated with a 1 in 100 year flood event.

4.4 Wetlands

A wetland adjacent to the coastal foreshore reserve in the area known as Booka Valley has been identified and proposed for reservation with Buffer Zone.

Further, during a site visit, DEP officers and members of the EPA identified another area possessing wetland characteristics and queried the potential for wetland areas to have been missed during vegetation surveys. This led to a desktop study of available contour information identifying low lying areas where other wetlands may occur. These areas were located on-site using Global Positioning Systems (GPS) and the vegetation used as a wetland indicator as necessary.

This exercise has now been completed and reported (ATA Environmental – Turquoise Coast Development, Jurien Bay, Wetland Survey, July 2001, Report 2001/92). The wetlands recommended for protection and associated buffers are included within reserves or extended reserves proposed in this Strategy. Buffers are to be based on detailed site studies and reflect the latest methodology for wetland buffer determination at the time of reservation.

4.5 Lower Spearwood Dunes Vegetation

The Spearwood Dunes and associated vegetation occupy a belt along the eastern boundary of the subject site, broadening from north to south. The Spearwood Dunes – Sand Surface Vegetation and Spearwood Dunes – Limestone Surface Vegetation occupy 88 ha and 58 ha respectively, totalling 146 ha.

The majority, 144 ha of the lower Spearwood Dune Vegetation is proposed to be contained within the nature conservation and biodiversity reserves recommended under this strategy.

There is a total of 7,509 ha of this particular Spearwood Dune vegetation sub-system within the West Midlands study area. Of this vegetation area, 3,081 ha or 41% of the total is contained within conservation reserves. The proposals contained within this strategy will increase the reserved portion of this sub-system by approximately 144 ha or 4.7%.

5. PROTECTION OF KEY LANDSCAPE ELEMENTS

Key landscape elements of the site may be listed as the ocean beaches, dune systems, vegetation, beach ridge plains and the Hill River with its associated flood plains and incised valley. The most important views of the site are from the ocean and offshore islands, Indian Ocean Drive and from the area of the Hill River.

This strategy addresses these issues by proposing coastal foreshore reserves, an extensive vegetation belt adjacent to the Indian Ocean Drive, extended reserves along the Hill River to incorporate flood plain areas as well as floodways and adjacent dune systems and in addition, the area of the tallest and steepest dunes on the site which are to the south of Booka Valley. Representative portions of typical landscapes and vegetation elements are contained within a central, east-west corridor.

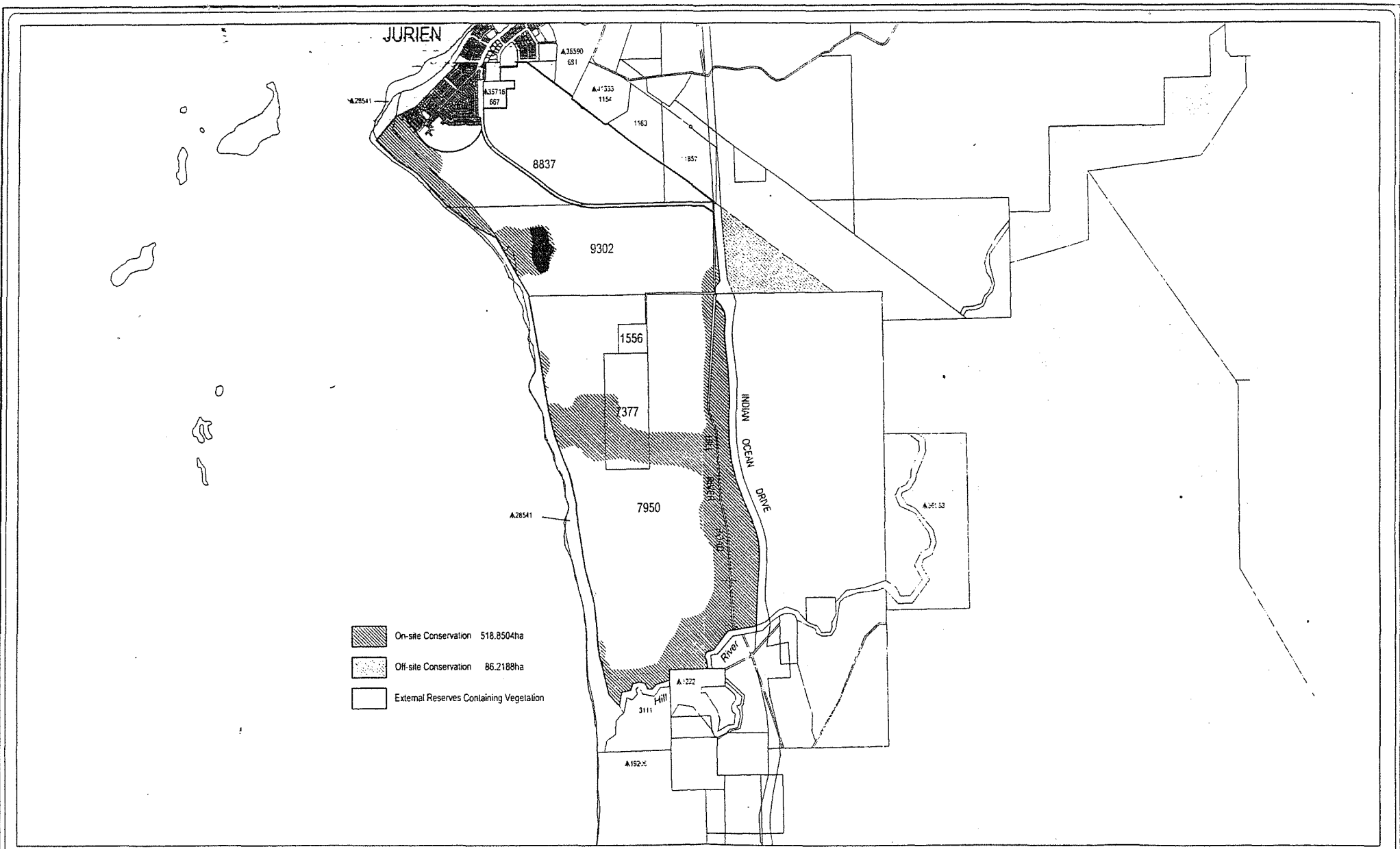
6. RETENTION OF NATURAL OR SEMI-NATURAL AREAS AS REQUIRED BY MANAGEMENT PLANS TO PROTECT KEY ECOSYSTEM PROCESSES




The provision of Local Open Space reserves retaining natural/semi-natural areas will be addressed during the planning process. In particular, semi-natural areas are likely to be associated with sites set aside for the treatment and disposal of stormwater and for passive and other general recreation areas. These spaces cannot be identified at this stage in the planning process but will be additional to this Strategy for Nature Conservation and Biodiversity.

7. INCLUSION OF BUSHLAND CORRIDORS THAT LINK THE ABOVE AREAS ON THE SITE WITH ADJOINING OFF-SITE BUSHLAND AREAS AND INCLUDE NATURAL SEQUENCES OF VEGETATION

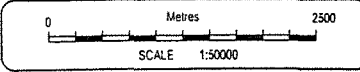
Figure 5 shows how the reserves proposed in this Strategy for Nature Conservation and Biodiversity can be linked to off-site areas. The figure shows three shades of green. The dark green reserves total approximately 518.8 ha and are the proposed on-site reserves. They include a transect through the centre of the property of a minimum of 400 metres width and an average exceeding 500 metres width protecting a sequence of vegetation from pioneer coastal species to the lower Spearwood Dunes sub-system adjacent to Indian Ocean Drive. The extended foreshore reserve associated with the Hill River in the south protects another sequence of vegetation from the coast to the most easterly portions of the site.

Approximately 86 ha of land is shaded mid-green and incorporates a portion of Location 9302, linking the belt of lower Spearwood Dune sub-system vegetation along Indian Ocean Drive with the existing Stock Route which in turn connects through to Reserve 36053 (a reserve for apiculture and conservation and flora). This reserve incorporates portion of the Hill River and associated foreshores and continues to the south towards Cervantes. In addition, a reserve 33287 continues along Hill River to the north-east. These existing reserves are shown shaded light green.



-  On-site Conservation 518.8504ha
-  Off-site Conservation 86.2188ha
-  External Reserves Containing Vegetation

Notes/Revisions



Date: 14 August 2001 Ref No. 1919/jan2001base

RELATIONSHIP OF PROPOSED ON-SITE & OFF-SITE CONSERVATION RESERVES TO EXISTING RESERVES Figure 5

8. THE DEVELOPMENT OF A SCHEDULE FOR THE PREPARATION OF MANAGEMENT PLANS OF DESCRIBED PROCEDURES TO MINIMISE DISTURBANCE IN THE LONG TERM TO KEY REMNANT VEGETATION ON AND ADJOINING THE SITE

The planning process requires the preparation of an overall Structure Plan indicating the location of the major uses and road system. The Structure Plan will divide the study area into neighbourhoods based on that use pattern and transportation network. Each neighbourhood requires the preparation of a Development Plan (or local structure plan) as a prerequisite to subdivision and development approval.

The Development Plans will therefore identify land use patterns and transportation networks in much greater detail and against the background of this detail, it would be appropriate to prepare management plans for adjacent reserves in order that management is coordinated with planning at the local level.

For example, pedestrian paths through foreshore reserves will be able to be related to the local movement system within the adjacent neighbourhood by scheduling the preparation of management plans to occur concurrently with the development plans.

9. THE DEVELOPMENT OF SCHEDULES FOR THE COLLECTION OF BASELINE ENVIRONMENTAL DATA AND MONITORING THE ECOSYSTEMS

It is proposed to collect baseline descriptive data for all of the major ecosystems represented in the reserve system and to establish monitoring locations and monitoring programmes that will enable the condition of those ecosystems to be routinely assessed over time. The nature of and responsibility for, the monitoring studies will be determined in consultation with relevant management authorities such as CALM and the WRC. This will commence when a Structure Plan has been approved.

10. TAKING INTO ACCOUNT THE LIKELY LONG TERM TIMEFRAME FOR THE DEVELOPMENT OF THE SITE, PROVISION FOR PERIODIC REVIEW OF THE CONSERVATION STRATEGY TO ENSURE THAT ENVIRONMENTAL OBJECTIVES CONTINUE TO BE MET AS DEVELOPMENT OCCURS ON THE SITE AND INCREMENTALLY IN THE CENTRAL COAST REGION

It is intended that the periodic review of this conservation strategy be primarily limited to the preparation of management plans as detailed planning of adjacent development areas occurs. It is essential to the project that there be a level of certainty in the identification of conservation areas and consequently, the remaining development areas.

The Water Corporation is proceeding to prepare a Total Water Management Plan and this and other processes are dependent upon a level of certainty in terms of which areas are available for development and likely development yields.

APPENDIX 1



Facsimile

To: M. P Rogers & Associates

Fax: 9444 4341

From: Peter Boreham

My phone: (08) 9216 8845

My fax: (08) 9216 8983

Date: 15 June 2001

No. of pages (incl this): 1

If you do not receive all pages, please phone

- Public Transport
- Transport Planning
- Road Safety
- Licensing Services
- School Buses
- Cycling
- Travel Subsidies
- Taxi Regulation
- Marine Safety

Jurien Bay - Turquoise Coast - Subdivision Property Setbacks

I have examined your revised proposals for the setbacks to property or road reserve boundaries contained in your letter dated 14 June 2001. While I have some reservations regarding the way in which we will ultimately use the SBEACH modelling in the MfP planning process, the setbacks which you have proposed do, with one group of exceptions, provide a reasonable basis for development planning.

I do have a problem accepting large steps in the setbacks between points which are relatively close, such as the 50 metre difference between chainage 6400 and 6600. I would prefer to see evenly graded changes rather than the steps which are implicit in your recommended table, with the larger steps being spread over a longer length of beach.

It is important to note that the setback is to be measured from a horizontal datum which is the "vegetation line" as defined for DMH/DOT coastal movement plans. This is the line of established vegetation on an accreting shore or the toe of the current erosion scarp on an eroding shore, at the time when the subdivision is being considered. Since some of this large tract will not be developed for many years, you need to check that development time is factored into your forward planning.

Yours sincerely,

Peter Boreham, Senior Coastal Engineer.

M P ROGERS & ASSOCIATES		
Received: 15/6/01	Job No: J247	
Action	Signed	Date
fax 544/01	MPR	18/6

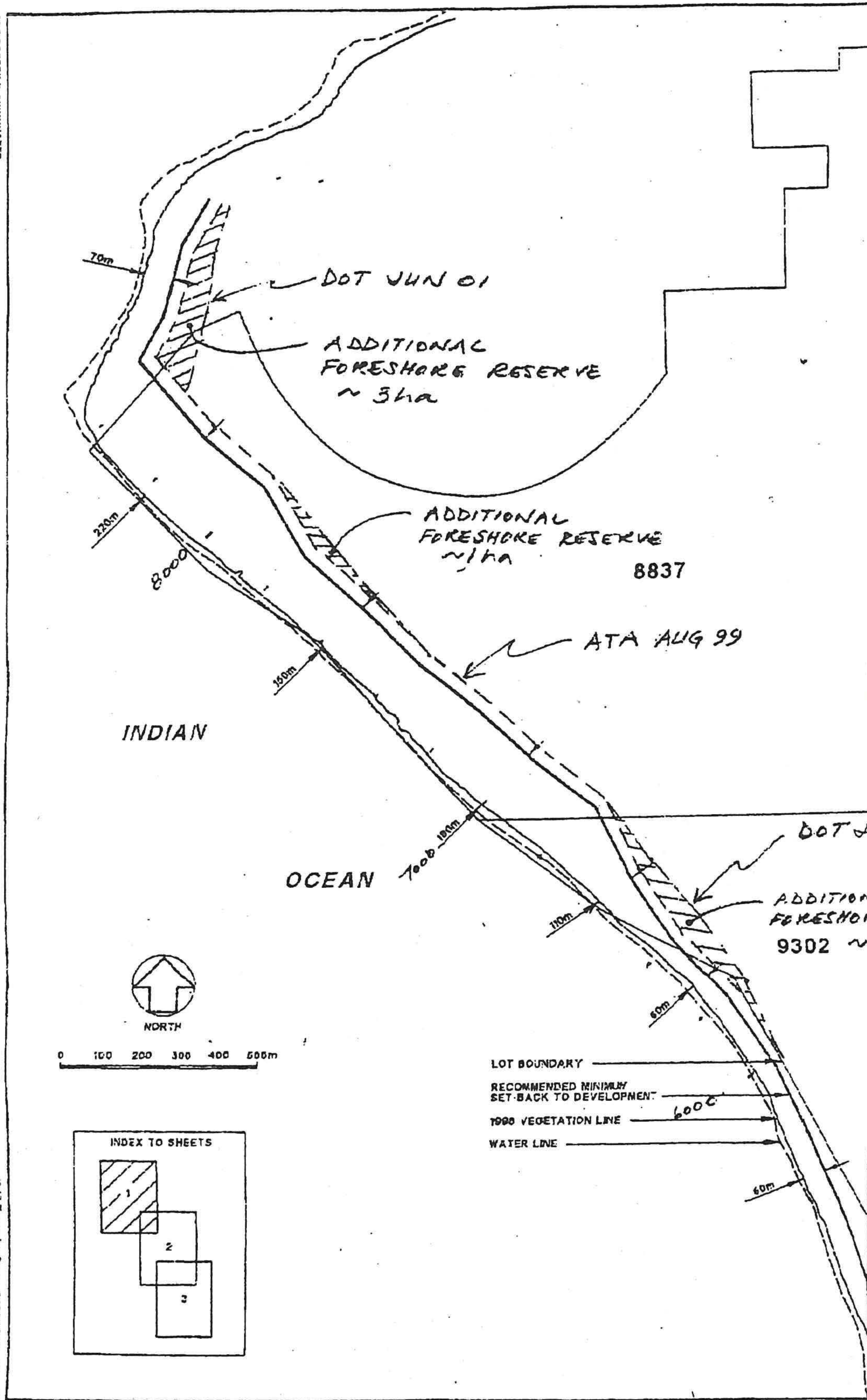
1 Essex Street
 PO Box 402 Fremantle
 Western Australia 6959
 Telephone (08) 9218 8999
 Facsimile (08) 9218 8979
 www.transport.wa.gov.au
 ABN 79 924 477 610

Working to achieve the best transport system for all Western Australians

J247 Turquoise Coast - Attachment to MRA Fax 544/01						
Set-Back Distance Summary						
Section No	Chainage (m)	Historical Erosion Rate (m/yr)	Set Back Distances (m)			Hill River
			ATA AUG 99	DOT JUN 01	DIFF / 200 m	
1	0					
2	200	-0.1	130	130		
3	400	-0.2	130	130	0	
4	600	-0.2	130	130	0	
5	800	-0.1	130	130	0	
6	1000	-0.3	140	140	-10	
7	1200	-0.1	140	140	0	
8	1400	-0.3	140	140	0	
9	1600	-0.3	140	140	0	
10	1800	-0.3	140	140	0	
11	2000	-0.1	140	140	0	
12	2200	-0.2	140	140	0	
13	2400	0.0	110	110	30	
14	2600	0.0	110	110	0	
15	2800	0.0	110	110	0	
16	3000	0.1	110	110	0	
17	3200	0.1	110	110	0	
18	3400	0.1	110	110	0	
19	3600	0.0	90	90	20	
20	3800	0.0	90	90	0	
21	4000	0.1	90	90	0	
22	4200	0.1	90	90	0	
23	4400	1.2	90	90	0	
24	4600	1.3	90	90	0	
25	4800	1.1	90	90	0	
26	5000	1.7	90	90	0	Booka Valley
27	5200	1.7	90	90	0	
28	5400	2.1	90	90	0	
29	5600	1.3	90	90	0	
30	5800	0.5	90	90	0	
31	6000	0.0	90	90	0	
32	6200	0.1	90	120	-30	
33	6400	0.0	90	150	-30	
34	6600	-0.4	140	180	-30	
35	6800	-1.1	210	210	-30	
36	7000	-1.2	210	210	0	
37	7200	-1.2	210	210	0	
38	7400	-0.9	180	180	30	
39	7600	-0.9	180	190	-10	
40	7800	-0.9	180	220	-30	
41	8000	-1.3	250	250	-30	
42	8200	-1.5	250	250	0	
43	8400	-1.7	250	250	0	Island Pt
44	8600	0.4	100	220	30	
45	8800	1.8	100	190	30	
46	9000	3.8	100	160	30	
47	9200	4.4	100	130	30	

M P ROGERS & ASSOCIATES

Figure 11 - Recommended Set-Back Distance
Sheet 1



J241 Turquoise Coast, 99004.DOC, Page 28