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SPECIALISTS IN ENVIRONMENTAL,
SOCIAL AND SAFETY PERFORMANCE

BAYONET HEAD - PLAN FOR DEVELOPMENT STRATEGIC ENVIRONMENTAL ASSESSMENT (EPA ASSESSMENT NO. 1758)

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EXECUTIVE SUMMARY

Strategic Environmental Assessment

The landowners of the Bayonet Head Plan for Development area (Figures 1 and 2) are proposing to develop their landholdings for urban purposes. The proposal was referred to the Environmental Protection Authority (EPA) on 30 September 2008, requesting that the proposed development be assessed as a Strategic Environmental Assessment (SEA). Under s37B(2) of the *Environmental Protection Act 1986* (EP Act) an SEA is a formal level of assessment that allows for conditions to be set on development by the Minister for the Environment. The EPA determined (5 November 2008) that the proposal is a strategic proposal under the provisions of the EP Act and should be assessed as an SEA (Assessment No. 1758).

The objective of the SEA is to determine the environmental values of the site, identify an environmentally acceptable development area, assess the impact of the proposed development on the environment and to identify future management of the proposed development to ensure long-term protection of environmental values.

The SEA process initially requires the preparation of an environmental scoping document which identifies the scope of the environmental investigations to be undertaken. The scoping document was endorsed by the EPA in May 2009 following a 2 week public review period. An SEA document is then prepared (this document) and released for public review.

This SEA document has been prepared in accordance with the *Guide to Preparing a Public Environmental Review/ Environmental Review and Management Program* (EPA 2008b, Version 5), with additional advice from the Office of the EPA (OEPA) regarding proposed changes to the EPA Environmental Impact Assessment (EIA) process. At this stage of the environmental review process, the suitability of this proposal has not been assessed, either by Agencies or the EPA.

The SEA addresses environmental considerations for the Bayonet Head area at the most strategic level of land use planning which will allow for flexibility and consideration of various development alternatives and options. The resulting development design will provide the basis for better environmental outcomes and a higher degree of certainty for the rezoning and development of areas in Bayonet Head.

The key information about this proposal is outlined in Table 1.

EXECUTIVE SUMMARY

Table 1:

Key Project Information

Element	Description
Proponents	Lowe Pty Ltd (ACN 009 354 143; ABN 29 009 354 143), Housing Authority, Kenneth Lindsay Slee, Ewin McNicol Cameron and Maureen Bertha Cameron, Martin John Greer and the City of Albany.
Nominated Contact Person	Brian Newman, Lowe Pty Ltd Project Manager Unit 6/136 Railway Street Cottesloe WA 6288 Phone: (08) 9380 1300 Fax: (08) 9385 1320
	Dr Paul van der Moezel – Principal Environmental Consultant Melanie Price – Senior Environmental Scientist, Environmental Planning Suite 2, 53 Burswood Road Burswood, WA 6100 Phone: (08) 9355 7100 Fax (08) 9355 71111
Study Area	191.09ha
Original Bayonet Head Outline Development Plan Area (some areas already approved for subdivision)	282ha
Existing Area of Native Vegetation	143 ha
Total Area of Public Open Space	49.6ha

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Element	Description
Area of Public Open Space Proposed for Conservation and Enhancement of Natural Values	39.6ha
Estimate of Area of Public Open Space for Low Key Active Recreation (e.g. pocket park)	4.3ha
Estimate of Area of Public Open Space for Water Resource Management (e.g. detention basin)	3.3ha
Number of Wetlands	9
Conservation Category Wetlands	6
Resource Enhancement Wetlands	2
Multiple Use Wetlands	1
Oyster Harbour Foreshore	500 linear metres

EXECUTIVE SUMMARY

The SEA describes the impact of the proposed development in the Plan for Development area for a number of environmental factors that were identified in the Scoping Document (Coffey Environments, 2009e) as follows:

Biophysical

- Native Terrestrial Vegetation and Flora;
- Native Terrestrial Fauna;
- Coastal Foreshore;
- Wetlands;

Pollution Management

- Acid Sulfate Soils;
- Surface Water Quantity and Quality;

Groundwater Quantity and Quality; and

Social Surroundings

- Aboriginal Heritage.

These environmental factors have provided a framework against which the structure and scope of the SEA document has been written, with each of the factors individually addressed in detail in Section 5 of this report.

Proponent Commitments

The proponents have made a number of commitments in this SEA to manage and minimise the impacts of the development on the environment, where possible. A summary of these commitments is provided in Table 2 (Details in Section 6).

Management Plans referred to in this SEA are commitments and have not yet been prepared. These documents will be prepared once there is more certainty about areas that can be developed and which areas will be retained as conservation POS or other functions.

EXECUTIVE SUMMARY

Table 2:

Summary Table of Proponent Commitments

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Native Vegetation and Flora	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.	The Plan for Development area contains 136.5ha of native vegetation with 18 vegetation associations (Coffey Environments 2009a). Sandiford and Rathbone (2008) identified 10 vegetation types. 'Keri' (AfEsNfOW) and 'Clan' (ClAf and ClEm) are likely to be poorly represented in secure tenure. Based on analysis of quadrat data, four of the six floristic groups were found to occur in two or less conservation reserves (Groups 2, 5a, 5b, and 7). The majority of remnant vegetation within the study area is considered to be in Excellent condition with few weed species and little sign of disturbance. Dieback has been recorded on Lots 1000 and 1001 Lower King Road. A total of 222 species of terrestrial vascular flora from 43 families were recorded, including 17 introduced species.	The proposed development will involve: - Clearing areas of remnant native vegetation; -Fragmentation of vegetation, which may lead to unviable/ unsustainable native vegetation conservation outcomes; -Protection and management of native vegetation that is not well represented in secure tenure.	The Plan for Development will result in the following: -Retention of 39.6ha of native vegetation in local reserves managed for conservation. -Preparation of a Construction Management Strategy to manage clearing, dust, dieback and weeds. -Preparation of a POS and Wetland Management Plan to address access, dieback, weeds, fire management, rehabilitation, monitoring and integration with surrounding areas. -Preparation of a Landscape and Streetscape Plan to outline the local native species to be planted on road reserves to provide green linkage. The plan will also guide water wise local native gardens in future development. -Areas of 'Keri' (AfEsNfOW) and 'Clan' (ClAf and ClEm) will be retained in conservation POS. Retention of representative areas of Floristic Groups 1, 2, 5a, 5b, 6 and 7 vegetation in conservation POS.	Areas of vegetation will be retained in conservation POS (39.6ha) to form consolidated, manageable areas with a linear or stepping stone function. The outcomes of the management of the conservation POS will be to enhance the integrity of the retained vegetation on the site by controlling access and weeds, actively managing dieback and stopping rubbish dumping. Poorly represented vegetation associations will be retained in conservation POS.

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Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Flora – Declared Rare and Priority Flora; Flora of conservation significance (including Threatened Ecological Communities)	Protect Declared Rare and Priority Flora consistent with the provisions of the *Wildlife Conservation Act 1950*, and the *Environment Protection and Biodiversity Act 1999*. Protect other flora of conservation significance.	The following significant species have been reported on the site: *Drakea micrantha* (Declared Rare Flora), *Andersonia jamesii* (Priority 1), *Leucopogon altissimus* (Priority 3), *Chorizema reticulatum* (Priority 3), *Andersonia depressa* (Priority 3), *Stylidium plantagineum* (Priority 4), *Laxmannia jamesii* (Priority 4), *Drosera fimbriata* (Priority 4). A Priority 1 Ecological Community (PEC) occurs on the site (vegetation association AfEsBc or Open Low *Allocasuarina fraseriana – Eucalyptus staeri* woodland in association with *Banksia coccinea* thicket). The PEC has elements that are highly susceptible to *Phythophthora cinnamomi*, which has been detected in the area.	No loss of DRF, which will be retained in conservation POS. While some of the Priority Flora will be retained, the majority will be removed. The proposed development may lead to fragmentation of native vegetation, which could lead to reduced viability for native vegetation conservation outcomes. Dieback has the potential to reduce biodiversity of remaining vegetation, especially elements of the PEC (e.g. *Banksia coccinea*). Retention of vegetation in POS, managed by an appropriate organisation could improve the long term environmental values of the areas protected. 2.8ha of the PEC is proposed to be within conservation POS, with 6ha to be removed for development.	The Plan for Development will result in the following: -Retention of 39.6ha of native vegetation in local reserves managed for conservation. -Preparation of a Construction Management Strategy to manage clearing, dust, dieback and weeds. -Preparation of a POS and Wetland Management Plan to address access, dieback, weeds, fire management, rehabilitation, monitoring and integration with surrounding areas. Preparation of a Landscape and Streetscape Plan will outline the local native species to be planted in road reserves to provide green linkage. It will also guide the use of water wise local native gardens in future development.	*Drakaea micrantha* (DRF) will be retained within conservation POS. *Andersonia jamesii* (P1) is not proposed for retention in POS. A population of *Drosera fimbriata* (P4) within Part Lot 1 Yatana Road will be retained within conservation POS. The population of Laxmannia jamesii (P4) is not proposed for retention in POS. *Stylidium plantagineum* (P4) is not proposed for retention in POS. *Leucopogon altissimus* (P3) is not proposed for retention in POS. *Andersonia depressa* (P3) is not proposed for retention in POS. 2.8ha of PEC retained for active management within conservation POS will prevent otherwise inevitable deterioration due to dieback infestation (6ha of PEC to be removed for development).

EXECUTIVE SUMMARY

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Native Fauna	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge. Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the Wildlife Conservation Act, 1950, and the Commonwealth Environment Protection and Biodiversity Conservation Act, 1999. rotect other fauna of conservation significance.	128 species of vertebrate fauna, including 7 frog, 21 reptile, 86 bird and 14 mammal species (including 4 introduced mammals). Habitat includes Jarrah/Sheoak Woodland, Heath Shrubland and Wetland Mosaic. Significant linkage occurs along the Oyster Harbour foreshore from north to south. Conservation significant fauna found in the study area include the western ringtail possum (Schedule 1, vulnerable) in low densities. Carnaby's Black Cockatoo (Schedule 1, endangered), Baudin's Black Cockatoo (Schedule 1, vulnerable) and Forest Red-tailed Black Cockatoo (Schedule 1) forage, but are unlikely to breed in the area. Western False Pipistrelle (P4) and Quenda (P5) occur in the area.	Development would result in the loss of fauna habitat, loss of sedentary species and displacement of other species. Possible increased risk of weed invasion and increase in domestic animals. The loss of fauna habitat is not considered to be significant at the State or Commonwealth level.	The Plan for Development will result in the following: -Retention of 39.6ha of native vegetation in local reserves managed for conservation, including mature trees with hollows. These areas include foraging habitat for cockatoos. -Provision of conservation POS which has either a linear or stepping stone function. -Preparation of a Construction Management Strategy to manage clearing, dust, dieback and weed management. -Preparation of a POS and Wetland Management Plan to address retention of fauna habitat, access, dieback, weeds, fire management, rehabilitation, management of domestic animals, monitoring, public education and integration with surrounding areas. Preparation of a Landscape and Streetscape Plan will outline the local native species to be planted on road reserves to provide green linkage. It will also guide water wise local native gardens in future development.	The Plan for Development will result in: Retention of key habitat areas for Western Ring-tail Possums, Quenda, cockatoos in foreshore reserve and conservation POS areas. Retention of trees with hollows (or salvaging of hollows during construction). A -combination of consolidated conservation POS with reduced edge effects and more linear conservation POS for linkage. Landscaping and streetscaping to include local native species to enhance connectivity within the development. Guides to be provided for prospective purchasers for fauna friendly gardens.

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Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Coastal Foreshore	To maintain the integrity of the Coastal Foreshore by maintaining its, ecological function and environmental values.	The eastern boundary of the Plan for Development area abuts a foreshore reserve on Oyster Harbour for approximately 500m. The existing foreshore reserve is between 10 and 40 m wide with a steep rocky, lateritic scarp rising 32m over 65m. The area is not susceptible to erosion. The area mostly contains native vegetation with some disturbed/cleared areas.	The Plan for Development will result in a significant increase in the width of the foreshore reserve which will result in better protection and more sustainable community use. Post development, there is likely to be higher visitation to the area with risk of disturbance and weed invasion.	The Plan for Development will result in the following: -Provision of a foreshore reserve to provide a 50m to 190m horizontal separation from Oyster Harbour. -Preparation of a Foreshore Management Plan to address increased human activity, recreation nodes, weed and fire management, maintenance of fauna corridor and habitat values, treatments of foreshore and development interface.	An adequate setback will be created to allow for coastal processes, climate change impacts, environmental values and recreation. Visual amenity will be protected through retention of native vegetation. Protection of the north - south fauna and flora link along foreshore will be strengthened. There will be provision of access for community along the foreshore area.

EXECUTIVE SUMMARY

Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Wetlands	To maintain the integrity, ecological functions and environmental values of wetlands.	The study area contains 9 discrete wetlands (6 Conservation, 2 Resource Enhancement, 1 Multiple Use).	Potential impacts include: -Altered hydrological regime (ground and surface water flows); -Application of nutrients and use of chemicals in future urban area; -Erosion and sedimentation; -Inappropriate water management; -Introduction of invasive species; -Dumping of rubbish; -Increased fire risk; -Increased human activity; and -Better management, including access.	The Plan for Development will result in the following: -Protection of Conservation Category wetlands in conservation POS. -Maintenance of pre-development hydrological regimes. -Preparation of a Local Water Management Strategy to ensure retention of groundwater levels and monitoring of groundwater quality. -Preparation of a POS and Wetland Management Plan to address access, weed management and passive recreation opportunities. -Treatment systems to prevent direct drainage of stormwater into Conservation Category wetlands. -Treatment of water quality through out the catchment.	Protection of Conservation Category wetlands with buffers in conservation POS will add significantly to the protection of Bayonet Head Suite wetlands. Water resource planning will allow for maintenance of hydrology required for wetlands. Wetlands will be protected for ecological and community values.

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Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Surface and Groundwater Quantity and Quality	To maintain the quantity of water (surface and ground) so that existing and potential environmental values, including ecosystem maintenance, are protected. To ensure that the quality of water emissions (surface, ground, and marine) does not adversely affect environmental values or the health, welfare and amenity of people and land uses, and meets statutory requirements and acceptable standards.	Surface water management has been modelled for proposed development, as required. The major surface water body is the lake on Lot 500, outside the Plan for Development area. There is limited surface water flow in the area. Perched groundwater supports some wetlands (31, 40 and D) while the deeper groundwater system supports wetlands 29, 41, 8 and 57. Groundwater monitoring for baseline data showed that natural background levels are sometimes higher than criteria suggested in ANSECC and ARMCANZ (2000) for Fresh Waters (Wetlands) and Short Term Irrigation. DEC indicators for acidity were also exceeded in the natural unimpacted system.	Potential impacts include: -Increased levels of nutrients, pesticides, pathogens, irrigation and stormwater run-off may impact upon surface water, groundwater and marine water quality of the surrounding area. -Potential changes to hydrology arising from the proposal may impact on wetlands and other groundwater dependent ecosystems both within and outside of the project area.	The Plan for Development will result in the preparation of a Local Water Management Strategy which will: -Formalise the conceptual water management design, identify specific locations for infrastructure, identify best management practices for water resource management, outline strategies for water reuse, waste minimisation and conservation, outline contingencies for accidents and pollution mitigation. -The LWMS will outline evaluation and monitoring plans for groundwater and surface water quality and quantity, based on baseline data already collected.	Water Sensitive Urban Design will ensure sustainable management of water resources and ground water dependent ecological systems. Use of best practice will be employed to manage water quality and quantity. Good design and monitoring will ensure that groundwater levels are maintained for the Conservation Category wetlands.

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Environmental Factor	EPA Objective	Existing Environment	Potential Environmental Impacts	Management Strategies	Predicted Outcome
Pollution Management - Acid Sulfate Soils	To minimise the risk to the environment resulting from Acid Sulfate Soils, to be achieved by implementing appropriate detection and management strategies.	The Plan for Development area has generally been assigned a 'no known risk of ASS occurring within 3m of natural soil surface (or deeper). Parts of Lots 38 and 39 Elizabeth Street may have a 'high risk of ASS and PASS less than 3m from the ground surface'.	Disturbance of ASS through earthworks could result in generation of sulphuric acid and iron compounds and release of other substances, including heavy metals, from the soil and into the environment. Disturbance of ASS could also result in parts of the study area becoming classified as contaminated as per the *Contaminated Sites Act 2003*.	The Proponents commit to the preparation of an ASS Management Plan for areas and activities that carry a risk of exposure of ASS. This will occur once development areas have been more comprehensively outlined.	Adequate management of risk associated with ASS and PASS for susceptible areas.
Aboriginal Heritage	To ensure that changes to the biophysical environment do not adversely affect Aboriginal heritage sites and/or cultural associations within the area and comply with the requirements of relevant Aboriginal and heritage legislation.	A review of records and consultation with local Aboriginal people has identified a previously recorded archaeological site and identified a new mythological site (the lake on Lot 500 Alison Parade – largely outside the Plan for Development area).	A Section 18 Notice under the *Aboriginal Heritage Act 1972* has been granted for use of the land for urban purposes. Development of the Plan for Development area will not impact on Aboriginal sites within the meaning of Section 5 of the *Aboriginal Heritage Act 1972*.	Appropriate management of any Aboriginal cultural materials found.	Any cultural material found will be fully recorded and salvaged by an archaeologist, in consultation with the Albany Heritage Reference Group Aboriginal Corporation.

1 THE PROPOSAL

1.1 The Study Area

Bayonet Head is situated 7km north east of the Albany Central Business District (Figures 1 and 2). The Plan for Development area (Figures 2 and 3) is situated within the City of Albany and is currently zoned 'Residential' and 'Rural' in the City of Albany's Town Planning Scheme No. 3 (Figure 4). The Plan for Development area (191.09ha) that is the subject of this SEA, comprises landholdings described in Table 3 and shown in Figure 2). The area contains cleared farmland, native vegetation and wetlands.

TABLE 3

DETAILS OF THE LAND INCLUDED IN THE STRATEGIC ENVIRONMENTAL ASSESSMENT

Property	Lot Area (ha)	Landowner
Part Lot 39 Elizabeth Street, Bayonet Head	18.86	K.L. Slee
Lot 38 Elizabeth St, Bayonet Head	16.76	Lowe Pty Ltd and Housing Authority
Lot 37 Elizabeth St, Bayonet Head	1.56	Lowe Pty Ltd and Housing Authority
Lot 3 Alison Parade, Bayonet Head	15.39	Lowe Pty Ltd and Housing Authority
Lot 2 Alison Parade, Bayonet Head	2.22	M.J. Greer
Lot 286 Alison Parade, Bayonet Head	24.28	Lowe Pty Ltd and Housing Authority
Part of Lot 42, Lower King Road, Bayonet Head	8.6	Lowe Pty Ltd and Housing Authority
Lot 1001 Lower King Road, Bayonet Head	26.62	Lowe Pty Ltd and Housing Authority
Lot 1000 Lower King Road, Bayonet Head	30.97	Lowe Pty Ltd and Housing Authority
Part Lot 1 Yatana Rd, Bayonet Head	26.26	Lowe Pty Ltd and Housing Authority
Location 476 Sibbald Rd	18.61	E.M. & M.B. Cameron
Lot 0	0.96	City of Albany
TOTAL AREA	**191.09**	

Lot 15 Hooper Road (owned by Water Corporation) has not been included in the SEA area, but will be considered in a regional context in the documentation. Similarly, Lot 500 Alison Parade, which contains a large lake/wetland area, will be discussed in terms of its proximity and function for water management.

1.2 Planning Background

The strategic planning of the Bayonet Head area has its origins in the preparation of an early layout and structure plans in the late 1970s (Taylor Burrell, 2001).

In 2001 the Bayonet Head Outline Development Plan (BHODP) was released (Taylor Burrell, 2001; Figure 5) as part of the City of Albany's strategic approach to land use planning designed to allow for cohesive and equitable development of the Bayonet Head area 'whilst ensuring that environmental and community priorities are maintained' (Taylor and Burrell, 2001) and was subsequently adopted by Council and the Western Australian Planning Commission (WAPC) in 2001 as a guide to coordinate future development and subdivision of the area. The BHODP was not submitted to the EPA for environmental assessment at that time.

The BHODP acknowledged that:

> *'The land encompassed by the ODP presents numerous environmental, landform and ownership issues which created the need for a sensitively designed and practical plan to ensure that these matters are closely considered and properly address during the process of development.'* (Taylor Burrell, 2001 p.1)

The strategic rationale associated with the various elements of the 2009 BHODP (referred to in this document as 'Plan for Development') has its origins in earlier studies and plans prepared for the City of Albany. With regard to environmental aspects associated with the original design for the ODP area, three studies were integral to developing this design:

i) Bayonet Head Physical Assessment Study (P & M Tooby 1983);

ii) Bayonet Head Drainage Study (Wood & Grieve 1999); and

iii) *Bayonet Head Flood Management Plan* (PPK Environment and Infrastructure, 2000).

All three studies resulted in recommendations that were either site-specific or pertaining to portions of the ODP such as on a catchment or sub-catchment basis. It is important to note that some of the recommendations contained within these reports reflected the planning and design philosophies current at the time of reporting and the various reports recommend that a review of data/information be undertaken at the time the land is being considered for development in light of changes to regulatory requirements, planning and detailed design.

A further document, *Residential Expansion Strategy for Albany* (State Planning Commission, 1994), identified the Bayonet Head locality as one of the key development areas to cater for the bulk of Albany's growth to the year 2021. The Strategy made a number of recommendations that were pivotal in guiding the design of the ODP area. These were:

- Detailed consideration being given to staging and co-ordination of development;
- The provision of infrastructure and services based on an orderly pattern of development and in accordance with the Water Corporations Modified Waste Water Scheme Plan;
- The development of low lying areas to be avoided and such areas to be used for controlling drainage and nutrient dispersal;
- The development of a housing strategy that provides for the needs of smaller households, particularly the elderly;
- The promotion of alternative housing types, "green street" initiatives and energy efficient designs;
- The development of comprehensive and attractive neighbourhood centres as focal points for surrounding residents;
- Provision of a comprehensive network of passive and active public open space, pedestrian footpaths and cycle ways;
- Creation of nutrient sinks to minimise pollution of harbours;
- Retention of the biological diversity of the study area; and
- Provision for wildlife corridors and habitats.

The *Residential Expansion Strategy for Albany* (State Planning Commission, 1994) suggested that consideration would be given to existing reserves, wetlands, waterways, proposed buffer areas and significant remnant vegetation for integration into a comprehensive regional, district and local open space system.

In 2005 an Interim Revised BHODP was developed (Chappell and Lambert, 2005) which incorporated greater recognition of the environmental values of the native vegetation and wetlands. The 2005 BHODP proposed a series of green corridors (Figure 6). Input from the (then) Department of Environment on the 2005 BHODP suggested that the corridors were not considered sustainable in the long term due to inadequate width (average 50m width with maximum 110m and minimum 30m). The current Draft Plan for Development (Figure 3) now has more consolidated POS areas which will be managed for conservation values.

Several areas that were originally part of the BHODP area have received subdivision approval and are not the subject of this SEA. These areas include Lot 43 Elizabeth St, Lot 9000 Elizabeth St, Part of Lot 42 Lower King Road, Lot 285 Allwood Parade and Lot 9000 Allwood Parade. A development proposal for Lot 500 Alison Parade has previously been considered by the EPA. The EPA set a Section 38 Level of Assessment at 'Not Assessed – Public Advice Given' for the proposal and for the purposes of the SEA, Lot 500 will be considered as part of the regional context of the Plan for Development.

The proposed subdivision of Lot 1000 Lower King Road (previously known as Part Lot 760 Lower King Road) was referred to the Environmental Protection Authority (EPA) by the Department for Planning and Infrastructure on the advice of the Department of Environment (now the Department of Environment and Conservation and the Department of Water). On 9 January 2006 the EPA set the

level of assessment at 'Public Environmental Review' (PER) (Assessment No. 1623) under Section 38(1) of the *Environmental Protection Act 1986*. In addition, the EPA decided to formerly assess (Environmental Review, ER) an amendment application to the Albany District Town Planning Scheme for Part Lot 1 Yatana Road and Lot 476 Sibbald Road, Bayonet Head where it was proposed to change the zoning from 'Rural' to 'Residential Development' (City of Albany Amendment No. 242, EPA Assessment No. 1640). The PER and ER are currently being held in abeyance while the SEA is being assessed. The scoping document for the PER and instructions for the ER provided the basis for Environmental Factors in this SEA.

1.3 Description of the Proposal

A Plan for Development has been prepared to guide development of the Bayonet Head area. The Plan is based on input over the last 15 years and is responsive to:

- Previous Agency comments on Adopted ODP (2001) and Interim Revised ODP (2005);
- Historical documents relating to servicing and stormwater management;
- Environmental assessments undertaken by Coffey Environments; and
- Comments from the City of Albany (CoA), Department of Water (DoW) and the Department of Environment and Conservation (DEC) from meetings held in 2008 have been considered in the preparation of the Plan for Development but not all could be included. Each Decision Making Authority (DMA) provided input that required different outcomes and the need to make a functional overall plan for urban development has led to the current Plan for Development.

The Plan for Development area (Figure 3) comprises the following elements:

- 49.6 hectares of POS overall;
- 39.5 hectares of Public Open Space (POS) will be managed for conservation values;
- 4.3 hectares of POS will be managed to provide low key (pocket park) recreation;
- 3.25 hectares of POS will be managed for water resource management; and
- 2.5 hectares of POS will be managed as a district recreation area (oval and parkland) associated with the existing primary school on the middle southern boundary.

The footprint of areas of Conservation POS to be retained seeks to strike a balance between large, consolidated areas for sustainable management and a linear connectivity function.

Due to the strategic nature of the Plan for Development, detail of the residential areas to be developed are not described Figure 3 but will include service infrastructure, roads and other elements required to support urban development. The following elements will be incorporated into area proposed to be developed.

Servicing/Infrastructure Requirements

The following is a summary of the servicing and infrastructure requirements for the BHODP (Taylor-Burrell Planning and Design, 2001) which will also apply to the Plan for Development area.

Roads

The road hierarchy will be based on the functional structure promoted in 'Liveable Neighbourhoods' (WAPC, 2008). Higher order access streets link Lower King Road at two points, through to a central

north-south high order access street and beyond to the Oyster Harbour foreshore. A network of access streets links the higher order access streets through to residential, Public Open Space and school areas.

The road surface profile will be consistent with the proposed method of stormwater management.

Power

Power will be obtained from the existing power network without additional major infrastructure construction. Underground powerlines will be installed within common use trenches with other services to minimise disturbance.

Drainage and Stormwater Management

Stormwater drainage and flood management for the Bayonet Head ODP area has initially been addressed by Wood and Grieve (1999) and PPK Environment and Infrastructure Pty Ltd (2000). The documents identified that the area is made up of three main catchments which direct stormwater and groundwater:

- From the majority of the Plan for Development area, north east to the lake on Lot 500 Elizabeth St and subsequently to Oyster Harbour;
- South from Lots 1000 and 1001 Lower King Road to the City of Albany drainage system in Purdie Road and McGonnell Park and subsequently to Yakamia Creek and Oyster Harbour; and
- West from Lot 47 (subdivision already approved) to City of Albany Reserve 329, into King River and subsequently to Oyster Harbour.

Wood and Grieve (1999) identify subcatchments, stormwater basin requirements and overland flow requirements (via road systems). Water management for the Plan for Development area will be designed to consider the urban water cycle as a single system where water supply, stormwater, wastewater, flooding, wetlands, waterways, estuaries and coastal waters are recognised through total water cycle management. Water sensitive urban design principles will be employed to ensure that development is consistent with current best management and planning practices for the sustainable use of water resources.

Conservation Category wetlands within the Plan for Development area will be protected from direct inflow of stormwater through water resource treatment systems.

Wastewater Management

The development will be serviced by a reticulated deep sewerage system connected via the Warrangoo Road pump station to the Timewell Road Waste Water Treatment Plant.

Potable Water

Water for the Albany area is supplied from the Sand Patch, Prison and Racecourse bore fields, which are located to the south west of Princess Royal Harbour. A pipe head on Angove Creek at Two Peoples Bay also contributes to this supply. The water is treated, pumped into the Albany town site, stored in reservoirs on Mt Clarence and Mt Melville, and reticulated through the City of Albany area.

A 300mm diameter main to Two Peoples Bay is located in Lower King Road and supplies water directly to the Bayonet Head area. The residential development proposed for Lot 1000 will receive a water supply from this main without further head-works being required within the Plan for Development area.

Potable PVC water pipes to normal subdivisional standards will be installed on all lots. Fire hydrants, sluice valves and fittings will be installed in accordance with standard practice.

Public Open Space

The proposed Plan for Development incorporates significant vegetation, flora, fauna habitat, wetlands and water resource management functions into 49.6ha of Public Open Space (POS). There are 14 areas of POS within the original BHODP area, 11 of which are in the Plan for Development which is the subject of this SEA. Of these 11 POS areas, 10 are largely to be retained for flora, fauna, wetland, nutrient and water resource management purposes. The remaining area (POS 14) is proposed to be developed as a community oval for active recreation. Each of the POS areas may incorporate small pockets parks in degraded sections to allow for well defined and low key local use. POS areas proposed, area, purpose and values retained is summarised in Table 4 and shown in Figure 3. It is important to note that many competing requirements have been taken into account in setting the areas and locations of the POS to allow for long term functioning in an urban environment. The conservation POS areas contain different vegetation associations in varying conditions (for summary see Table 4). The POS also caters for a number of important functions, including water resource and nutrient management, hydrological function and wetland protection. Coffey Environments considers that these land uses are compatible with conservation values due to best practice methodology which will be put in place to manage them. For instance, structures will be put in place to manage water flow and nutrient retention so that conservation category wetlands are not affected by direct or indirect input of stormwater. The configuration of the POS has been designed to form viable cohesive parcels of land with reduced edge effects. It is proposed to enhance values of degraded areas, through rehabilitation with local native species to improve the medium to long term vegetation values and ecological connectivity. Connectivity will be strengthened through streetscaping and incentives for use of local native plants in residential gardens.

TABLE 4: PUBLIC OPEN SPACE PROPOSED FOR PLAN FOR DEVELOPMENT AREA (AND BAYONET HEAD ODP AREA)

Public Open Space (Figure 3)	Location	Area/ dimensions	Purpose	Environmental values retained/ enhanced
POS 1	Lots 39 & 38 Elizabeth Street.	2.1ha, width of 30 to 90m. Area retained for: Natural values: 0.7ha Low key recreation: 0.1ha Water Resource Management: 1.25ha	Water resource management, (overland water flow), vegetated corridor, active and passive recreation.	POS to be managed for nutrient retention, surface water flow and create flora and fauna linkage through revegetation. Area is currently cleared/pasture and in a Degraded condition and will be rehabilitated with local native plant species. Areas retained for water resource management will be designed to contribute to natural values.
POS 2	Lot 38 Elizabeth Street	5.7ha, (part of 20ha POS area on Lots 500 and 2 Alison Parade) Area retained for: Natural values: 5.5ha Low key recreation: 0.2ha Water Resource Management: 0ha	Water resource management, retention of wetlands, active and passive recreation	POS to be managed for hydrological function, flora and fauna habitat and as a Conservation Category wetland. Area is considered to have high conservation value with *Allocasuarina fraseriana* Low Closed Forest vegetation in Degraded to Good condition. Vegetation condition to be improved through weed management. Areas retained for water resource management will be designed to contribute to natural values.
POS 4	Lot 3 Alison Parade	3.7ha. Area retained for: Natural values: 2.5ha Low key recreation: 1ha Water Resource Management: 0.2ha	Water resource management, retention of wetlands, active and passive recreation.	POS to be managed for hydrological function, flora and fauna habitat and as a Conservation category wetland. While some of the buffer of the lake is Completely Degraded, values will be improved through rehabilitation with local native species. Areas retained for water resource management will be designed to contribute to natural values.

Public Open Space (Figure 3)	Location	Area/ dimensions	Purpose	Environmental values retained/ enhanced
POS 7	Lot 39 & 38 Elizabeth Street (exact area to be determined)	Detailed planning, including dimensions yet to be determined. Indicative location shown with arrows in Figure 3.	Water resource management, (overland water flow), vegetated corridor, active and passive recreation.	POS to be managed for surface water flow, flora and fauna linkage created through revegetation. The area contains *Allocasuarina fraseriana* Low Closed Forest and Tall Open *Astartea scoparia* and *Callistachys lanceolata* Scrub currently in Degraded to Good condition and it is proposed to rehabilitated with local native species.
POS 8	Lot 2 Alison Parade & eastern end of Lot 286 Alison Parade	4ha, 50 to 210m width by 500m long. Area retained for: Natural values: 3.8ha Low key recreation: 0.2ha Water Resource Management: 0ha	Foreshore protection, vegetated corridor, active and passive recreation.	This POS and Foreshore Reserve to be managed for flora and fauna habitat, ecological linkage to north, west and south. This area retains trees with hollows, WRP habitat, foraging area for Black Cockatoos and Osprey nesting area. Vegetation includes *Eucalyptus marginata, Allocasuarina fraseriana* with *Banksia grandis* in very Good to Excellent condition. Areas retained for water resource management will be designed to contribute to natural values.
POS 9	Lot 3 Alison Parade	1.9ha with water management node. Area retained for: Natural values: 1.1ha Low key recreation: 0.3ha Water Resource Management: 0.5ha	Water resource management, fauna habitat.	This POS to be managed for hydrological function and fauna linkage created through revegetation. The area currently contains *Melaleuca preissiana* Low Woodland in Completely Degraded to Good condition. Areas retained for water resource management will be designed to contribute to natural values.
POS 10	Part Lot 1 Yatana	13.5ha, narrowest linkage is 50m	Vegetated corridor, active and	This POS to be managed for hydrological function, a Conservation

Public Open Space (Figure 3)	Location	Area/ dimensions	Purpose	Environmental values retained/ enhanced
	Road, Location 476 Sibbald Road, Lot 42 Lower King Road.	Area retained for: Natural values: 12.2ha Low key recreation: 1ha Water Resource Management: 0.3ha	passive recreation	category wetland and flora and fauna linkage. The area contains *Eucalyptus marginata/ Allocasuarina fraseriana* Open to Closed Forest (some with *Banksia grandis*), *Allocasuarina fraseriana/ Eucalyptus staeri/ Banksia grandis* Closed Forest, *Callistachys lanceolata/ Agonis flexuosa*, Woodland in Good to Excellent condition. The area also contains Priority Flora (*Drosera fimbriata*), trees with hollows and foraging areas for Black Cockatoos. Areas retained for water resource management will be designed to contribute to natural values.
POS 11	Location 476 Sibbald Road	0.8ha Area retained for: Natural values: 0.8ha Low key recreation: 0ha Water Resource Management: 0ha	Wetland protection, passive recreation.	This POS to be managed for hydrological function, a Conservation category wetland and flora and fauna linkage. The area contains *Allocasuarina fraseriana/ Eucalyptus staeri/ Nuytsia floribunda* Open Woodland with *Melaleuca preissiana/ Eucalyptus staeri* Woodland in Very Good to Excellent condition.
POS 12	Lot 1001 Lower King Road	4.2ha Area retained for: Natural values: 3.7ha Low key recreation: 0.5ha Water Resource Management: 0ha	Wetland protection, passive recreation.	This POS to be managed for hydrological function, a Conservation category wetland, flora and fauna habitat and a foraging area for Black Cockatoos. This area contains *Allocasuarina fraseriana/ Eucalyptus staeri* Open Woodland, *Allocasuarina fraseriana/ Eucalyptus staeri/ Nuytsia floribunda* Open Woodland and *Eucalyptus marginata/ Allocasuarina fraseriana* Open to Closed Forest and Open Forest in Excellent condition.

Public Open Space (Figure 3)	Location	Area/ dimensions	Purpose	Environmental values retained/ enhanced
POS 13	Lot 1000 & 1001 Lower King Road	11.2ha Area retained for: Natural values: 9.2ha Low key recreation: 1ha Water Resource Management: 1ha	Water resource management, flora and fauna habit, passive recreation.	This POS to be managed for Priority Ecological Community (*Allocasuarina fraseriana/ Eucalyptus staeri/ Banksia coccinea* Woodland, 2ha), a Conservation Category Wetland, Declared Rare Flora (*Drakea micrantha*). Vegetation comprises *Allocasuarina fraseriana/ Eucalyptus staeri* Open Woodland, *Allocasuarina fraseriana/ Eucalyptus marginata* Open to Closed Woodland, Open Homalospermum firmum and Cosmelia rubra Heath in Good to Excellent condition. The area serves as a foraging resource for Black Cockatoos and habitat for WRP. Areas retained for water resource management will be designed to contribute to natural values.
POS 14	Lot 1000 Lower King Road	2.5ha Area retained for: Natural values: 0ha Active recreation: 2.5ha	Active recreation	This POS is primarily to be managed for active recreation. Retention of mature trees around the periphery of POS will occur, where possible.
POS within BHODP Area but outside the Plan for Development for this SEA (described to show related linkage and water management function)				
POS 3	Lot 500 Alison Parade	14.4ha	Water resource management	POS to be managed for hydrological function, flora and fauna habitat and as a Conservation category wetland. The area is considered to have high conservation and heritage values. Vegetation is Tall Open *Astartea scoparia* and *Callistachys lanceolata* scrub in Degraded to Good condition which will be improved through weed management (Note: Lake itself is mostly outside SEA assessment area).

Public Open Space (Figure 3)	Location	Area/ dimensions	Purpose	Environmental values retained/ enhanced
POS 5	Lot 9000 Elizabeth Street	4ha	Water resource management, active recreation.	POS to be managed for hydrological function.
POS 6	Lot 47 Lower King Road	4.1ha	Water resource management, active and passive recreation.	POS to be managed for hydrological function and fauna linkage function. Although the vegetation is Completely Degraded, it is proposed to rehabilitate with local native species to enhance habitat values.

2 BASIS FOR JUSTIFYING PROPOSAL AND SELECTING PREFERRED OPTION

The Bayonet Head area has been the subject of long term planning and development for residential purposes, is supported by the Albany Local Planning Strategy (ALPS, City of Albany, 2006) and previous Town Planning Scheme Amendments in the City of Albany's Town Planning Scheme No. 3. Therefore, no alternative options to residential development have been considered. The Plan for Development considers environmental issues such as native vegetation and wetland preservation in much more depth than the WAPC adopted BHODP (Taylor Burrell, 2001).

The preferred option for the urban development of the Bayonet Head 'Plan for Development' area is consistent with the zoning of some of the land (e.g. Lot 1000 Lower King Road is zoned 'Residential', (the zoning of which pre-dates assessment processes under the *Environmental Protection Act 1986*). The BHODP area is designed as 'Future Urban' in the Albany Local Planning Strategy (City of Albany, 2006). The Plan for Development has been prepared following long term and ongoing consultation with government agencies (including the (then) Department for Planning and Infrastructure (Albany), the Department of Water, the Department of Environment and Conservation and the City of Albany) and includes consideration of often competing requirements. For example, retention of native vegetation has been balanced with concerns that the City of Albany has about the management burden of for conservation purposes. The Plan for Development has not been endorsed by all parties consulted.

In summary, the proponent considers that the proposed Plan for Development:

- Is generally consistent with the major principles and key components of the 2001 BHODP;
- Retains significant vegetation, fauna habitat and Conservation Category wetlands;
- Is consistent with the WAPC's Liveable Neighbourhoods (WAPC, 2008);
- Meets the minimum and average lot size requirements of the Residential Design Codes;
- Ensures good connectivity, permeability and integration with future roads;
- Ensures a balance of active, passive and conservation areas of open space and importantly will provide a regionally important recreational facility for the City of Albany; and
- Promotes a variety of housing types relative to the location, topography and features of the site.

3 EXISTING ENVIRONMENT

3.1 Regional Setting

The land surrounding the Plan for Development area has the following current and proposed land uses under the Albany Local Planning Strategy (ALPS, City of Albany, 2006) (Figure 7):

- Native vegetation to the west in City of Albany Reserve No 329 with a purpose of 'Recreation' and shown as 'Local Reserve' in ALPS;
- Native vegetation and Cemetery to the west in Reserve 23074 with a purpose of 'Cemetery' and shown as 'Major Public Purpose Use' in ALPS;
- Native vegetation to the west in Reserves 31174 and 31175, with a purpose of Church and School Site – Church of England and Roman Catholic (respectively). These areas are shown as 'Local Reserve' in ALPS;
- A residential suburb to the north (Lower King);
- A residential area to the south (Bayonet Head) including Primary School and Neighbourhood Centre; and
- Oyster Harbour to the east (existing foreshore of between 7m and 50m width and 560m in length).

3.1.1 Ecological Linkage

The Western Australian South Coast Macro Corridor Network project (Wilkins *et al.* 2006) identifies regional level ecological linkages that could be protected and/or enhanced to increase the long-term viability of flora and fauna populations by connecting major national parks and nature reserves with other remnant vegetation on the South Coast. The project outlines major macro corridors at the sub regional level, especially along the coast and running inland along river valleys, but also narrower corridors, good quality remnant vegetation and a gradation down to 'micro' corridor establishment or protection at the individual farm or property level. The Macro Corridor project was not designed to consider small scale areas such as Bayonet Head, but it is likely that the north south corridor along Oyster Harbour foreshore would be an important part of the Macro Corridor System. Other significant existing corridors identified in the Macro Corridor project for the Albany area include:

- Torndirrup National Park and adjoining coastal areas west to Denmark and north to Redmond;
- Redmond State Forest to Bakers Junction;
- Bakers Junction to Mount Martin and adjoining coastal area east; and
- Bakers Junction north to the Porongurup Ranges.

On a more local scale, the City of Albany Greenway Plan (ATA Environmental *et al.* 2001) identifies connections between Mt Melville, Mt Clarence, Lake Seppings, Yakamia Creek, along the Princess Royal and Oyster Harbours as the most significant links in the Albany urban area. Yakamia Creek was identified as an important ecological corridor to provide habitat connectivity between Oyster Harbour and within the Albany urban area. It also forms the basis of connectivity to other important corridors such as the King and Kalgan Rivers and coastal areas to the east of Albany. Bayonet Head was also shown as a possible link.

The City of Albany Draft Local Planning Strategy (City of Albany, 2006) has identified reserves that contain native vegetation as 'Regional Reserves' and 'Local Reserves'. Some of these areas are close to Bayonet Head and are described in Section 3.1. However, these Reserves do not necessarily have a purpose designation that reflects conservation or retention of vegetation, so there is the possibility that these areas could be developed for other purposes, including schools.

Reserves within a 6km radius which contain significant vegetation and habitat and also have a purpose considered to be compatible with conservation of habitat are listed below (and shown on Figure 1):

- Bayonet Head Foreshore (Purpose: Public Recreation and Foreshore Protection, Area: 40ha);
- Bill Gibbs Reserve and associated Reserve No. 329 (Purpose: Recreation (managed for conservation values) Area: 241ha);
- Yakamia Creek, Lake Seppings (including Lake Seppings Delta and Wesley Maley Reserve) (Purpose: Conservation, Parklands and Recreation; Area 228ha);
- Mt Martin Reserve No. 33308 (Purpose: Regional Botanic Park managed by DEC; Area: 403ha);
- Gull Rock National Park (Purpose: National Park, Area: 2,593ha);
- Bakers Junction Nature Reserve No. 30463 (Purpose: Conservation of Flora and Fauna, Area: 998ha);
- Bon Accord Reserves 34934 and 3490 (Purposes: Government Requirements and Parklands; Area 127ha); and
- Chester Pass Reserve 22892 (Purpose: Conservation and Protection of Flora, Area: 149ha).

These Reserves contribute significant cohesive and/or linked areas of native vegetation and habitat around the Bayonet Head area.

3.2 Climate

The climate of the Bayonet Head area is characterised by cool, wet winters and warm, dry summers. During winter, anticyclonic depressions cause rain to approach from the south-west for periods of up to three to five days as they move from west to east across the Australian continent. During summer, the low pressure systems are located further to the south of Australia and a series of high pressure systems affect most of the continent, bringing associated easterly winds that result in warmer, dry air.

The hottest month is January with the mean temperature ranging from 18°C to 25^{o}C with a maximum mean temperature of 25.8°C, while in winter the mean minimum and maximum temperatures range from 7°C to 17^{o}C and the coolest month is August with a maximum mean temperature of 15.5°C (ATA Environmental, 2005).

The mean annual rainfall for Albany is 936mm, the majority of which falls between the wettest period occurring from May and October (Bureau of Meteorology 2007).

3.3 Topography

The site is dominated by a broad plateau lying at approximately 40m-45m AHD over the mid western portion of the Plan for Development area, which falls away to approximately 20m AHD in the southwest, 26m AHD in the south east, 10m AHD in the north and 4m AHD in the northeast of the site. A steep

lateritic scarp (32m AHD to 0m AHD, over 65 linear metres) separates the Plan for Development area from Oyster Harbour.

3.4 Geology and Soils

A review of the Environmental Geology Series maps prepared by the Geological Survey of Western Australia was undertaken to determine the geology of the site. The site is located on the Albany Part Sheets 2427 I, 2428 II, 2527 IV and 2528 III (Gozzard 1989).

The geology of the site is mapped as comprising predominantly laterite within a gently undulating upland, with the western portion along Lower King Road falling away to a colluvial slope while the northern portion comprises an alluvial plain.

The majority of the superficial soils across the site consist of light grey to white sands (predominantly quartz sand) overlying laterite at variable depths.

WAPC Planning Bulletin 64 identifies the southern portion of the study area as having “low to no known risk of ASS occurring within 3m of natural soil surface (or deeper)” (WAPC, 2003b). The low lying areas on Lot 15 Hooper Rd, Lot 3 Alison Parade, Lot 500 Alison Parade, Lot 38 Elizabeth Street and Lot 39 Elizabeth Street are predicted to have a high risk of actual acid sulfate soils and potential acid sulfate soil less than 3m from the ground surface. However, this risk needs to be verified through field testing once development areas have been determined.

4 ENVIRONMENTAL FACTORS

Based on previous studies undertaken for the Plan for Development area, consultation with industry professionals and the EPA, the potential environmental factors identified as relating to the site are considered to be:

Biophysical

- Native Terrestrial Vegetation and Flora;
- Native Terrestrial Fauna;
- Coastal Foreshore;
- Wetlands;

Pollution Management

- Acid Sulfate Soils;
- Surface Water Quantity and Quality;
- Groundwater Quantity and Quality;

Social Surroundings

- Aboriginal Heritage.

The EPA's environmental objective for each of these environmental factors, a brief overview of the existing environment, potential impacts, and proposed management are presented in Table 2.

Table 5 shows the EPA's Principles of Environmental Protection, against which the proposed development has been measured.

TABLE 5

PRINCIPLES OF ENVIRONMENTAL PROTECTION AS APPLIED TO THE PROPOSED DEVELOPMENT

PRINCIPLE	Relevant Yes/No	If Yes, consideration
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by: (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk-weighted consequences of various options.	Yes	There is sufficient knowledge to address potential environmental impacts. Specialist studies (e.g. flora, fauna, groundwater) have been undertaken. These studies have assisted in the assessment of the environment and potential impacts, and have been applied to factors including vegetation, wetlands, hydrology and fauna.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	The Plan for Development reflects the initial requirements of the 2001 BHODP, and also incorporates significant environmental improvements to the 2001 BHODP through retention of wetlands and native vegetation. The consolidated areas of POS will enable retention of significant wetlands and upland vegetation and a sustainable and environmentally appropriate water management solution.
3. The principle of conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	Investigations undertaken for flora (vegetation, DRF and PEC) and fauna (priority and scheduled species) have been undertaken in accordance with the EPA's relevant guidance statements. The findings will form the basis of a series of Environmental Management Plans to be prepared for the project area to address the sustainable management of vegetation, flora, fauna and water resources.

PRINCIPLE	Relevant Yes/No	If Yes, consideration
4. Principles relating to improved valuation, pricing and incentive mechanisms • Environmental factors should be included in the valuation of assets and services. • The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement. • The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and ultimate disposal of any waste. • Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and responses to environmental problems.	No	
5. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	Environmental Management Plans will be prepared for the proposed development to minimise the clearing of significant native vegetation, the conservation and reuse of water and the management of building materials during construction. The preferred management options for waste management are to avoid, reduce, reuse, recycle and recover waste.

5 ENVIRONMENTAL ASSESSMENT

5.1 Native Terrestrial Vegetation and Flora

5.1.1 EPA's Objective

To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

5.1.2 Applicable Legislation, Criterion or Guidance

- State Planning Policy 2.0 – Environment and Natural Resources Policy (WAPC, 2003a);
- EPA (2004b) Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia;
- *Environment Protection and Biodiversity Conservation Act 1999;*
- *Wildlife Conservation Act 1950;*
- Commonwealth of Australia (2001) National Targets and Objectives for Biodiversity Conservation 2001-2005;
- Commonwealth of Australia (1996) National Strategy for the Conservation of Australia's Biological Diversity; and
- City of Albany Town Planning Scheme No. 3.

5.1.3 Existing Environment

An assessment of native vegetation and flora in the Plan for Development area has been carried out by Coffey Environments (2009a and 2009b), Technical Appendices A and C.

The Plan for Development area contains approximately 136.5ha of native vegetation. The vegetation of the study area has previously been broadly mapped according to rainfall variations and landform/soil properties (Beard 1981). Beard described the vegetation of the Albany area as representative of the Albany System within the Menzies Subdistrict Vegetation Unit, and more specifically mapped the study area as a Jarrah (*Eucalyptus marginata*) and Jarrah-Sheoak (*Allocasuarina fraseriana*) Low Woodland.

A total of 18 vegetation associations were identified in the study area (Coffey Environments 2009b). These associations are mapped in Figure 8 and described below. An additional two vegetation associations were recorded from vegetation outside of the Plan for Development area (Figure 8).

Dryland Vegetation Associations

AfEmOCF Open to Closed *Allocasuarina fraseriana* and *Eucalyptus marginata* Forest over *Agonis theiformis*, *Bossiaea linophylla, Leucopogon racemulosus, Beaufortia decussata, Astartea scoparia*, *Xanthorrhoea brunonis* and *Dasypogon bromeliifolius* over *Anarthria scabra, Anarthria prolifera*, *Desmocladus fasciculatus* and *Lepidosperma squamatum*.

AfEsBc Open *Eucalyptus staeri* and *Allocasuarina fraseriana* Woodland over *Banksia coccinea* over *Melaleuca thymoides, Leucopogon glabellus, Leucopogon obovatus* and *Dasypogon bromeliifolius* over *Lyginia imberbis, Anarthria scabra* and *Anarthria prolifera*.

AfEsOW Open *Eucalyptus staeri* and *Allocasuarina fraseriana* Woodland over *Agonis theiformis, Leucopogon glabellus, Jacksonia* sp. and *Melaleuca thymoides* over *Anarthria scabra*.

AfNfBiBaOF Open *Allocasuarina fraseriana, Nuytsia floribunda, Banksia ilicifolia* and *Banksia attenuata* Forest over *Astartea* sp. and *Agonis theiformis* over weeds.

EmAfBgCF Closed *Eucalyptus marginata, Allocasuarina fraseriana* Forest with occasional *Banksia grandis* over *Agonis theiformis, Melaleuca thymoides, Petrophile heterophylla, Daviesia preissii* and *Xanthosia rotundifolia* over *Anarthria scabra* and *Lepidosperma squamatum*.

EmAfF *Eucalyptus marginata* and *Allocasuarina fraseriana* Forest over *Agonis theiformis, Acacia* sp. and *Kingia australis* (Severely Burnt).

EmAfNfOF Open *Eucalyptus marginata, Allocasuarina fraseriana* and *Nuytsia floribunda* Forest over *Psoralea pinnata, Acacia myrtifolia, Hibbertia cuneiformis, Xanthorrhoea platyphylla* and *Zantedeschia aethiopica* over *Anthoxanthum odoratum, Sonchus oleraceus* and *Hypochaeris glabra*.

EmAfOCF Open to Closed *Eucalyptus marginata* and *Allocasuarina fraseriana* Forest over *Agonis theiformis, Xanthorrhoea* sp., *Xanthorrhoea platyphylla, Acacia* sp., *Dasypogon bromeliifolius, Gompholobium knightianum, Conostylis setigera, Leucopogon revolutus, Bossiaea linophylla, Hibbertia cunninghamii, Tetratheca setigera, Opercularia vaginata* and *Sphenotoma* sp. over *Chordifex laxus, Anarthria scabra, Desmocladus fasciculatus, Lepidosperma gladiatum, Lepidosperma squamatum, Anarthria prolifera, Tetraria capillaris* and *Hypolaena exsulca*.

EmAfOF Open *Eucalyptus marginata* and *Allocasuarina fraseriana* Forest with occasional *Eucalyptus staeri* over *Agonis theiformis, Astartea* sp., *Allocasuarina humilis, Melaleuca thymoides, Xanthorrhoea brunonis, Conostylis setigera* and *Leucopogon propinquus* over *Mesomelaena tetragona, Anarthria scabra* and *Anarthria prolifera*.

EmAfW *Eucalyptus marginata* and *Allocasuarina fraseriana* Woodland over *Jacksonia* sp., *Melaleuca thymoides, Leucopogon glabellus, Dasypogon bromeliifolius, Adenanthos obovatus* and *Xanthosia rotundifolia* over *Lepidosperma gladiatum, Chordifex laxus* and *Hypolaena* sp.

Wetland/Transitional Vegetation Associations

AfEsNfOW Open *Allocasuarina fraseriana, Eucalyptus staeri* and *Nuytsia floribunda* over *Melaleuca thymoides, Agonis theiformis, Jacksonia spinosa, Leucopogon glabellus, Dasypogon bromeliifolius, Leucopogon unilateralis, Pericalymma ellipticum* var. *ellipticum, Adenanthos obovatus, Sphenotoma* sp. and *Darwinia vestita* with occasional *Kingia australis* over *Evandra aristata, Anarthria scabra, Juncus pauciflorus, Mesomelaena graciliceps, Chordifex laxus, Hypolaena exsulca, Anarthria prolifera, Anarthria scabra* and *Lomandra sonderi*

AfLCF Low Closed *Allocasuarina fraseriana* Forest over *Agonis theiformis, Jacksonia* sp. and *Xanthosia rotundifolia* over *Anarthria scabra* and *Lepidosperma squamatum.*

AsClTOS Tall Open *Astartea scoparia* and *Callistachys lanceolata* Scrub over *Juncus kraussii, Baumea articulata, Lepidosperma gladiatum* and *Hypolaena exsulca.*

ClAf *Callistachys lanceolata* with occasional *Agonis flexuosa* over *Pteridium esculentum*.

ClEm *Callistachys lanceolata* and *Eucalyptus marginata* over *Melaleuca viminea* subsp. *viminea* over *Agonis theiformis* over *Lepidosperma gladiatum, Anarthria gracilis, Juncus pauciflorus, Chordifex laxus* and *Hypolaena exsulca*.

HfCrOH Open *Homalospermum firmum* and *Cosmelia rubra* Heathland over *Xyris lacera* and *Hypolaena exsulca*

MpEsW *Melaleuca preissiana* and *Eucalyptus staeri* Woodland over *Taxandria linearifolia, Astartea fascicularis, Acacia rostellifera, Gompholobium villosum, Dasypogon bromeliifolius, Sphenotoma squarrosum* and *Dampiera linearis* over *Chordifex laxus, Mesomelaena graciliceps* and *Hypolaena exsulca*.

MpLW Low *Melaleuca preissiana* Woodland over *Astartea scoparia* over *Hypolaena exsulca*.

Degraded Vegetation Associations

Pp *Psoralea pinnata*

C/P Cleared/Pasture

As indicated above a number of vegetation associations are described as either wetland or transitional. During site survey and mapping it became apparent that vegetation associated with wetland areas had a mosaic nature with a transition from wet to dryland vegetation over short distances. Vegetation mapped as the wetland/transitional associations in particular (AfEsNfOW) comprised a mosaic nature with understory species including wetland/transitional species such as *Pericalymma ellipticum* and *Juncus pauciflorus* as well as species more common in drier areas such as *Anarthria scabra* and *Dasypogon bromeliifolius.*

A small area in the northern portion of the study area comprised the introduced species **Psoralea pinnata* (African Scurfpea or Taylorina).

Vegetation Condition

Vegetation condition was assessed according to the condition rating scale presented in Bush Forever (Government of Western Australia, 2000). The majority of remnant vegetation in the southern part of the study area is considered to be in Excellent condition with few weed species and little sign of disturbance. Vegetation in the northern part of the Plan for Development is relatively degraded (Good to Completely Degraded). Dieback has been recorded in Lots 1000 and 1001 Lower King Road as described in Section 5.2. Numerous sandy tracks are present within the study area, however weed infestation was generally limited to a few plants scattered next to the tracks. The eastern portion of the study area (with the exception of the area directly adjacent to Oyster Harbour) comprises vegetation in Completely Degraded to Good condition. This is largely due to a history of agricultural land use and clearing. Vegetation directly adjacent to the foreshore at the eastern extent of the study area is considered to be in Excellent condition.

Albany Regional Vegetation Survey - Vegetation Associations

The Department of Environment and Conservation has embarked on an Albany Regional Vegetation Survey (Interim report, Sandiford and Rathbone, 2008, Technical Appendix B). It has been indicated that the total remaining remnant vegetation in the ARVS study area contains 37% of its original extent. This estimated percentage is likely to decrease on completion of the ARVS. The interim report was based on surveys of 12% of the study area and provides comments on the vegetation type and status for Bayonet Head, Emu Point and Yakamia areas, which are all the subject of development proposals. The interim report that was made available for this SEA represents an ongoing and incomplete survey and is included in Technical Appendix B. The interim report identified 10 vegetation types at Bayonet Head (full descriptions are in Technical Appendix B):

- Afra/Emar/Athe: Low Open Woodland/Forest over Tall Open Shrubland, Shrubland/Low Shrubland and Open Sedgeland characterised by *Allocasuarina fraseriana*, *Eucalyptus marginata*, *Agonis theiformis.*
- Afra/Emar/Esta: Low Open Woodland over Tall Shrubland, Open Heath, Low Shrubland and Sedgeland characterised by *Allocasuarina fraseriana*, *Eucalyptus marginata* and *E. staeri*.
- Esta/Afra/Bcoc: Low Open Woodland over Tall Open Scrub/Open Heath and Sedgeland characterised by *E. staeri*, *A. fraseriana* and *Banksia coccinea*.
- Eari/Bspa/Sgra: Closed to Open Heath over Sedgeland characterised by *Evandra aristata*, *Beaufortia sparsa* and *Sphaerolobium grandiflora*.
- Emar/Afra/Hspp: Low Open Woodland over Tall Open Scrub, Low Open Heath and Sedgeland characterised by *E. marginata*, *A. fraseriana* and *Hakea* species.
- Pspo/Ttre/Esta: Open Low Heath over Sedgeland characterised by *Pericalymma spongiocaule*, *Tremulina tremula* and *E. staeri*.
- Mpre: Low Open Woodland over Open Shrubland, Open Sedgeland characterised by *Melaleuca preissiana*.
- Keri: Closed Tall Shrubland or Closed Heath characterised by *Kunzea ericifolia*.
- Hfir/Crub/Lten/Egra: Tall Open Shrubland/Sedgeland characterised by *Homalospermum firmum*, *Cosmelia rubra*, *Leptocarpus tenax* and *Empodisma gracillimum*.

- Clan: Closed Tall Open Shrub/Open Sedgeland.

Based on the mapping undertaken by Sandiford and Rathbone (2008), the vegetation associations 'Keri' and 'Clan' are the only vegetation associations that occur within the Bayonet Head ODP that are currently below 30% (Table 6; based on incomplete data). There is approximately 9.4% (or 1.6ha) of the vegetation association 'Keri' represented in conservation reserves. This is below the 10% level for vegetation associations to be considered to be poorly reserved (Mattiske and Havel, 2002). There is approximately 10.1% (or 0.6ha) of the vegetation association 'Clan' remaining in conservation reserves. This is only marginally above the 10% poorly reserved level.

Table 6

Percentage of Vegetation Associations Remaining in Surveyed Area and Bayonet Head

(based on incomplete data)

Vegetation Association	Surveyed Area (ha)	Total Area in Conservation Reserves (ha)	% Area in Conservation Reserves	Bayonet Head (ha)	% Area in Bayonet Head
Afra/Emar/Athe	2359.6	1043.3	44.2	30.2	1.3
Afra/Emar/Esta	1300.5	784.4	60.3	46.2	3.6
Esta/Afra/Bcoc*	500.2	385.9	77.1	25.6	5.1
Eari/Bspa/Sgra	153.7	83.1	54.1	7.3	4.7
Emar/Afra/Hspp	153.5	132.9	86.5	1.0	0.7
Pspo/Ttre/Esta	140.1	80.4	57.4	8.5	6.0
Mpre	111.5	39.2	35.2	0.4	0.3
Keri	18.8	1.6	9.4	0.9	5.0
Hfir/Crub/Lten/Egra	6.2	3.8	62.1	2.0	32.7
Clan	6.4	0.6	10.1	1.6	24.6
Hspp Complex	316.9	296.0	93.4	1.0	0.
Pspo Complex	273.7	202.0	73.8	8.5	3.1

* It has been noted that one of the reasons that this vegetation association has been nominated as a PEC is due to its vulnerability to dieback. It should be noted that the Esta/Afra/Bcoc community at Bayonet Head is infested with dieback and no parts of it have been identified as 'protectable'.

Regional Vegetation Analysis (Coffey Environments, 2009a)

Numerical results of the assessment undertaken by Coffey Environments (2009a, Technical Appendix A) indicates that the quadrats surveyed were generally grouped with vegetation associations recorded in reserves managed by DEC and the City of Albany at the 10 group level. The classification of quadrats within the Plan for Development area compared with quadrats recorded in regional reserves as described by Coffey Environments (2009a) is given in Technical Appendix A and Table 7. Five floristic groups have been identified in the Plan for Development area (Group 5 is broken into two sub-groups) (Coffey Environments 2009a). The five floristic groups are Floristic Group1, Group 2, Group 5 (5a and 5b), Group 6 and Group 7.

As indicated in Technical Appendix A, quadrats BH01, BH02, BH03, BH04, BH05, BH06, BH07, BH08, BH11, BH12, BH13, BH14, BH15, BH16, BH19, BH20, BH23, BH25, 07Q04, 07Q05, 07Q06, 07Q07, 07Q08, 07Q09, 07Q10, 07Q11, 07Q12, 07Q13, 07Q14, 07Q15 and 07Q16 (Figure 8) were grouped with quadrats representing floristic types found in greater than or equal to sixteen (16) conservation reserves. Quadrats BH09, BH10, 07Q01, 07Q02 and 07Q03 were grouped with quadrats representing floristic types found in one or two conservation reserve. Quadrats BH17, BH18, BH21, BH22 and BH24 were grouped with quadrats representing floristic types not recorded in any conservation reserve.

Coffey Environments based the reservation status of the floristic groups on the location of the vegetation groups within conservation reserves. For the purposes of this analysis DEC reserves and reserves managed by the City of Albany for preservation purposes have been included. In a formal sense, not all City of Albany reserves have a purpose of 'Conservation'. However, discussions with the City of Albany (pers. comm. City of Albany Reserves Officers, 2009) have indicated that large vegetated reserves are managed for conservation and the 'purposes' of these reserves is going to be reviewed in the short to medium term to more formally reflect this.

In this analysis, if a floristic group occurs in four conservation reserves, the reservation status of that floristic group is 'Four Reserves' (Coffey Environments, 2009a). As with Gibson *et al.* (1994), Coffey Environments does not provide any estimation of the actual area of the floristic group and although it may be within several reserves the size of the floristic group may be small and isolated and represent only a small portion of the total floristic area.

Using the data presented in Technical Appendix A and reservation status requirements described above there are a number of quadrats within the study area, representing floristic groups which are not present in any conservation reserves that were sampled by Coffey Environments (2009a).

Quadrats BH01, BH02, BH03, BH04, BH06, BH11, BH12, BH14, BH15, BH19, 07Q04, 07Q09, 07Q11, 07Q12, 07Q15 and 07Q16 are representative of Floristic Group 1 (Coffey Environments, 2009a). Floristic Group 1 comprises *Allocasuarina fraseriana* and/or *Eucalyptus staeri/Eucalyptus marginata* on Sandy Gravel to Heavy Wet Soils. Vegetation representative of Floristic Group 1 is protected in 16 different conservation reserves (DEC reserves and Albany conservation reserves).

Quadrats BH09, BH10, 07Q01 and 07Q03 are representative of Floristic Group 2 (Coffey Environments, 2009a). Floristic Group 2 comprises *Homalospermum firmum* over Sedgeland Species. Vegetation representative of Floristic Group 2 is protected in one conservation reserve (DEC Reserve).

Quadrats BH17, BH18, BH21 and BH24 are representative of Floristic Group 5a (Coffey Environments, 2009a). Floristic Group 5a comprises *Eucalyptus marginata* and *Allocasuarina fraseriana* on Wet/Transitional Habitats. There is no remnant native vegetation representative of Floristic Group 5a protected in any DEC and/or Albany reserves.

Quadrat BH22 is representative of Floristic Group 5b which comprises *Melaleuca preissiana* and *Eucalyptus staeri.* There are no areas of native vegetation representative of Floristic Group 5b protected in any DEC and/or Albany reserves.

Quadrats BH05, BH07, BH08, BH13, BH16, BH20, BH23, BH25, 07Q05, 07Q06, 07Q07, 07Q08, 07Q10, 07Q13 and 07Q14 are representative of Floristic Group 6 Which comprises *Eucalyptus marginata* and *Allocasuarina fraseriana* over *Agonis theiformis* on Dry Upland Habitats. Vegetation representative of Floristic Group 6 is protected in 17 different conservation reserves (DEC and Albany reserves).

Quadrat 07Q02 is representative of Floristic Group 7 which comprises *Agonis flexuosa* over *Pteridium esculentum.* There are two different conservation reserves that contain remnant vegetation that is representative of Floristic Group 7.

Given the data available, Quadrats BH17, BH18, BH21, BH22 and BH24 are not represented within any conservations reserves sampled by Coffey Environments (2009a). Quadrats BH18, BH21 and BH24 are located in vegetation which has been subject to disturbance (either recent fire, historical grazing, past vegetation clearance or invasion by introduced species). These quadrats are not considered to be representative of vegetation of regional significance.

Comparisons between floristic groups, quadrats and vegetation association terminology is included in Table 7.

Table 7

Comparison Between Floristic Groups, Quadrats and Vegetation Associations

Quadrats	Vegetation Associations present in Bayonet Head Plan for Development Area	Floristic Groups present in Bayonet Head Plan for Development area	Floristic Group Description
BH01, BH02, BH03, BH04, BH06, BH11, BH12, BH14, BH15, BH19, 07Q04, 07Q09, 07Q11, 07Q12, 07Q15 and 07Q16	AfEsOW, AfEsBc, EmAfOCF/EmAfOF, AfEsNfOW, EmAfW	Group 1	*Allocasuarina fraseriana* and/or *Eucalyptus staeri/Eucalyptus marginata* on Sandy Gravel to Heavy Wet Soils.
BH09, BH10, 07Q01 and 07Q03	HfCrOH, AfEsNfOW, AfEsOW, AfEmOCF	Group 2	*Homalospermum firmum* over Sedgeland Species.
BH17, BH18, BH21 and BH24	AfEsOW, EmAfF, EmAfNfOF	Group 5a	*Eucalyptus marginata* and *Allocasuarina fraseriana* on Wet/Transitional Habitats.
BH22	MpEsW	Group 5b	*Melaleuca preissiana* and *Eucalyptus staeri.*
BH05, BH07, BH08, BH13, BH16, BH20, BH23, BH25, 07Q05, 07Q06, 07Q07, 07Q08, 07Q10, 07Q13 and 07Q14	EmAfOCF/EmAfOF, AfEmOCF, EmAfOCF, EmAfBgCF	Group 6	*Eucalyptus marginata* and *Allocasuarina fraseriana* over *Agonis theiformis* on Dry Upland Habitats.
07Q02	ClAf	Group 7	*Agonis flexuosa* over *Pteridium esculentum*

Flora

A total of 222 species of terrestrial vascular flora from 43 families were recorded during the surveys conducted by ATA Environmental in 2005 and Coffey Environments in 2007 (Coffey Environments 2009b, Technical Appendix C). A species list is provided in Appendix 1. Seventeen of these species are introduced flora. The flora list contains species recorded from quadrats as well as opportunistic records (See Section 5.2 for Significant Flora).

5.1.4 Potential Impacts

The proposed development will involve:

- Clearing areas of remnant native vegetation;
- Fragmentation of vegetation, which may lead to unviable/unsustainable native vegetation conservation outcomes; and
- Protection and management of native vegetation that is not well represented in secure tenure.

5.1.5 Management Strategies

The Bayonet Head Plan for Development will protect 39.5ha of bushland in conservation POS. The areas to be retained have been chosen based on drainage function, association with wetlands and associated upland vegetation. In addition, it is important to ensure that the most sustainable configuration for long term management is retained to reduce edge effects in consolidated areas.

The Plan for Development also seeks to retain the vegetation associations identified by Sandiford and Rathbone (preliminary report in 2008) as being potentially significant in the Albany Regional Vegetation Survey study area (due to low representation in secure tenure). These include 'Keri' (AfEsNfOW in Figure 8) and 'Clan' (ClAf and ClEm in Figure 8) within POS in the south-west of Lot 1000, northern POS in Lot 1001 and the large central POS covering portions of Part Lot 1 and Lot 476. It is recognised that the ARVS information is based on preliminary and incomplete data.

Based on the regional vegetation analysis undertaken by Coffey Environments (2009a), the vegetation that is of most significance (due to low presence in conservation reserves) is represented in Quadrats BH17, BH18, BH21, BH24 (Floristic Group 5a) and BH22 (Floristic Group 5b). The vegetation associated with quadrats BH17 and BH22 are proposed for retention in two of the POS areas. A summary of this information is in Tables 8 and 9.

The remaining quadrats (BH18, BH21 and BH24) and their associated vegetation are not proposed to be retained. Quadrat BH18 is not likely to be a correct representative of Floristic Group 5b due to fire and sampling effort effects. The quadrats representative of Floristic Groups 2 and 7 within the study area are proposed for retention within conservation POS areas.

Quadrats BH01, BH02, BH08, BH09, BH10, BH14, BH15, BH17, BH20, BH22, BH23, 07Q01, 07Q02, 07Q03, 07Q04, 07Q07, 07Q11, 07Q12 and 07Q14 and their associated vegetation are all proposed to be retained within conservation POS areas of the Study Area (Table 8).

Areas to be retained in Conservation POS have been summarised by vegetation association and condition in Table 9.

Table 8

Vegetation Retention Proposed Based on Floristic Groups

Quadrats	Bayonet Head Vegetation Associations	Floristic Groups present in Bayonet Head Plan for Development area	Group Description	Protected Status	Proposal for retention in Bayonet Head Plan for Development
BH01, BH02, BH03, BH04, BH06, BH11, BH12, BH14, BH15, BH19, 07Q04, 07Q09, 07Q11, 07Q12, 07Q15 and 07Q16	AfEsOW, AfEsBc*, EmAfOCF/EmAfOF, AfEsNfOW, EmAfW *Sandiford and Rathbone (2008) call this vegetation type (PEC) Esta/Afra/Bcoc)	Group 1	*Allocasuarina fraseriana* and/or *Eucalyptus staeri/Eucalyptus marginata* on Sandy Gravel to Heavy Wet Soils.	Protected in 16 Conservation Reserves.	Vegetation types associated with this group will be retained in POS Nos 10, 12 and 13.
BH09, BH10, 07Q01 and 07Q03	HfCrOH, AfEsNfOW, AfEsOW, AfEmOCF	Group 2	*Homalospermum firmum* over Sedgeland Species.	Protected in one Conservation Reserve.	Vegetation types associated with this group will be retained in POS No 13.
BH17, BH18, BH21 and BH24	AfEsOW, EmAfF, EmAfNfOF	Group 5a	*Eucalyptus marginata* and *Allocasuarina fraseriana* on Wet/Transitional Habitats.	Not protected in any Conservation Reserves sampled.	Vegetation types associated with this group will be retained in POS No 10.
BH22	MpEsW	Group 5b	*Melaleuca preissiana* and *Eucalyptus staeri.*	Not protected in any Conservation Reserves sampled.	Vegetation types associated with this group will be retained in POS No 11.
BH05, BH07, BH08, BH13, BH16, BH20, BH23, BH25, 07Q05, 07Q06, 07Q07, 07Q08, 07Q10, 07Q13 and 07Q14	EmAfOCF/EmAfOF, AfEmOCF, EmAfOCF, EmAfBgCF	Group 6	*Eucalyptus marginata* and *Allocasuarina fraseriana* over *Agonis theiformis* on Dry Upland Habitats.	Protected in 17 Conservation Reserves.	Vegetation types associated with this group will be retained in POS Nos 8, 10, 12 and 13.

07Q02	ClAf	Group 7	*Agonis flexuosa* over *Pteridium esculentum*	Protected in two Conservation Reserves.	Vegetation types associated with this group will be retained in POS No 13.

Table 9

Vegetation to be Retained in POS by Vegetation Association and Condition

POS No.	Vegetation Condition Rating	Vegetation Association (See Figure 8 for legend)	Area of Vegetation in POS Areas (ha)*		Area POS (ha)
1	Degraded to Good	AfLCF	0.5		
1	Completely Degraded	C/P	0.1		
1	Completely Degraded	C/P	1.5	**Area POS 1**	2.1
2	Degraded to Good	AfLCF	3.8		
2	Completely Degraded	C/P	0.1		
2	Completely Degraded	C/P	1.8	**Area POS 2**	5.7
4	Good to Very Good	ClAf	0.9		
4	Very Good to Good	MpLW	0.1		
4	Degraded to Good	AsClTOS	0.8		
4	Completely Degraded	C/P	1.9	**Area POS 4**	3.7
8	Excellent to Very Good	EmAfBgCF	4.0	**Area POS 8**	4.0
9	Good	MpLW	1.0		
9	Completely Degraded	C/P	0.9	**Area POS 9**	1.9
10	Excellent	AfEsNfOW	1.0		
10	Excellent	EmAfOF	0.6		
10	Excellent	AfEsOW	1.9		
10	Excellent	ClEm	0.1		
10	Excellent	AfEsNfOW	2.1		
10	Excellent	AfEsOW	0.9		
10	Excellent	EmAfBgCF	2.5		
10	Excellent	EmAfOCF-EmAfOF	0.4		
10	Excellent	EmAfOCF	0.8		
10	Good to Very Good	EmAfOCF	2.7		
10	Completely Degraded	C/P	0.4	**Area POS 10**	13.5
11	Excellent	AfEsNfOW	0.7		
11	Very Good	MpEsW	0.1	**Area POS 11**	0.8
12	Excellent	AfEsOW	0.1		
12	Excellent	AfEsOW	0.4		
12	Excellent	AfEsNfOW	2.8		
12	Excellent	EmAfOCF-EmAfOF	1.0	**Area POS 12**	4.2

13	Excellent	AfEmOCF	0.7		
13	Excellent	AfEsNfOW	3.8		
13	Excellent	AfEsOW	1.3		
13	Excellent	HfCrOH	0.4		
13	Excellent	AfEsBc	2.9		
13	Excellent	EmAfOCF	0.2		
13	Excellent	EmAfOCF-EmAfOF	0.4		
13	Good	ClAf	1.6	**Area POS 13**	11.2
14	Excellent	EmAfOCF	0	**Area POS 14**	2.5
	Total Area of POS		**47.2**		

Notes:
The minimum area of POS to be retained for natural/conservation values will be 39.6ha.
The estimated area for low key active recreation in POS (e.g. pocket parks and paths) will be 4.3ha.
The estimated area for water resource management in POS will be 3.3ha (subject to design).
The area proposed for active recreation (in POS 14 only) is 2.5ha.
See Table 4 and Figure 3 for details.

Low key recreation areas such as pocket parks and pathways are proposed to be located in POS areas that are outside Conservation Category wetlands and associated buffers. They will be placed in disturbed sites, where possible. More detailed site planning will be undertaken in consultation with DEC, DoW and the City of Albany to prepare management plans for the POS areas.

Water resource management infrastructure (basins and stream lines) will be designed to incorporate native vegetation (existing or via rehabilitation) to enhance the long term conservation values.

	Plan for Development Area - Vegetation Condition	**Area in Plan for Development (ha)**	**Areas in POS (ha)****		
	Excellent	100.2	25.0		
	Excellent to Very Good	7.1	4.0		
	Very Good	0.1	0.1		
	Good to Very Good	8.8	3.7		
	Good	6.2	2.5		
	Good to Degraded	21.1	5.2		
	Completely Degraded	47.7	7		
	Total Area	**191.3 ha**	**47.2 ha**		

* Areas calculated by Geographic Information System analysis.

** Not including area in POS 14 which is proposed to be cleared for active recreation

The Proponents commit to preparing POS and Wetland Management Plans as part of subdivision approval. The Management Plans will address issues including access, signage, fire management, weed control, rehabilitation, monitoring and integration with surrounding areas. It is intended that small areas within the POS would be used as pocket parks for low key active recreation (e.g. 1000m^2). This would be done in such a way to reduce impacts on surrounding native vegetation (e.g. though proper delineation of pocket park elements and prevention of invasion of weeds).

The exact location for these parks has not yet been determined, but will be based on pedestrian access and use degraded areas, where possible.

In addition, the Proponents are committed to preparing and implementing a Construction Management Strategy (to be prepared prior to subdivision) which will include consideration of clearing of vegetation, dieback, dust and weed management.

Preparation of Landscape and Streetscape Plans will outline the local native species to be planted in road reserves to provide green linkage. These plans will also provide guides for water wise local native garden opportunities for residences in future development.

5.2 Terrestrial Flora – Declared Rare, Priority Flora and Flora of Conservation Significance

5.2.1 EPA's Objective

Protect Declared Rare and Priority Flora consistent with the provisions of the *Wildlife Conservation Act 1950*, and the *Environment Protection and Biodiversity Act 1999*.

Protect other flora of conservation significance.

5.2.2 Applicable Legislation, Criterion or Guidance

- State Planning Policy 2.0 – Environment and Natural Resources Policy (WAPC, 2003a).
- EPA (2004b) Guidance Statement No. 51 – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia.
- *Environment Protection and Biodiversity Conservation Act 1999.*
- *Wildlife Conservation Act 1950.*
- Commonwealth of Australia (2001) National Targets and Objectives for Biodiversity Conservation 2001-2005.
- Commonwealth of Australia (1996) National Strategy for the Conservation of Australia's Biological Diversity.
- City of Albany Town Planning Scheme No. 3.

5.2.3 Existing Environment

Conservation Significant Flora

An assessment of Declared Rare Flora, Priority Flora and Flora of Conservation Significance has been carried out by Coffey Environments (2009b), Technical Appendix C.

The following significant species have been reported on the site (Sandiford and Rathbone, 2008):

- *Drakaea micrantha* (Declared Rare Flora);
- *Andersonia jamesii* ms (Priority 1);
- *Andersonia depressa* (Priority 3);
- *Chorizema reticulatum* (Priority 3);
- *Leucopogon altissimus* (Priority 3);
- *Drosera fimbriata* (Priority 4);
- *Laxmannia jamesii* (Priority 4);
- *Stylidium plantagineum* (Priority 4);

Drakaea micrantha (DRF) was recorded from one location within Lot 1000 within vegetation association AfEsBc. *Drakaea micrantha* is known from 32 small, scattered populations from Perth to Albany with secure populations in Mount Frankland National Park. It has been calculated that the area of occupancy is approximately 0.961ha (obtained from http://www.environment.gov.au/). *Drakaea micrantha* is listed as Vulnerable under the Commonwealth's Department of the Environment, Water, Heritage and the Arts Environment Protection and Biodiversity Conservation Act 1999.

Andersonia jamesii ms (P1) is currently a manuscript name and is yet to be formally published. There are only two known confirmed populations of *Andersonia jamesii* (P1), near Narrikup. The Bayonet Head populations represent a range extension of approximately 30km to the south-east of the known populations near Narrikup.

Andersonia depressa (P3) was recorded from one location along the boundary between Lot 1000 and Part Lot 1 within the Bayonet Head SEA. *Andersonia depressa* (P1) has been recorded throughout much of the greater Albany region.

Chorizema reticulatum (P3) has been recorded from one location within Lot 1000 of the Bayonet Head SEA. *Chorizema reticulatum* (P3) is located over much of the south-west from Cape Naturaliste to Bremer Bay.

The population of *Leucopogon altissimus* (P3) located within Lot 1000 is both an outlier and the most westerly known occurrence of the Priority 3 taxa.

Drosera fimbriata (P4) is currently known from 500 (approximately) plants in seven populations.

One population of the Priority 4 taxa *Laxmannia jamesii* was recorded from within the Bayonet Head SEA. There are approximately 39 populations (including confirmed and unconfirmed recordings) occurring around the Busselton and greater Albany region.

Stylidium plantagineum (P4) was recorded from three locations within the Bayonet Head SEA. There are approximately 26 populations (including confirmed and unconfirmed recordings) of *Stylidium plantagineum* (P4) across the greater Albany region, Bridgetown and Harvey regions.

The Albany Pitcher Plant (*Cephalotus follicularis*) is an iconic species of the Albany region, and although it is not listed as significant (under the *Wildlife Conservation Act 1950*) for Western Australia, it is listed on the IUCN Red List 2008 for Threatened Species. The Albany Pitcher Plant is a relictual species and is the only representative of its type in the world. The Albany Pitcher Plant was recorded

from two locations within the Bayonet Head SEA (within Wetland 29 and Wetland 57), with both populations located within POS 13 (Wetland 29) and POS 11 (Wetland 57). Therefore, the Albany Pitcher Plant is proposed for protection within two POS areas.

The Club Moss, *Lycopodiella serpentine,* generally grows alongside the Albany Pitcher Plant and may also be considered to be a relictual species. However, considering both populations of the Albany Pitcher Plant are located within POS 11 and 13, it can be assumed that the Club Moss will also be located within the two POS, if it indeed occurs in association with the Albany Pitcher Plants located within the SEA boundary.

Priority Ecological Community

According to the DEC database search no Threatened Ecological Communities (TECs) are known to occur within the vicinity of the study area (ATA Environmental, 2005). However, there is a Priority 1 Ecological Community (PEC) on the site which corresponds with vegetation association AfEsBc on Lots 1000 and 1001 Lower King Road (Figure 8). The PEC is described by DEC (2007a) as:

- Open Low Allocasuarina fraseriana – Eucalyptus staeri woodland in association with Banksia coccinea thicket.

Part of the vegetation association AfEsBc has been nominated as a TEC, along with 35 other small dispersed occurrences with a combined area of 285ha, of which 75% (or 215ha) occurs in the Conservation Estate. Sites nominated range from Millbrook (18km north-north west of Albany) to Waychinicup (35km east of Albany).

The DEC, as a component of the ARVS, has mapped the boundaries of the PEC within the Bayonet Head ODP as occurring along the western boundary of Lot 1000 and the western and northern boundary of Lot 1001. Small pockets also occur in the central area of Lot 1000 and near the centre of the eastern boundary of Lot P1 Yatana Road. Sandiford and Rathbone (2008) have mapped a larger area (Technical Appendix B, Figure 4) compared to Coffey Environments (2009c). This appears to be due to the fact that Coffey Environments only mapped areas where *Banksia coccinea* is obviously in association with *Allocasuarina fraseriana* and *Eucalyptus staeri*. Floristic composition of the PEC has been based on the data collected from quadrats within the PEC where *Banksia coccinea* is in association with *Allocasuarina fraseriana* and *Eucalyptus staeri*.

The DEC has nominated a smaller area (than the area mapped in Figure 8) to become a TEC (DEC, pers. comm. 2008). The nominated area covers a small portion of what has been mapped along the western boundary of Lot 1000 and Lot 1001. The current mapping of the PEC as submitted to the Threatened Species Scientific Committee is a draft and will be superseded with information obtained from the ARVS mapping (when complete). The TEC nomination will also be updated upon completion of the ARVS.

This community is highly susceptible to *Phytophthora cinnamomi*, in particular the key component *Banksia coccinea* as well as other susceptible members of the Proteaceae, Papilionaceae, Epacridaceae and Myrtaceae (DEC, 2007a). Other threatening processes have been described as land clearing and altered fire regimes.

Dieback (*Phytophthora cinnamomi*)

To clarify the risks to the PEC associated with *Phytophthora cinnamomi (*Pc*)*, an accredited Disease Interpreter has undertaken a survey for the presence of Pc in association with the PEC on Lot 1000 and 1001 Lower King Road (Coffey Environments, 2008; Technical Appendix D).

The vegetation present on Lots 1000 and 1001 consists of interpretable woodlands of *Allocasuarina fraseriana*, *E. staeri, E. marginata* and *Banksia coccinea* and uninterpretable open areas dominated by *Melaleuca* and *Agonis* species (Figure 10).

The expression of Pc at the survey site is evidenced through the presence of dead *Xanthorrhoea* species and *Banksia coccinea* as well as secondary indicator species. Areas of infection have been mapped and are shown in Figure 10. Soil samples were also taken for analysis, and six of eight samples returned a positive result for Pc.

Although there are disease free areas located on Lots 1000 and 1001, there are no disease free areas that were of suitable size to be demarcated as 'protectable' (in accordance with *Interpreters' Guidelines for Detection, Diagnosis and Mapping;* CALM; 2001). Two of the disease free areas are down slope of open roads and all are located on private land, which in accordance with current DEC guidelines results in these areas being classified as un-protectable.

Due to the relatively free draining, deep sandy nature of the soils there is restricted Pc spread by water movement through the soil. This means that autonomous spread is limited to root to root contact, resulting in patchy expression of the disease. There is evidence of historical deaths in many areas where there was no fresh plant deaths, suggesting that the disease has been present at the site for a considerable period of time. There appeared to be an association of fresh deaths with a series of tracks entering the site from the eastern boundary and traversing the site in a general east to west direction. There is also evidence of vehicle access and activity not associated with formed tracks throughout Lot 1000 and 1001.

No protectable areas have been identified in the area surveyed for dieback, so operational hygiene management is unlikely to significantly reduce the risk of disease spread at the site. However, due to the infected status of the entire area, all vehicles, equipment and machinery would need to be cleaned down prior to leaving the site so that *Pc* is not spread from the site to other areas. Soil from the area should not be transported off-site for reuse in dieback free areas.

There are a large numbers of plants that have remained disease free due to the patchy nature of disease spread. It is feasible to consider these as areas that may remain disease free for some time. The Open Low *Allocasuarina fraseriana – Eucalyptus staeri* woodland in association with *Banksia coccinea* thicket vegetation community (Figure 10) is currently listed as a PEC and is proposed to become a Threatened Ecological Community (TEC). If this vegetation community was classified as a TEC, then the population area is likely to be considered as protectable subject to on-going active management through the application of phosphite.

Potential Impacts

The proponent does not anticipate that there will be any loss of, or disturbance to any known species of Declared Rare Flora. The majority of the Priority Flora populations, excluding part of one population (*Drosera fimbriata* (P4)) in Part Lot 1, will be lost or disturbed as a consequence of the proposed development of Bayonet Head. The proposed development may lead to fragmentation of vegetation, which could lead to unviable/unsustainable native vegetation conservation outcomes. There are

potential impacts to the Priority 1 Ecological Community (Open Low *Allocasuarina fraseriana* – *Eucalyptus staeri* woodland in association with *Banksia coccinea* thicket) on Lots 1000 and 1001.

Infestation of susceptible areas by dieback has the potential to reduce biodiversity through the loss of key plant species. In this instance, *B. coccinea* is a significant component of the PEC and is highly susceptible to dieback.

5.2.4 Management Strategies

Significant vegetation associations identified in the Albany Regional Vegetation Assessment – Phase 1 (Coffey Environments, 2009a) and the Albany Regional Vegetation Survey (Sandiford and Rathbone, 2008) will be retained in conservation POS as shown in the Plan for Development (Figure 3).

It is proposed to retain significant flora (Figure 8), in conservation POS in the Plan for Development (Figure 3), where possible:

- One population of the DRF, *Drakaea micrantha*, was recorded from Lot 1000. The population is proposed to be retained within POS No. 13 in the south-west of Lot 1000. The population recorded is on the boundary of vegetation associations AfEsBc and AfEsNfOW (Esta/Afra/Bcoc and Hfir/Crub/Lten/Egra, respectively in Sandiford and Rathbone, 2008; Figure 8). DEC (pers. comm. 2010) has commented that habitat critical for the species is not adequately retained in POS in the Plan for Development. The Plan for Development proposed to retain two hectares of AfEsBc in conservation POS (6ha to be developed) and 10.4ha of AfEsNfOW in POS 1, 9, 12 and 13 (of approximately 22.9ha of AfEsNfOW identified in Plan for Development Area). It should be noted that *D. micrantha* is generally found in infertile grey sands in Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*) woodland or forest associated with *Banksia* species (Brown *et al*., 1998) and may therefore be supported in proposed POS areas that contain grey sands with suitable vegetation composition. The species is noted for being found on cleared firebreaks or open sandy patches that have been disturbed, where competition from other plants has been removed (Brown *et al*., 1998). This suggests that plants may require disturbance at a point in their lifecycle and that plants regenerate from soil stored seed after disturbance events (DEC, 2007d).
- One population of the P1, *Andersonia jamesii*, was recorded from the study area (Part Lot 1). The population of *Andersonia jamesii* (P1) is not proposed for retention within POS.
- One population of the P3 *Andersonia depressa* was recorded from the boundary of Lots 1000 Lower King Road and Pt Lot 1 Yatana Road. This population is not proposed to be retained within POS.
- One population of the P3 *Chorizema reticulatum* was recorded from the boundary of Lots1001 Lower King Road and Pt Lot 1 Yatana Road. This population is not proposed to be retained within POS. The population is not proposed to be retained in POS.
- One population of the P3 *Leucopogon altissimus* was recorded from Lot 1000 Lower King Road. This population is not proposed to be retained within POS. The population is both an outlier and the most westerly occurrence in this location. The population is not proposed to be retained in POS.
- Two populations of the P4, *Drosera fimbriata*, were recorded from Lot 1001 and Part Lot 1 within the study area. The population located within Part Lot 1 is located within a proposed POS area, the other population (Lot 1001) is not located within POS. *Drosera fimbriata* (P4) is currently known from 500 (approximately) plants in seven populations.

- One population of the P4, *Laxmannia jamesii*, was recorded from Lot 1000. The population is not proposed to be retained in POS.
- Three populations of the P4, *Stylidium plantagineum*, were recorded from Lot 1000 (one population) and Lot 1001 (two populations). The populations are not proposed to be retained in POS.
- Retention of 2.8ha of the PEC in POS No. 13, with active management for dieback will prevent otherwise inevitable deterioration due to dieback infestation. Six hectares of the PEC is not proposed for retention within the Plan for Development.

Management of DRF, Priority Flora, the PEC and dieback will be addressed in a POS and Wetland Management Plan.

A Hygiene Management Plan for the PEC area during construction and earthworks will be prepared to outline management measures including appropriate drainage along Lower King Road, implementation of clean down standards, entry conditions and dry soil operating conditions would need to be applied.

As the City of Albany will be granted the management orders for the conservation POS after development commitments have been completed, the role of active management (including for dieback) will become the responsibility of the City of Albany.

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5.3 Terrestrial Fauna and Specially Protected (Threatened) Fauna

5.3.1 EPA's Objective

To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.

5.3.2 Applicable Legislation, Criterion or Guidance

- State Planning Policy 2.0 – Environment and Natural Resources Policy (WAPC, 2003a);
- *Wildlife Conservation Act 1950;*
- *Environment Protection and Biodiversity Conservation Act 1999;*
- EPA (2004c) Guidance No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia; and
- City of Albany Town Planning Scheme No. 3.

5.3.3 Existing Environment

Studies Undertaken

An assessment of the terrestrial fauna in the Plan for Development area has been carried out by Coffey Environments (2009c, Technical Appendix E). Prior to the fauna survey work undertaken for this SEA, there have been very limited fauna studies in the Albany area.

No systematic fauna surveys (vertebrate or invertebrate) have been previously conducted across the bioregion (Hearn *et al.,* 2002). As a consequence, data are sparse and patchy and there are no fauna data for most of the reserves in the region.

Occasional invertebrate studies have mainly been confined to some wetlands and to selected invertebrate taxa. The region has been identified as containing significant relict taxa and their habitat, in particular, for invertebrates; but targeted surveys and assessments have only just begun (Hearn *et al.,* 2002).

Coffey Environments conducted a bi-season survey in accordance with Guidance Statement No 56 (EPA, 2004). The survey included a search of the DEC's Threatened Fauna database was undertaken to identify potential scheduled and threatened species in the vicinity of the project area. A search of the DEWHA *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* online database was also undertaken for the area 34.75^{o} to 35.00^{o}S, and longitude 117.5^{o} to 118.00^{o}E to identify species of conservation interest to the Commonwealth Government. In addition, a number of published and unpublished reports for fauna surveys have been used to provide a regional context for the small vertebrate assemblages sampled in the survey area.

To allow data collected from the Bayonet Head project area to be analysed in a regional context, the Bayonet Head survey was included in a broader survey by Coffey Environments (2009c) of the Yakamia and Emu Point areas. The fauna habitats that were sampled in the regional survey included:

- **Jarrah/Sheoak Woodland (JSW)** – Jarrah (*E. marginata*) and Sheoak (*A. fraseriana*) Woodland over Shrubland of species such as *A*. *theiformis*, *A. fascicularis*, *A*. *humilis*, *M*. *thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland.
- **Heath Shrubland (HS)** – Heath containing species such as *A. theiformis, Leucopogon glabellus, Lepidosperma gladiatum, Melaleuca thymoides, M. bracteosa, Pericalymma ellipticum* var. *ellipticum* and *Beaufortia decussata* with occasional Albany Blackbutt (*Eucalyptus staeri*).
- **Wetland Mosaic (WM)** – Degraded Peppermint (*Agonis flexuosa*) and *Callistachys lanceolata* Woodland over *Pteridium esculentum*.

The field based fauna assessment within the project area consisted of:

- Two, seven night trapping programs;
- Systematic avifauna survey;
- Spotlighting survey including bat echolocation survey;
- Targeted tadpole and frog survey;
- Targeted Western Ringtail Possum survey;
- Targeted Black-Cockatoo survey; and
- Short range endemic invertebrate survey.

Results of Surveys

One hundred and twenty eight species of vertebrate fauna were recorded within the Bayonet Head project area during December 2006, March 2007 and March 2009. This includes 7 amphibian species, 21 reptile species, 86 bird species and 14 mammal species (including four introduced species). Most species recorded within the project area were also recorded from regional sites. At a local scale, the trappable fauna assemblage within the Jarrah/Sheoak Woodland and Heath Shrubland habitats of the project area were very similar to the same habitats surveyed elsewhere regionally. The Heath Shrubland habitat within the project area was slightly more diverse than that outside the project area, while little diversity differences within the Jarrah/Sheoak Woodland habitat inside and outside the project area were recorded. The species recorded in the project area occurred in a range of habitats across the region and were recorded from other habitats surveyed in the Albany region at Emu Point and Yakamia. Sites surveyed and results are shown in Figure 11. Details of results and analysis are included below and in Technical Appendix E.

Fauna Habitat Type and Quality

The project area contains three broad fauna habitat types; Jarrah/Sheoak Woodland, Heath Shrubland and Wetland Mosaic. The project area contains fauna habitat typically found in the Albany region. Although no Wetland Mosaic fauna habitat was surveyed regionally (unavailable/inaccessible), Jarrah/Sheoak Woodland and Heath Shrubland are commonly found in the greater Albany area. On a regional basis, the south west part of the project area is linked to similar fauna habitat but is dissected by Lower King Road (Figure 11). Furthermore, the easterly section of the project area directly connects fauna habitat from Emu Point in the south to northern habitats of Oyster Harbour. Both of these habitat corridors within the project area are rated as high quality fauna habitat and are considered stands of natural remnant vegetation – comparable to Emu Point and Yakamia.

Fauna habitat within the project area varied from highly degraded to high quality fauna habitat. The habitat condition of the project area is shown in Figure 12 with descriptions below.

High quality fauna habitat (1) – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.

Very good fauna habitat (2) – These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.

Good fauna habitat (3) – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.

Disturbed fauna habitat (4) – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.

Highly degraded fauna habitat (5) – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Faunal assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

Based on these descriptors, approximately half of the fauna habitat (central and south west sections of the project area) is considered to be very good to high quality (Lots 1000, 1001, 476 and Part Lot 1; approximately 112ha) (Figure 12). Fauna habitat assessment of the remaining project area (Lots 37, 38, 39, 2, 3 and 286; approximately 79ha) was conducted in 2009 and varies from large areas of Cleared/Paddock – highly degraded – to small parts of high quality Jarrah/Sheoak Woodland.

Throughout the project area, over 40 trees with hollows considered suitable as nesting sites (diameter greater than 200mm) for Masked Owls and WRPs were recorded (for details refer to Technical Appendix E, Table 9). These trees are considered important habitat for fauna as hollows often take 130 or more years to develop (Saunders *et al.*, 2003). Tree hollow locations tended to be concentrated in two areas: the central and eastern section of the project area. In excess of 20 tree hollows were located in the eastern section while 15 were located in the central section. The high densities of tree hollows located in these two areas indicate they are likely to be key areas of fauna habitat (due to value of hollows, presence of mature trees and diverse intact understorey). Other habitat values include intact understorey, leaf litter, fallen branches and other debris.

Trapping was conducted at other sites in the Albany area to provide data for regional comparisons. These sites were at Emu Point and Yakamia, both less than 10km from the Bayonet Head. Habitats at Emu Point and Yakamia included:

- Jarrah/Sheoak Woodland – (JSW);
- Heath Shrubland – (HS);

Amphibians

Seven amphibian species were recorded from the project area (Appendix 2). The captured amphibian assemblage included two Hylids (tree frog), two Limnodynastidae and three Myobatrachids (ground-dwelling frogs). *Heleioporus eyrei* was the most commonly recorded amphibian (182 individuals). In contrast, only two individual *Litoria adelaidensis* were recorded within the Wetland Mosaic habitat. Most frogs (218 individuals) were recorded within the Wetland Mosaic habitat, suggesting it is an important habitat for frogs. In comparison, approximately 75 individuals were recorded each from Jarrah/Sheoak Woodland and Heath Shrubland. Therefore, permanent water or sufficient ground moisture with associated vegetation appears to be a focal point for frogs.

Reptiles

A total of 19 species of reptile were trapped from the project area including 15 skinks, three elapids and one gecko (Appendix 2). Most reptiles were captured from the Wetland Mosaic habitat, (259 individuals from six sites) while approximately half that number were recorded each from the Jarrah/Sheoak Woodland (142 individuals from five sites) and Heath Shrubland (129 individuals from 3 sites). *Acritoscincus trilineatum* and *Hemiergis peronii* were found in all three fauna habitats and all 14 trapping sites and made up the majority of reptile recordings (132 and 110 individuals respectively) (Appendix 2). In comparison, *Echiopsis curta* and *Ctenotus labillardieri* were recorded only from the Jarrah/Sheoak Woodland and *Egernia luctuosa* was found solely in the Wetland Mosaic habitat. Furthermore, *Varanus rosenbergi* was also recorded opportunistically from the Wetland Mosaic habitat.

Within the project area, more species of reptile and slightly more individuals were recorded during the March 2007 survey compared with the December 2006 survey. Species that were caught during the March 2007 survey but not in the December 2006 survey include *Menetia greyii* and *Morethia obscura*, although, one species, *Echiopsis curta* was only recorded in the December 2006 survey (Appendix 2). Within the project area a number of species including *Elapognathus coronatus*, *Egernia napoleonis* and *Lerista microtis* were recorded in higher numbers during the March 2007 survey and several species including *Glaphyromorphus gracilipes*, *H. peronii* and *Tiliqua rugosa* were recorded in higher numbers during the December survey. These differences may be related to a number of factors, such as the temperatures at which these species are active and timing of their breeding season.

Mammals

Four species of mammal were trapped within the project area (Appendix 2). An additional nine species, including three introduced species were recorded during spotlight and bat surveys (Appendix 2). A total of 566 individual mammals were captured within the project area, with *Rattus fuscipes* being the most commonly caught species (516 individuals). Two mammal species of conservation significance, the Western Ringtail Possum (*Pseudocheirus occidentalis*) and Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) were recorded within the project area. Another conservation significant species, the Western False Pipistrelle (*Falsistrellus mackenziei*) was also tentatively recorded from bat echolocation surveys.

Within the project area, the number of individuals and species did not differ between the two seasons. Slightly more individuals and species were recorded during the December 2006 survey compared with the March 2007 survey, but this difference is mostly due to one species, *R. Fuscipes.*

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Conservation Significant Mammals

Western Ringtail Possums were found in low numbers (12 individuals) throughout the project area (Figure 11). However, Western Ringtail Possums tended to concentrate in two areas within the project area. These areas contained approximately 80% of WRPs and dreys observed and were located in the central and eastern sections of the project area. In total, 20 dreys were recorded and rated as being of a high quality (i.e. well formed and maintained instead of a platform of twigs, often in a tree or branch fork, with no more than a shallow depression where the possum rests).

Avifauna

Seventy-eight bird species and 10,409 individual birds were recorded in the project area during the December 2006 and March 2007 surveys (Appendix 3). Three of the species that were recorded, the Australian Pelican, Straw-necked Ibis and Australian White Ibis were seen flying over but did not land within the project area. The White-breasted Robin was abundant in the project area with over 1,400 individuals. Thirteen species were also very common in the project area with over 300 individuals recorded per species.

Other species expected to be found in the area (EPA pers. comm., 2010) include:

- Painted Button-quail;
- Brush Bronzewing;
- Brown Falcon;
- Peregrine Falcon;
- Regent Parrot;
- Pallid Cuckoo;
- White-cheeked Honeyeater;
- Western Wattebird;
- Rufous Whistler;
- Dusky Wood-swallow; and
- Restless Flycatcher.

Invertebrates

The following invertebrate species were collected from pit traps and through active searching in the project area and were identified by the staff at the Western Australian Museum (WAM).

Millipedes

Several specimens of *Akamptogonus novarae* (family Paradoxosomatidae) were found in the Wetland Mosaic habitat of the project area. This species is very widespread across south-western Australia and is thought to have been introduced into the region from eastern Australia as early as the late 19th century (Framenau *et. al.* 2008). Several specimens of the native millipede family Lulomorphidae were found in the Wetland Mosaic habitat. Adult males were lacking from the samples and thus it was not possible to identify the specimens to genus or species level.

Land Snails

All specimens of snails collected from the Wetland Mosaic habitat at Bayonet Head belong to the family Zonitidae and genus *Oxychilus*. This genus is considered to be native to Europe and to have been introduced into north and South America, northern Asia, Japan, New Zealand, South Africa and Australia (M. Harvey pers. comm.).

Scorpions

Two species of scorpion were recorded in the Jarrah/Sheoak Woodland habitat within the project area. *Urodacus novaehollandiae* (family Urodacidae) is a large burrowing scorpion that is relatively common in uncleared regions of south-western Australia (Framenau *et. al.* 2008). Of the three species of the genus *Cercophonius* now recognised from south-western Australia, *C. sulcatus* (family Bothriuridae) is the only species found along the south coast of Western Australia and was recorded from the project area.

Pseudoscorpions

One species of pseudoscorpion was recorded under the bark of trees in the Jarrah/Sheoak Woodland habitat within the project area. *Protogarypinus giganteus* (family Garypinidae) is a bark-dwelling species that occurs over much of the wetter regions of south-western Australia and can be locally common, especially in areas that have remained free of frequent burning regimes (Framenau *et. al.* 2008).

Mygalomorph Spiders

Two species of mygalomorph (trapdoor) spider were recorded from the Heath Shrublands habitat and these included two female specimens of *Chenistonia tepperi* (family Nemesiidae) and one immature specimen of *Chenistonia "paludigena"* ms. nom. BYM. This *Chenistonia species* is widespread and found in most habitats throughout south-western Australia (Framenau *et al.,* 2008).

Comparisons to Historical Regional Surveys

Prior to Coffey Environments survey of the Bayonet Head project area and two regional areas (Yakamia and Emu Point), few surveys had been conducted in the greater Albany region (Table 10). The surveys carried out by Coffey Environments were significantly larger than all other studies performed in the past. Furthermore, many former surveys lacked the diversity of trap types to capture a complete representative of fauna species. Coffey Environments has a high level of confidence in the likely presence and absence of fauna and faunal assemblages, when considering the size and scale (local and regional) of the data presented in this report.

TABLE 10:
COMPARISON OF TRAP TYPE AND INTENSITY OF SURVEYS UNDERTAKEN IN REGION

Trap type						Survey location and source
Bucket Pit-trap nights	**Pipe-pit trap nights**	**Funnel trap nights**	**Elliott trap nights**	**Cage trap nights**	**Total trap nights**	
5712	5712	11424	5712	952	28560	Bayonet Head Outline Development Plan Area (Coffey Environments, 2009c)
425	425	1700	850	425	3825	Mardo Ave, Australind; ATA Environmental, (2005)
180*		-	500	50	730	Australind; *ecologia* Environmental Consultants, (2001a)
112	168	-	560	140	980	Smiths Beach; *ecologia* Environmental Consultants, (2001b)
50	190	-	525	315	1080	Eagle Bay; Harewood, (2005)
60**			250		310	Cape Naturaliste; How, Dell and Humphreys, (1987)

*Estimate based on conversation with consultant as the exact pit-trap used is not clear.
**Estimate based on personal communication with author.

5.3.4 Terrestrial Fauna – Specially Protected (Threatened) Fauna

Vertebrate Fauna

The fauna species listed in Table 11 have conservation status under State and/or Commonwealth *EPBC Act 1999* legislation. Each species has either been previously recorded or has been listed as having the potential to occur in the vicinity of Bayonet Head.

Ten threatened species of fauna and 14 migratory species of birds listed as potentially occurring in the project area were identified under the *EPBC Act 1999* as having national environmental significance and could occur in the Bayonet Head area (Table 11). Threatened and Priority species listed under the Western Australian *Wildlife Conservation Act 1950* and the DEC's Priority Fauna List as potentially occurring in the region are listed in Table 11. 14 Schedule 1, two Schedule 4 and five Priority fauna species potentially occur in the vicinity of the project area. Only those migratory species recorded in the database searches are listed in Table 11.

TABLE 11

SIGNIFICANT FAUNA SPECIES RECORDED OR PREDICTED TO OCCUR IN THE REGION

Species	DEC Schedule / Priority	Status under Commonwealth *EPBC Act*	Comment
Carnaby's black-cockatoo *Calyptorhynchus latirostris*	Schedule 1	Endangered	Species *recorded* in the project area
Baudin's black-cockatoo *Calyptorhynchus baudinii*	Schedule 1	Vulnerable	Species *recorded* in the project area
Forest red-tailed black-cockatoo *Calyptorhynchus banksii naso*	Schedule 1	*	Species *recorded* in the project area
Western ground parrot *Pezoporus wallicus flaviventris*	Schedule 1	Endangered/ migratory	Species *highly unlikely* in the project area
Western whipbird (western heath) *Psophodes nigrogularis nigrogularis*	Schedule 1	Endangered	Species *unlikely* in the project area
Dibbler *Parantechinus apicalis*	Schedule 1	Endangered	Species *unlikely* in the project area
Noisy scrub-bird *Atrichornis clamosus*	Schedule 1	Vulnerable	Species *unlikely* in the project area
Western bristlebird *Dasyornis longirostris*	Schedule 1	Vulnerable	Species *unlikely* in the project area
Chuditch, western quoll *Dasyurus geoffroii*	Schedule 1	Vulnerable	Species *possibly* in the project area
Western ringtail possum *Pseudocheirus occidentalis*	Schedule 1	Vulnerable	Species *recorded* in the project area
Quokka *Setonix brachyurus*	Schedule 1	Vulnerable	Species *unlikely* in the project area
Gilbert's potoroo *Potorous gilbertii*	Schedule 1	Critically endangered	Species *unlikely* in the project area
Southern brush-tailed phascogale *Phascogale tapaotafa tapaotafa*	Schedule 1		Species *possibly* in the project area
Carpet python *Morelia spilota imbricata*	Schedule 4		Species recorded in region and *possibly* found in the project area
Peregrine falcon *Falco peregrines*	Schedule 4		*Possible* infrequent visitor to the project area

Species	DEC Schedule / Priority	Status under Commonwealth *EPBC Act*	Comment
Masked owl *Tyto novaehollandiae novaehollandiae*	Priority 3		Species *possibly* in the project area
Western brush wallaby *Macropus irma*	Priority 4		Species *unlikely* in the project area
Western false pipistrelle *Falsistrellus mackenziei*	Priority 4		Species *recorded* in the project area
Eastern curlew *Numenius madagascariensis*	Priority 4	Migratory	Species *highly unlikely* in the project area
Quenda, southern brown bandicoot *Isoodon obesulus fusciventer*	Priority 5		Species *recorded* in the project area
Rainbow bee-eater *Merops ornatus*		Migratory	Species *possibly* in the project area
White-bellied sea eagle *Haliaeetus leucogaster*		Migratory	Species *possibly* in the project area
Grey plover *Pluvialis squatarola*		Migratory	Species *highly unlikely* in the project area

The following species descriptions provide a commentary on fauna that are listed in *FaunaBase*, the DEC's Threatened fauna database and DEWHA *EPBC Act 1999* database as being potentially found in the project area. * Potential to be assessed under the *EPBC Act 1999* in the near future.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)

This species inhabits the south-west of WA. It is uncommon to common in the subhumid zone and wetter parts of the semiarid zone, with scarce to patchy distribution in the driest parts of its range. Recent surveys suggest it appears to be increasing in relative abundance in the northern Jarrah forest and in the deep south-west and is relatively common in the far south-east of its range (Johnstone *et al.*, 2003). Carnaby's Black-Cockatoo breed mainly in the Wheatbelt and move west after breeding. However, it would appear that land clearing may have influenced breeding areas with a shift southwards and westwards (Johnstone *et al.*, 2003). Breeding has recently been recorded in the northern Darling Range at Bindoon, Chittering, Walyunga, The Lakes, the Upper Helena River, near Christmas Tree Well, Karragullen, Serpentine National Park, and Bannister (Johnstone *et al.*, 2003). It has also been recorded breeding on the Swan Coastal Plain at Yanchep, east of Gingin, Mooliabeenee, south of Mandurah, near Bunbury and in the deep south-west at Nannup (Johnstone *et al.*, 2003).

Carnaby's or mixed flocks of Black-Cockatoo has been observed feeding on a wide range of foods including the seeds of *Banksia, Hakea, Eucalyptus, Corymbia, Grevillea, Mesomelaena, Pinus* and *Allocasuarina* spp. (Saunders, 1974a; b; 1980). It also feeds on the flowers of *Banksia sessilis, B. lindleyana, B. quercifolia, B. squarrosa, Lambertia inermis, Banksia grandis, Eucalyptus*, *Corymbia, Grevillea* and *Callistemon* spp., the fruiting nut trees, fruiting apples, soft fruits, Plane trees,

Liquidambar and the seeds of Corkscrew, *Erodium* spp., and Wild Radish (Johnstone and Storr, 1998; Saunders, 1980; Saunders, 1974b).

Carnaby's Black-Cockatoo was recorded foraging in the project area during the December 2006 survey.

Coffey Environments' assessment is that clearing the Jarrah/Sheoak Woodland habitat in the project area is likely to result in a loss of potential foraging habitat for Black-Cockatoos.

Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*)

Baudin's Black-Cockatoo is distributed across the south-western humid and subhumid zones of Western Australia. Between March and September it visits the central and northern Darling Range and adjacent far eastern areas of the Swan Coastal Plain and during the breeding season (September to December) it is found in the deep south-west (Johnstone and Storr, 1998). Baudin's Black-Cockatoo breeds in the south-west Jarrah/Marri and Karri forests and Wandoo woodland north to Serpentine, and possibly also further north, with unconfirmed reports near Christmas Tree Well and Hovea (Johnstone *et al.*, 2003). It has also been recorded breeding east to Kojonup, possibly further east to Waychinicup National Park and there are also unconfirmed reports from near Bunbury (Johnstone *et al.*, 2003).

Baudin's Black-Cockatoo has been recorded mainly feeding on the seeds of Marri, *Corymbia calophylla* as well as *Eucalyptus* spp., *Banksia grandis, B. littoralis, B. ilicifolia, Hakea undulata, H. prostrata, H. trifurcata,* and *Xanthorrhoea* (Saunders, 1974a; 1974b; 1979; Johnstone and Storr, 1998; Sedgwick, 1964). The species also feeds on the flowers of *Banksia* and *Eucalyptus* spp., the seeds of introduced trees *Macadamia* and *Pinus*, fruiting apples, pears and persimmons, and the seeds of weeds such as *Erodium* spp.

Baudin's or mixed flocks of Black-Cockatoo was recorded foraging in the project area during the December 2006 survey only.

Coffey Environments' assessment is that clearing the Jarrah/Sheoak Woodland habitat in the project area is likely to result in a loss of potential foraging habitat for Black-Cockatoos.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)

The Forest Red-tailed Black-Cockatoo is endemic to the south-west humid and subhumid zones of Western Australia (Mawson and Johnstone, 1997). It inhabits the dense Jarrah, Karri and Marri forests receiving more than 600mm of annual average rainfall (Saunders *et al.*, 1985). The current distribution of the Forest Red-tailed Black-Cockatoo is north of Perth and east to Mount Helena, Christmas Tree Well, North Bannister, Mt Saddleback, Rocky Gully and the upper King River. The movements of this species are irregular (Sedgwick, 1949) and they can now be found on the Swan Coastal Plain at any time of the year. The Forest Red-tailed Black-Cockatoo roosts in Jarrah/Marri/Blackbutt habitat on roadsides, paddocks and forest blocks (Johnstone and Kirby, 1999). It appears that they may only breed in the north and east of their range on the margins of the forest (Higgins, 1999) and nest in the large hollows of Marri, Jarrah and Karri (Johnstone and Kirby, 1999).

The Forest Red-tailed Black-Cockatoo feeds mainly on the seeds of Marri and Jarrah (90% of diet; Johnstone & Kirby 1999). Other species used for feeding include Blackbutt, *E. patens*, Albany Blackbutt, *E. staeri*, *Allocasuarina fraseriana*, *Persoonia longifolia* and the introduced Spotted Gum, *E. maculata* and Cape Lilac, *Melia azedarach* (Johnstone and Kirby, 1999).

Forest Red-tailed or mixed flocks of Black-Cockatoos were recorded foraging within the project area during the December 2006 survey.

Coffey Environments' assessment is that clearing the Jarrah/Sheoak Woodland habitat in the project area is likely to result in a loss of potential foraging habitat for Forest Red-tailed Black-Cockatoos.

Western Ground Parrot (*Pezoporus wallicus flaviventris*)

The Western Ground Parrot is listed as Endangered under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. The Western Ground Parrot was previously found on the coastal plains of south-west Western Australia from Perth to Dongara and Israelite Bay to Augusta. It is now restricted to Fitzgerald River National Park, Cape Arid National Park and Waychinicup-Many Peaks area. The Western Ground Parrot lives in floristically diverse heathlands, where it feeds on fruits, seeds and leaves. Fire is currently the main threat to this subspecies and the more dense populations are found in heath that has not been burnt for at least 35 years.

Coffey Environments' assessment is that the Western Ground Parrot is highly unlikely to be found in the project area due to its highly restricted distribution and that the project area is surrounded by residential and rural development. The proposed development is therefore highly unlikely to have any impact on this species.

Western Whipbird (western heath) (*Psophodes nigrogularis nigrogularis*)

The Western Whipbird is listed as Endangered under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. This subspecies was previously found in the south-west of Western Australia, along the west coast from Perth to Augusta and on the south coast from King George Sound east to at least Two Peoples Bay. It is now restricted to a small area east of Albany between Mt Taylor and Cheyne Beach/Waychinicup River, Two Peoples Bay Nature Reserve and Mt Manypeaks. At Two Peoples Bay, the Western Whipbird (western heath) occurs in dense shrubland with an open overstorey and the structure of the vegetation is more important than floristics. The main threat to this subspecies is fire and it will normally only re-colonise an area 4-10 years after being burnt.

Coffey Environments' assessment is that the Western Whipbird (western heath) is unlikely to be found in the project area due to its restricted distribution, its susceptibility to disturbance and the distance of the Plan for Development area from known populations. The proposed development is therefore highly unlikely to have any impact on this species.

Dibbler (*Parantechinus apicalis*)

The Dibbler is listed as Endangered under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. Its initial distribution extended along the west coast from Perth north to Shark Bay and along the south coast from Torndirrup to Israelite Bay and as far inland as Peak Charles. The Dibbler is currently known from Whitlock, Escape and Boullanger Islands, Jurien Bay, and Fitzgerald River National Park on the south coast. It has also been recorded in Torndirrup National Park and Waychinicup National Park in recent years. In Fitzgerald River National Park, Dibblers have usually been trapped in dense, historically unburnt vegetation with a thick litter layer and sandy soils. Dibblers typically occupy heath and mallee-heath vegetation communities, where they have been located on the south coast of Western Australia. Threats to the Dibbler include feral cats and foxes, land clearing of important vegetation such as *Banksia* woodlands and kwongan heath, dieback disease

that can alter the vegetation structure of a plant community, and frequent fire that may reduce thick vegetation.

Coffey Environments' assessment is that the Dibbler is unlikely to be found in the project area due to its restricted distribution and the proximity of the project area to residential development. The proposed development is therefore highly unlikely to have any impact on this species.

Noisy Scrub-bird (*Atrichornis clamosus*)

The Noisy Scrub-bird is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. It is endemic to the south-west of Western Australia. There are currently five gradually coalescing sub-populations east from Two Peoples Bay near Albany to Cheyne Beach. It has been successfully reintroduced to Bald Island and the Darling Ranges near Waroona. Noisy Scrub-bird habitat typically contains dense clumps of sedges, shrubs or piles of debris for nesting interspersed with small open areas with a thick accumulation of leaf litter and a well-developed litter fauna for feeding. The disappearance of the Noisy Scrub-bird from most of its former range has been attributed to changes in fire regimes.

Coffey Environments' assessment is that the Noisy Scrub-bird is possibly found in the project area as suitable habitat is present; however it is considered unlikely due to the small size and proximity of the project area to development. The proposed development is therefore unlikely to have any impact on this species.

Western Bristlebird (*Dasyornis longirostris*)

The Western Bristlebird is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. This species was previously known along the coast from Perth to Augusta, Albany and the eastern end of Fitzgerald River National Park. It is now found east of Albany between Two Peoples Bay Nature Reserve and east of Waychinicup River, and from five locations in the Fitzgerald River National Park. Some birds were translocated in 1999 to Walpole. The Western Bristlebird is terrestrial and sedentary, with a preference for dense low heaths. The Western Bristlebird is particularly vulnerable to habitat destruction or alteration and fire is the main threat, with fires at less than 5-10 year intervals leading to local extinctions.

Coffey Environments' assessment is that the Western Bristlebird is unlikely to be found in the project area due to the small size and proximity of the project area to development and the species susceptibility to disturbance. The proposed development is therefore highly unlikely to have any impact on this species.

Chuditch (*Dasyurus geoffroii*)

The Chuditch is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. Formerly known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA, but they have been found in dry sclerophyll forests, riparian vegetation, beaches and deserts.

The Chuditch is able to utilise bush remnants and corridors and its preferred habitat does occur within the project area. However, the Chuditch was not recorded within the project area during either survey. The proposed development is therefore highly unlikely to have any impact on this species.

Western Ringtail Possum (*Pseudocheirus occidentalis*)

The Western Ringtail Possum (WRP) is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. The WRP is closely associated with stands of Native Peppermint trees (*Agonis flexuosa*). The leaves of Peppermint trees are the primary food source of the species, but individuals in residential areas may feed on garden plants, fruit and vegetables in compost heaps. Western Ringtail Possums are nocturnal and usually shelter by day in dreys (bird-like nests). These dreys are typically located in the crown of Peppermint trees, but may be constructed in other tree species, such as *Melaleuca, Banksia*, or Marri and Jarrah trees. Dreys may also be present in hollow trees.

Sixteen WRP dreys and 32 trees with hollows suitable for possums were recorded within the project area (Table 12). Dreys were recorded in Peppermint, Jarrah and Marri trees, as well as several other species of trees that were unable to be identified at the time. WRPs were recorded during each of the December 2006 and March (2007 and 2009) surveys and on Jarrah/Sheoak Woodland and Wetland Mosaic habitats.

Coffey Environments recorded the Western Ringtail Possum in very low densities within the project area and has determined that although clearing of vegetation is likely to result in some loss of habitat for this species, it is considered unlikely to be a significant impact given the species' low density.

TABLE 12

WESTERN RINGTAIL POSSUM OBSERVATIONS

Location (MGA Zone 50H)		WRP/Drey	Drey Rating	Tree Species
586380	6130042	Drey	4	Marri
586448	6130063	Drey	4	Marri
586426	6130058	Drey	4	Marri
586438	6130058	Drey	4	Eucalyptus sp.
586429	6130093	Drey	4	Eucalyptus sp.
586422	6130134	Drey	3	Marri
586418	6130181	Drey	3	Marri
585706	6130156	Drey	3	Jarrah
586399	6130061	WRP	4	Marri
586390	6130082	WRP	3	Peppermint
585698	6130124	WRP	3	Marri
585703	6130126	WRP	3	Eucalyptus sp.
585696	6130135	WRP	2	Peppermint
585610	6129911	Drey	4	Eucalyptus sp.
585606	6129911	Drey	4	Eucalyptus sp.
585691	6130129	Drey	4	Marri
585703	6130122	Drey	4	Marri
585713	6130130	Drey	4	Eucalyptus sp.
585708	6130112	Drey	4	Jarrah
585706	6130127	WRP	2	Jarrah
585668	6130117	WRP	4	Jarrah
585671	6130122	Drey	3	Eucalyptus sp.
586448	6130047	WRP	4	Eucalyptus sp.
584858	6129748	Drey	3	Jarrah
584495	6129746	Drey	2	Peppermint
586402	6129833	Drey	4	Allocasuarina fraseriana
584762	6128921	WRP	4	Eucalyptus sp.
584935	6129439	WRP	4	Eucalyptus sp.
586328	6130000	WRP	3	Eucalyptus sp.
586328	6130000	WRP	3	Eucalyptus sp.
584858	6129748	Drey	2	Eucalyptus sp.
586402	6129833	Drey	4	Eucalyptus sp.

Quokka (*Setonix brachyurus*)

The Quokka is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. At the time of European settlement the Quokka was common across the south-west of WA. The current distribution of the Quokka now includes Rottnest and Bald Islands and at least 25 sites on the mainland including Two Peoples Bay, Torndirrup National Park, Mt Manypeaks National Park, Walpole-Nornalup National Park, muddy lakes and swamp areas throughout the south-west forests from Jarrahdale to Walpole. The mainland Quokka generally inhabits densely vegetated coastal heaths, swamps and riverine habitats where they are less vulnerable to predation. The Quokka was not listed in the DEC threatened fauna database search for the area.

Coffey Environments' assessment is that the Quokka was not recorded during the trapping survey despite the presence of suitable habitat within the project area. However, the proposed development will result in the loss of habitat for the Quokka if present.

Southern Brush-tailed Phascogale (*Phascogale tapaotafa tapaotafa*)

The Southern Brush-tailed Phascogale is listed as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. The present range of this species is believed to have been reduced to 50% of its former range. It is now known from Perth and south to Albany, west of Albany Highway. It occurs in low densities in the northern Jarrah forest with highest densities found in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton. This subspecies was previously listed as a Priority 3 species but was recently added to the threatened species list as Schedule 1 due to an ongoing decline in its population. This arboreal marsupial has been observed in dry sclerophyll forests and open woodland that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests.

Coffey Environments' assessment is that the Southern Brush-tailed Phascogale possibly occurs in the Jarrah/Sheoak Woodland habitat; however, it was not recorded despite extensive trapping and spotlighting surveys. If present, any clearing of vegetation is likely to result in a loss of habitat for this species.

Carpet Python (*Morelia spilota imbricata*)

The Carpet Python is listed as a Schedule 4 species under the WA *Wildlife Conservation Act 1950*. The Carpet Python is a large snake found across the south-west of Western Australia, from Northampton, south to Albany and eastwards to Kalgoorlie including undisturbed remnant bushland near Perth and the Darling Ranges. This subspecies has been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands and grasslands.

Coffey Environments' assessment is that the Carpet Python is likely to occur in the region and possibly in the project area due to suitable habitat, however, it was not recorded during the recent survey. If the Carpet Python is present, clearing of the vegetation is likely to result in a loss of habitat for this species.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as a Schedule 1 species under the WA *Wildlife Conservation Act 1950*. The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers and ranges and in woodlands along watercourses and around lakes. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the project area.

Coffey Environments' assessment is that the Peregrine Falcon is possibly an infrequent visitor to the project area, but the potential loss of habitat due to development is unlikely to have an impact on this species.

Masked Owl (*Tyto novaehollandiae novaehollandiae*)

The Masked Owl is listed as a Priority 3 species by the DEC. Little information is available on the Masked Owl; however, it is known from Yanchep east to Yealering, south to Gnowangerup and Albany and occasionally seen north to Geraldton. The Masked Owl inhabits forests and woodlands and nests in tree hollows. It is locally common around Karridale and Manjimup, but is generally uncommon elsewhere.

The Masked Owl was recorded from Green Valley in 2001. Coffey Environments' assessment is that the Masked Owl possibly occurs in the project area with several trees containing potentially suitable nesting hollows observed in the project area (Figure 11). However, the Masked Owl has a large home range and if this species is present, there are likely to be few individuals. Therefore, clearing may force individuals to move to alternative habitats.

Western Brush Wallaby (*Macropus irma*)

The Western Brush Wallaby is listed as a Priority 4 species by the DEC. This species was very common in the early days of settlement, however, its range has been seriously reduced and fragmented and there is a significant decline in abundance in most remaining habitat. It is now distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.

The Western Brush Wallaby possibly occurs in the project area due to suitable habitat. However, it is Coffey Environments' assessment that given the size of the project area it is considered unlikely to be present as it was not seen during any of the surveys.

Western False Pipistrelle (*Falsistrellus mackenziei*)

The Western False Pipistrelle is listed as a Priority 4 species by the DEC. This bat species lives in hollows in old trees, branches and stumps. It is normally found in colonies of five to 30 bats. Western False Pipistrelles are vulnerable to loss of roosting sites in tree hollows and loss of feeding grounds by forestry activities, clearing for agriculture and housing. They live mainly in wet sclerophyll forests of Karri, Jarrah and Tuart.

The Western False Pipistrelle was recorded from Mill Brook Nature Reserve in 1999 and was tentatively identified from the echolocation surveys within the project area. It is Coffey Environments' assessment that if this species occurs within the project area it is likely to be in low numbers due to the small number of hollows for roosting. Clearing of vegetation and the subsequent decline in available prey will have a minor impact on this bat species.

Eastern Curlew (*Numenius madagascariensis*)

The Eastern Curlew is listed as a Priority 4 species by the DEC. The Eastern Curlew is an uncommon visitor to the northern Peel Inlet and southern Leschenault Inlet, but is generally rare to scarce elsewhere. It is mainly found on mudflats and samphire flats in estuaries and also can be found on ocean beaches, reef flats and near-coastal lakes.

The Eastern Curlew was recorded from Albany and Oyster Harbour in 1998. Coffey Environments' assessment is that this species is highly unlikely to occur in the project area due to an absence of suitable habitat.

Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)

The Southern Brown Bandicoot or Quenda is listed as a Priority 5 species by the DEC. Quenda prefer dense scrub (up to one metre high), often in or near swampy vegetation. They will often feed in adjacent forest and woodland that is burnt and in areas of pasture and cropland lying close to dense cover. Major threats to Quenda include habitat fragmentation and loss of habitat on the Swan Coastal Plain and Wheatbelt, fire in fragmented habitat, predation by foxes, predation of young by cats and predation around residential areas by dogs.

Coffey Environments recorded one individual in the Jarrah/Sheoak Woodland habitat at site BH2 and two individuals in the Heath Shrubland habitat at site BH3 (Figure 11). It is therefore likely that the Quenda occurs at low densities in all habitats throughout the project area. Any clearing of vegetation is likely to result in a loss of habitat for the Quenda.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed as Migratory under the *EPBC Act 1999*. This species is found across the better-watered parts of Western Australia including islands. It prefers lightly wooded, preferably sandy, country near water. It is a resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor, wintering from the Gascoyne north to Indonesia. It moves south mainly in late September and early October and north from February to April. It is scarce to very common across its range.

Coffey Environments' assessment is that the Rainbow Bee-eater, although possibly occurring but not recorded in the project area, is unlikely to rely on the project area for survival.

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

The White-bellied Sea Eagle is listed as Migratory under the *EPBC Act 1999*. White-bellied Sea Eagles are most commonly found around the coastline; however, they have been reported many kilometres inland.

This species was not recorded during the survey but Coffey Environments' assessment is that the White-bellied Sea Eagle possibly occurs in the project area, however it is considered unlikely to rely on the project area for survival.

Grey Plover (*Pluvialis squatarola*)

The Grey Plover is listed as Migratory under the *EPBC Act 1999*. The Grey Plover is a common migrant from the Arctic and is common along the western and southern coasts of Australia. On the coast it usually inhabits marine shores of estuaries or lagoons on broad, open mudflats, sandy bars or beaches, rock platforms and reef flats of rocky coasts. It can be found inland but still near the coast on margins of salt lakes and swamps.

Coffey Environments' assessment is that the Grey Plover is highly unlikely to occur in the project area due to an absence of suitable habitat.

Project Area Analysis

Similar fauna species and numbers were recorded between sites within each fauna habitat type (Figure 11). The Honey possum was trapped at every Jarrah/Sheoak Woodland site other than BH1 and no Elapidae species were recorded from sites BH7 and BH14. No Myobatrachidae or Gekkonidae fauna species were recorded from site BH3 within the Heath Shrubland habitat and few differences were observed between sites in the Wetland Mosaic habitat. Species accumulation curve modelling revealed 31 of the 32.9 predicted species were recorded from the project area. Moderate diversity indices were revealed from all fauna habitats in the project area. Most sites in the Jarrah/Sheoak Woodland habitat showed similar Fishers Alpha indices (5.26 – 5.72) except BH14 (3.68). Similarly, two sites in the Heath Shrubland habitat had moderate Fishers Alpha indices (5.40 – 5.43), while site BH10 was higher in comparison (6.47). The greatest range of diversity estimates between vertebrate trapping sites was shown amongst the Wetland Mosaic habitat (Fishers Alpha indices: 4.06 – 6.22). All sites within the project area showed very even trapped vertebrate assemblages with values ranging from 0.37 – 0.57 across all fauna habitats using Smith and Wilson's B measure.

Similarity indices based on Morisita-Horn calculations demonstrated 50% of sites with high similarity (greater than 0.8) in the Jarrah/Sheoak Woodland habitat. Only 40% of Wetland Mosaic habitat sites showed high similarity. In comparison, all sites in the Heath Shrubland habitat were significantly similar.

In addition to those species trapped, a further six native species were opportunistically recorded from habitats in the project area. These included the Western Grey Kangaroo and five species of bat. Spotlighting surveys showed low numbers of WRPs throughout the project area. Two exceptions were the central and eastern sections of the project area – both Jarrah/Sheoak Woodland habitat – where most WRPs were observed (Figure 11). These two areas are rated as high quality habitat because they include remnant old-growth Jarrah/Sheoak Woodland habitat and support higher numbers of conservation significant fauna species. Furthermore, the majority of trees with suitable hollows for WRPs and the Masked Owl in the project area are found within these two areas.

One additional habitat patch of high priority is the western section of Heath Shrubland habitat in the project area. This section contains mature stands of *Banksia* and Black-Cockatoos were observed feeding in this area during both the December 2006 and March 2007 surveys. The Heath Shrubland habitat also provides a link to fauna habitat adjacent to the project area dissected only by Lower King Road.

Excellent habitat connectivity currently exists in the central and south west sections of the project area (Lots 1000, 1001, 476 and Part Lot 1) (Figures 11 & 12). Few tracks or roads dissect these areas and fauna are likely to disperse freely among all habitat types. Similarly, Oyster Harbour foreshore on the eastern part of the project area provides a continuous link to north and south of the coastal Jarrah/Sheoak woodland habitat (Figures 11 & 12). In comparison, the northern and eastern sections of the project area (Lots 37, 38, 39, 2 and part of 286) are characterised by isolated pockets of Jarrah/Sheoak Woodland, Heath Shrubland and Wetland Mosaic surrounded by Cleared/Pasture (Figures 11 & 12).

Regional Comparison and Analysis

Most species captured within each fauna habitat from the project area were also recorded regionally and in similar numbers. Two exceptions in the Jarrah/Sheoak Woodland habitat were the Honey Possum where none were recorded regionally but 12 individuals trapped in the project area and *Varanus rosenbergi* where no individuals were recorded from the project area but four were recorded at Yakamia. In the Heath Shrubland habitat, one frog species dominated the amphibian assemblage (*H. eyrei*) and 26 individuals of Grey-bellied Dunnart were captured regionally compared to a diverse amphibian assemblage and no Grey-bellied Dunnarts in the project area. Species accumulation curve modelling showed 34 of the predicted 34.4 species were recorded from the project area and region sites. A greater range of diversity estimates (Fisher's Alpha indices) for the regional Jarrah/Sheoak Woodland habitat sites were calculated (2.70 – 8.62) compared to the project area sites (3.68 – 5.72) which is likely due to the high number of regional sites surveyed. In comparison, lower diversity estimates were found regionally (Fisher's Alpha indices; 4.17 – 5.30) than those of the Heath Shrubland habitat sites in the project area (5.40 – 6.47). Historically, Shannon Weiner and Simpsons Index diversity indices were often calculated for fauna assessments and were performed here for comparison to other reports. However, all historical reports found from the greater Albany region did not contain any diversity estimates and therefore, no direct comparisons could be made. Fisher's Alpha diversity indices were used here because it is the most appropriate and accurate diversity estimate with the vertebrate trapping scheme used. Similar trapped vertebrate assemblages between the project area and regionally within both the Jarrah/Sheoak Woodland and Heath Shrubland habitat sites were found with evenness values ranging from 0.39 – 0.67 using Smith and Wilson's B measure.

Similarity indices based on Morisita-Horn calculations showed 48% of sites between the project and regional areas with high similarity (greater than 0.8). A comparable percentage of similarity indices (47%) were found between the two areas in the Jarrah/Sheoak Woodland habitat. However, higher similarity indices in the Heath Shrubland habitat between the project area and regional sites were calculated with 57% of sites having a similarity value greater than 0.8.

In addition to those species trapped, a further six native species were opportunistically recorded from habitats at Bayonet Head. The trapping program did not indicate high small mammal species richness within the project area. A key factor for the low small mammal species richness may be the three introduced species opportunistically recorded: the cat, fox and European rabbit.

Three conservation significant mammal species were recorded regionally. The Western False Pipistrelle was tentatively identified from the echolocation surveys within the Jarrah/Sheoak Woodland habitat in the project area. This species was also recorded during the Southdown mine site survey (*ecologia*, 2007). Quenda were recorded from both the Jarrah/Sheoak Woodland and Heath Shrubland habitats but in very low densities. The close proximity to residential land and observations of feral cats and foxes is likely to impact on the Quenda populations and densities. Higher numbers of WRPs were recorded from the Jarrah/Sheoak Woodland habitat at Emu Point compared to project area and Yakamia. The higher density of WRPs recorded at Emu Point was possibly due to the dominance of Peppermint trees, which are a significant food resource for the species. Predatory species such as foxes and cats may also play a role in their low numbers.

Avifauna

Eighty six bird species were recorded from the sites surveyed in the Albany region, with 78 of these species being recorded within the project area. Most bird species recorded within the project area were also recorded from Yakamia and Emu Point. Species accumulation curve modelling was conducted to predict the number of species expected in the project area by plotting the cumulative number of species discovered in a defined sampling area against increasing levels of survey effort (Thompson, *et al*., 2007). Species accumulation curve modelling revealed 86 of the predicted 87.9 species were recorded from the project area and region sites suggesting sufficient surveys were conducted. Bird species of conservation significance recorded in the project area included Black-Cockatoos (Carnaby's, Baudin's and Forest Red-tails). The bird assemblage recorded within the project area was more diverse than the bird assemblage recorded at Emu Point and Yakamia (Appendix 3). The bird assemblage recorded within the project area at Bayonet Head was reasonably similar to that of Yakamia but Emu Point was most dissimilar with less than half the bird species observed (38) (Appendix 3). This is likely due to the small available habitat at Emu Point compared to Yakamia and Bayonet Head. Many of the bird species can be maintained in the project area provided sufficient habitat is retained. Specifically, if areas of the Wetland Mosaic habitat and the old-growth Jarrah/Sheoak Woodland habitat in the western, central and eastern sections of the project area are preserved, much of the key factors important to the bird assemblage will be kept.

Amongst the bird species recorded within the project area, a number of these are considered regionally significant habitat specialist. Although not formally listed with State or Commonwealth legislation, species such as the Southern Emu Wren, Western Thornbill, Grey Currawong and White-breasted Robin are considered to be of local significance in the project area because they are at the limit of their distribution, or they have a restricted range, or possibly have declining populations (Government of WA, 2000a).

Short Range Endemic Invertebrate Fauna

The species identifications and comments provided by WAM indicate that the invertebrate species recorded during the survey are typical of many environments in the Albany region (unpub. data for the Western Australian Museum, Technical Appendix D). Most, if not all, of the species collected are found throughout relatively large regions of south-west Australia. The snail species identified from Bayonet Head are introduced from Europe and not considered to be native to Australia. The conservation significance of some of the specimens collected is unknown due to the uncertainties with the taxonomy of a number of the groups. However, no specimens are thought to represent significant SRE species (Dr M. Harvey, pers. comm.).

Inter Habitat Comparisons

Project Area Analysis

Similar numbers of species and individuals were captured between all three fauna habitat types (Jarrah/Sheoak Woodland, Heath Shrubland and Wetland Mosaic habitat) in the project area. Vertebrate fauna trappable species ranged from 21 (405 individuals) in the Jarrah/Sheoak Woodland habitat to 27 (710 individuals) in the Wetland Mosaic habitat in the project area. Furthermore, most species captured were recorded from two or more fauna habitat types. Conservation significant species were recorded from all three fauna habitat types. Western Ringtail Possums were recorded from Jarrah/Sheoak Woodland and Wetland Mosaic habitats and are likely to make use of both habitat types for food requirements and dispersal. Quenda were captured from both Jarrah/Sheoak Woodland

and Heath Shrubland habitat and utilise the two fauna habitats for food requirements and nesting. Although fauna habitat was not generally recorded for birds, Black-Cockatoos were observed feeding in Heath Shrubland habitat due to the concentration of *Banksia* species and may make use of hollows in the Jarrah/Sheoak Woodland habitat for breeding and rearing young.

Regional Analysis

Regional comparisons from sites at Yakamia and Emu Point to the project area showed similar fauna assemblages. Species accumulation curve modelling revealed 96% of the predicted vertebrate trappable species were recorded from combined surveys in the Jarrah/Sheoak Woodland and Heath Shrubland habitat. In contrast, 28 of the predicted 37 species were recorded from the surveys conducted in the Wetland Mosaic habitat (75%). Despite a lower number of species captured from the Wetland Mosaic habitat, the 28 species still lies within the 95% confidence intervals of the expected number of vertebrate species based on Chao 2 estimates and sufficient surveys were carried out in all fauna habitats. Similarity indices based on Morisita-Horn calculations show all fauna habitats are very similar with values ranging from 0.91 – 0.93 indicating none of the fauna habitats is likely to be unique in the greater Albany region. However, fauna habitat on the western area of Oyster harbour is highly fragmented. The project area, Emu Point and Yakamia are part of the few remaining moderate sized fauna habitats remaining in this area and further fragmentation will cause additional loss in numbers and habitat of several species, particularly conservation significant species. However, the loss is unlikely to be significant to the species as a whole.

Biodiversity Value

The EPA *Position Statement No. 3* indicates an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels, and its ecological functional value at the ecosystem level (EPA, 2002).

From a vertebrate fauna perspective, approximately half of the vegetation on the project area could be described as high quality or very good quality. All species recorded within the project area were also recorded from other sites surveyed regionally. At a local scale, the trappable fauna assemblage within the Jarrah/Sheoak Woodland and Heath Shrubland habitats of the project area were very similar to the same habitats surveyed regionally. The Heath Shrubland habitat within the project area was slightly more diverse than that outside the project area, whereas the Jarrah/Sheoak Woodland habitat within the project area was slightly less diverse than that outside the project area. The trappable fauna assemblage of the Wetland Mosaic habitat within the project area was unable to be compared regionally as no replicate trapping data were available. The species recorded in the project area are mostly wide-ranging species that occur in a range of habitats across the region and many were recorded from other habitats surveyed in the Albany region such as Emu Point, Yakamia and Southdown (86% of amphibians; 100% mammals; 90% of reptiles; 86% of birds; Appendices 2 & 3).

Conservation Significant Species

Carnaby's and/or Baudin's Black-Cockatoo, Forest Red-tailed Black-Cockatoo, Western Ringtail Possum, Quenda and Western False Pipistrelle were recorded within the project area and are important considerations for planning design. Other species of conservation significance that may occur in the project area, but were not recorded include the Southern Brush-tailed Phascogale, Carpet Python, and Masked Owl.

Black-Cockatoos were recorded feeding on *Banksia* and *Eucalyptus* species in the Jarrah/Sheoak Woodland habitat of the project area. More than 40 trees containing tree hollows that are potentially

suitable for nesting Black-Cockatoos were recorded in the project area. The Western Ringtail Possum was recorded in very low densities within the Jarrah/Sheoak Woodland and Wetland Mosaic habitats in the project area. Three Quenda (two in the Heath Shrubland and one in the Jarrah/Sheoak Woodland) were recorded within the project area and is likely to occur throughout the project area at low densities. The Western False Pipistrelle was tentatively recorded within the project area and is likely to utilise the Jarrah/Sheoak Woodland habitat for roosting and feeding.

Although not listed as conservation significant species, a resident pair of Ospreys was located within the project area. Local naturalists indicate the birds have bred successfully multiple times in the past. The tree containing the Osprey collapsed between December 2006 and March 2007, however, a new nest has been built north of the previous location (Figure 11).

Fauna Habitat

Fauna habitat remaining in the project area is generally 'very good' quality (119.9ha) with 'high' quality (0.9ha), 'good' (20.6ha), disturbed (15.6ha) and highly degraded (33.3ha). The habitat supports a diverse assemblage of generally wide-ranging species that occur within *Eucalyptus sp*. habitats across the region. The project area is bordered by residential/rural development to the north and south but links Oyster Harbour and other areas of remnant vegetation in an east-west direction. The low forests and woodlands of Jarrah, Albany Blackbutt and Sheoak to the west, north and east of Albany have been extensively cleared for agriculture. This Jarrah Forest subregion is rated as a high priority for reservation by McKenzie *et al*. (2003). Given the proximity to residential and rural development, a surprisingly low number of introduced fauna species were recorded within the project area. The Jarrah/Sheoak Woodland and Heath Shrubland habitats are considered to have a high ecological value as they generally contain 'very good' quality habitat and support a diverse but typical fauna assemblage of the region with few introduced fauna, and in addition they provide habitat for a number of conservation significant fauna. The Wetland Mosaic habitat is also important as it provides habitat for the Western Ringtail Possum and Quenda.

It is not possible to assess the biodiversity value at a genetic level based on the information available. However, the project area does not contain isolated fauna habitat. Eastern sections of the project area are linked to Emu Point in the south and northern habitats along Oyster Harbour and the western sections are separated from fauna habitat outside the project area by Lower King Road (but accessible to more mobile species such as birds). Therefore, the project area is unlikely to be genetically isolated.

Commonwealth EPBC Act 1999 Referral

The project area contains a number of species listed as significant under the Commonwealth *EPBC Act 1999*. The clearing of vegetation will result in the loss of feeding habitat for the two species of Black-Cockatoo listed under the *EPBC Act 1999*. There will also be loss of WRP habitat and individuals during the development. However, due to the low density of WRPs and the fact that significant and large areas of Black-Cockatoo feeding areas are near to the project area the clearing is considered to not be significant under the *EPBC Act 1999* and therefore, Coffey Environments considers that referral to DEWHA is not required. Reserves within a 5km radius which contain significant vegetation and habitat and also have a purpose considered to be compatible with conservation of habitat are listed below:

- Mt Martin Reserve No. 33308 (Purpose: Regional Botanic Park managed by DEC; Area: 403ha)
- Gull Rock National Park (Purpose: National Park, Area: 2,593ha)

- Bakers Junction Nature Reserve No. 30463 (Purpose: Conservation of Flora and Fauna, Area: 998ha)
- Bill Gibbs Reserve and associated Reserve No. 329 (Purpose: Recreation (managed for conservation values) Area: 241ha)
- Bon Accord Road Reserves 34934 and 3490 (Purposes: Government Requirements and Parklands; Area 127ha)
- Chester Pass Reserve 22892 (Purpose: Conservation and Protection of Flora, Area: 149ha)
- Yakamia Creek, Lake Seppings (including Lake Seppings Delta and Wesley Maley Reserve) (Purpose: Conservation, Parklands and Recreation; Area 228ha)
- Bayonet Head Foreshore (Purpose: Public Recreation and Foreshore Protection, Area: 40ha)

It is considered unlikely that these Crown Land areas would be cleared with subsequent loss of habitat for species such as the Black-Cockatoo.

5.3.5 Potential Impacts

The Plan for Development (Figure 3) proposes to retain 39.6ha of vegetation for fauna habitat as shown in Figure 11 and Appendices 2 and 3. Areas and values to be retained are shown in Table 13. A mix of habitats will be preserved, including Wetland Mosaic, Heath and Jarrah/Sheoak Woodland. These areas will be managed for their conservation and passive recreation values. It is noted that the habitats to be retained are not always adjacent, due to the existing distribution of habitat types. Therefore the retained habitat will be fragmented with less (or no) linkage compared to the current area. This may result in some fauna species not being able to access different types of habitat. However, it is also noted that some fauna species (e.g. WRPs) are unlikely to migrate across some existing intact habitat types.

The proposed conservation POS on Lots 1000 and 1001 retains Black Cockatoo foraging habitat, habitat and hollows where WRPs have previously been observed (including dreys) and significant wetlands. Connectivity has been retained by supplementing the current foreshore Reserve of Oyster Harbour to strengthen and secure the current north south link. In addition a balance has been struck between the creation of conservation POS with a linear component that has a consolidated are to reduce edge effects (15ha on Pt Lot 1 Yatana Road, Loc 476 Sibbald Road and Lot 42 Lower King Road).

The proposed development will result in the clearing of some Heath and Jarrah/Sheoak Woodland habitats. The proposed clearing of habitat is likely to result in a loss of some of the more sedentary species, with more mobile species able to move to retained bushland areas or to adjacent areas off site that have similar habitat.

TABLE 13

Areas of Vegetation to be Retained in POS Within the Plan for Development Area (and Bayonet Head ODP Area)

Public Open Space in Plan for Development area (Figure 3)	Area of POS	Fauna Habitat Quality and Type	Values Retained	Species to benefit
POS 1 Lots 39 and 38 Elizabeth Street.	2.1ha, width of 30 to 90m. Area retained for: Natural values: 0.7ha Low key recreation: 0.1ha Water Resource Management: 1.25ha	Currently Highly Degraded cleared/pasture and seasonal soak line.	Linkage and wetland values when revegetated.	General.
POS 2 Lot 38 Elizabeth Street.	5.7ha, (part of 20ha POS area on Lots 500 and 2 Alison Parade) Area retained for: Natural values: 5.5ha Low key recreation: 0.2ha Water Resource Management: 0ha	Good Quality Fauna Habitat, Wetland Mosaic.	Wetland habitat, linkage to Oyster Harbour.	General.
POS 4 Lot 3 Alison Parade, Lot 37, 38 and 39 Elizabeth Street (and Lot 500 Alison Parade- not part of this SEA but part of water resource management area).	3.7ha. Area retained for: Natural values: 2.5ha Low key recreation: 1ha Water Resource Management: 0.2ha	Wetland, Lake and Sheoak Closed Forest.	Wetland habitat, linkage to Oyster Harbour.	General.
POS 7 Lot 39 and 38 Elizabeth Street.	Area to be determined.	Good Fauna Habitat, Wetland Mosaic.	Water Management, Potential East – West Linkage.	General, Western Ring-tailed Possum, Quenda (if revegetated).

Public Open Space in Plan for Development area (Figure 3)	Area of POS	Fauna Habitat Quality and Type	Values Retained	Species to benefit
POS 8 Foreshore – Oyster Harbour; Lot 286 and Lot 2 Alison Parade.	4ha, 50 to 210m width by 500m long. Area retained for: Natural values: 3.8ha Low key recreation: 0.2ha Water Resource Management: 0ha	Jarrah/Sheoak Woodland with hollows.	Foraging habitat for Black Cockatoos, habitat and shelter for Western Ring-tailed Possum, significant linkage to north and south, Osprey nest.	Black Cockatoos, Western Ring-tailed Possum, Quenda.
POS 9 Lot 286 Alison Parade.	1.9ha with water management node. Area retained for: Natural values: 1.1ha Low key recreation: 0.3ha Water Resource Management: 0.5ha	Melaleuca wetland.	Wetland habitat.	General.
POS 10 South eastern area; Pt Lot 1 Yatana Road, Lot 476 Sibbald Road and Lot 42 Lower King Road.	13.5ha, narrowest linkage is 50m Area retained for: Natural values: 12.2ha Low key recreation: 1ha Water Resource Management: 0.3ha	Heath (contains wetland), Jarrah/Sheoak Woodland with hollows.	Foraging habitat, shelter and hollows.	General, Black Cockatoos, Western Ring-tailed Possum, Quenda.
POS 11 Location 476 Sibbald Road.	0.8ha Area retained for: Natural values: 0.8ha Low key recreation: 0ha Water Resource Management: 0ha	Very Good Fauna Habitat, Heath Shrubland, connected to proposed POS on adjacent Lot 9000 to make up a total of 4ha of POS).	Wetland habitat, foraging habitat and shelter.	General, Quenda.
POS 12 North west boundary; Lot 1001, Lower King Road.	4.2ha Area retained for: Natural values: 3.7ha Low key recreation:	Heath (contains wetland).	Foraging habitat and shelter.	General, Black Cockatoos, Quenda.

Public Open Space in Plan for Development area (Figure 3)	Area of POS	Fauna Habitat Quality and Type	Values Retained	Species to benefit
	0.5ha Water Resource Management: 0ha			
POS 13 South western corner; Lot 1000 and Lot 1001, Lowe King Road.	11.2ha Area retained for: Natural values: 9.2ha Low key recreation: 1ha Water Resource Management: 1ha	Wetland mosaic and Heath.	Foraging habitat and shelter.	General, Black Cockatoos, Western Ring-tailed Possum.
POS 14 Lot 1000 Lower King Road.	2.5ha Area retained for: Natural values: 0ha Active recreation: 2.5ha	POS for active recreation, limited retention of vegetation.	Peripheral trees, limited vegetation.	Limited.
POS within BHODP Area but outside the Plan for Development for this SEA (described to show related linkage and water management function)				
POS 3 Lot 500 Alison Parade.	14.4ha	Very Good Quality Fauna Habitat, Wetland Mosaic, Lake.	Wetland habitat, linkage to Oyster Harbour.	General.
POS 5 Lot 9000 Elizabeth Street.	4ha.	Currently Highly Degraded Fauna Habitat, cleared/ pasture.	Water Management, Active Recreation Node, Potential Linkage via overland water flow system.	General, limited.
POS 6 Lot 47 Lower King Road.	4.1ha.	Currently Highly Degraded Fauna Habitat, cleared/ pasture.	Water Management, Active Recreation, Potential East – West Linkage.	General.

Potential impacts to fauna from the proposed development identified in the risk assessment include:

Direct Impacts

- Habitat loss and fragmentation through clearing of native vegetation; and
- Loss of fauna during the clearing and construction process.

Indirect Impacts

- Degradation of fauna habitat due to invasion and spread of weeds and dieback; and
- Increase in feral and domestic fauna in the area resulting in increased predation pressure.

Direct Impacts

The proposed development will result in the clearing of native vegetation and consequential loss and alteration of fauna habitat. Besides the initial mortality of fauna during clearing there will also be an ongoing indirect impact, largely consisting of the loss and degradation of habitat resources including feeding areas and shelter sites.

Removal of vegetation from the project area will require species that utilise these areas to find alternative suitable habitats. Some species and individuals will remain in the POS where vegetation is retained for conservation purposes. However, some will seek new areas during the clearing and development stages (or alternatively could perish) and some that move away may return to the area once the development and construction work has ceased.

The clearing of vegetation in the project area may impact on species of conservation significance, including the loss of habitat for the Western Ringtail Possum, Western False Pipistrelle and Quenda and the loss of feeding habitat for the three species of Black-Cockatoo.

The loss of fauna habitat is not considered to be significant at the State or Commonwealth level.

Indirect Impacts

Increased human activity is often associated with a change in fire regimes, leading to degradation of natural ecosystems. Fire has been identified as one of the threatening processes in the Southern Jarrah Forest subregion and a number of small mammal and bird species rely on long unburnt vegetation. Provided that fire prevention strategies are implemented, fires are unlikely to be a significant threat to native fauna species in the vicinity of the project area.

Introduced plant species may invade areas of cleared native vegetation or areas otherwise disturbed by humans. Introduced plant species may replace native species that provide shelter or foraging areas for native fauna. Major changes to the structure of vegetation will alter the fauna habitat and consequently may influence fauna species composition. Preparing and implementing a weed management plan will largely reduce their threat to native fauna species. Dieback caused by the pathogen *Phytophthora cinnamomi* is a threat to the susceptible native vegetation in Lots 1000 and 1001. Dieback has been recorded within this area (Coffey Environments, 2008a).

An increase in human activity is also often associated with an increase in the abundance of introduced species, such as cats and dogs.

Impacts of light in extreme conditions may include the disturbance of nocturnal fauna activities. Extremely loud or irregular noises may affect the activities some fauna species. It is not considered

that light and noise from the proposed residential development are likely to have any more of an impact on fauna species than is currently the case with the existing residential area.

Tables 20-22 of Technical Appendix D provides a detailed summary of the risk assessment associated with this project.

5.3.6 Management Strategies

Retention of representative areas of the three key habitat types is achieved in the Plan for Development (Figure 3), through strategic placement of conservation POS areas that retain consolidated sections of native vegetation, some of which are elongated to act as habitat corridors (for areas and fauna habitat quality see Table 14).

Table 14

Areas of Vegetation to be Retained in POS by Fauna Habitat Quality (including other POS Functions)

POS Id	Fauna Habitat Quality	Area of Vegetation (ha)	Function of POS
1	Good	0.3	Total area of POS 1: 2.1ha
	Good	0.6	Area retained for natural values: 0.7ha
	Disturbed	0.7	Area retained for low key recreation: 0.1ha
	Highly Degraded	0.5	Area retained for water resource management: 1.25ha
2	Very Good	0.3	Total area of POS 2: 5.7ha
	Good	4.2	Area retained for natural values: 5.5ha
	Disturbed	0.2	Area retained for low key recreation: 0.2ha
	Disturbed	0.1	Area retained for water resource management: 0ha
	Disturbed	0.3	
	Disturbed	0.1	
	Highly Degraded	0.4	
4	Very Good	0.8	Total area of POS 4: 3.7ha
	Good	1.1	Area retained for natural values: 2.5ha
	Highly Degraded	1.8	Area retained for low key recreation: 1ha
8	High Quality	0.9	Total area of POS 8: 4ha
	Very Good	3.0	Area retained for natural values: 3.8ha
	Good	0.2	Area retained for low key recreation 0.2ha
9	Disturbed	1.0	Total area of POS 9: 1.9ha
	Highly Degraded	0.2	Area retained for natural values: 1.1ha
	Highly Degraded	0.1	Area retained for low key recreation: 0.3ha
	Highly Degraded	0.5	Area retained for water resource management: 0.5ha

POS Id	Fauna Habitat Quality	Area of Vegetation (ha)	Function of POS
10	Very Good	13.5	Total area of POS: 13.5ha Area retained for natural values: 12.2ha Area retained for low key recreation: 1ha Area retained for water resource management: 0.3ha
11	Very Good	0.8	Total area of POS: 0.8ha Area retained for natural values: 0.8ha
12	Very Good	4.2	Total area of POS: 4.2ha Area retained for natural values: 3.7ha Area retained for low key recreation: 0.5ha
13	Very Good	11.2	Total area of POS: 11.2ha Area retained for natural values: 9.2ha Area retained for low key recreation: 1ha Area retained for water resource management: 1ha
14	Excellent	2.5	Total area of POS: 2.5ha Area retained for active recreation: 2.5ha
	Total	**49.6**	Total area retained for natural values: 39.6ha Total area retained for low key recreation: 4.3ha Total area retained for water resource management: 3.3ha Total area retained for active recreation: 2.5ha

Notes for Table 14: See Figure 3 for details. Low key recreation areas such as pocket parks and pathways are proposed to be located in POS areas that are outside Conservation Category wetlands and associated buffers. They will be placed in disturbed sites, where possible. More detailed site planning will be undertaken in consultation with DEC, DoW and the City of Albany to prepare management plans for the POS areas. Water resource management infrastructure (basins and stream lines) will be designed to incorporate native vegetation (existing or via rehabilitation) to enhance the long term conservation values.

Black-Cockatoo feeding habitat is retained throughout the development as 'stepping stones' in conservation POS (POS areas 2, 4, 8, 9, 10, 12 and 13). The main habitat corridor will be located on Part Lot 1 Sibbald Road and continue north and south east over Lots 42 Lower King Road and Location 476 Sibbald Road through Jarrah/Sheoak Woodland habitat (POS areas 10 and 11). Connectivity will also be maintained through POS areas 6, 5, 7, 9, 4, 3, 2 and 1. It is considered that the provision of larger more consolidated POS will reduce 'edge effects' and assist in preventing weed invasion. It is considered that the provision of connection type corridors may have limited usefulness for WRP and other animals for movement and gene flow due to inherent patchiness of habitat types, social structuring and territoriality (Horskins et al., 2006). It is also considered that in an urban environment, which is divided by road reserves of approximately 20m width, it is inherently very difficult to create an effective 'ecological corridor'. However, it is considered that the retention and creation of habitat across the site will retain linkage value to significant species such as the WRP and is consistent with actions outlined in the EPBC Act Policy Statement 3.10. These actions include:

- re-creating habitat areas and corridors (e.g. streetscaping, landscape and garden plantings for areas where connectivity does not currently apply);
- planting new peppermint trees with sedge understorey to replace removed peppermints and fill gaps; and
- construct fences (where they are required) to a height that reduces the risk of dog attack (e.g. 2100mm).

An area of overland flow for water resource management on Lots 39 and 38 Elizabeth Street (POS 7) will provide a link to the Oyster Harbour foreshore as it will be revegetated to function as a natural drainage line and will join up with landscaped road reserves.

Trees with hollows will be retained where they are located in conservation POS. Where possible, hollows on trees not to be retained will be retrieved and mounted in conservation POS areas. Strengthening of linkage from west to east will be achieved through landscape planting of appropriate native trees and shrubs along road reserves between habitat refuges.

As part of the development, a Construction Management Strategy will be prepared to detail management and mitigation strategies for all vertebrate fauna affected by the development;

The Construction Management Plan will include details on vegetation clearing protocol that should be used as part of the clearing operations and treatment of fauna in this process.

A POS and Wetland Management Plan will be prepared to outline:

- The areas that will be retained as corridors and public open space (POS);
- Rehabilitation strategies for retained areas;
- Weed management;
- Fire Management;
- Signage and access;
- Public consultation and education; and
- Feral animal control.

Control measures for cats and dogs will be implemented in line with City of Albany Policy and Local Laws. Current City of Albany Local Laws require that dogs be kept on a leash at all times outside the owners' property boundary. Dogs also need to be registered with the council. The City of Albany has recently gazetted cat Local Laws that require registration and sterilisation of cats.

A public education program for new residents will be implemented describing the importance of remnant vegetation in the conservation of native fauna and the threat that domestic animals present to native fauna. This may be in the form of education pamphlets and signage in public areas.

5.4 Coastal Foreshore

5.4.1 EPA's Objective

To maintain the integrity of the coastal foreshore by maintaining its ecological functions and environmental values.

5.4.2 Applicable Legislation, Criterion or Guidance

- Western Australian Planning Commission (2003a) State Planning Policy No. 2 Environment and Natural Resources Policy.
- *Planning and Development Act 2005.*
- Western Australian Planning Commission (2003b) State Planning Policy 2.6 State Coastal Planning Policy.
- Western Australian Planning Commission Development Control Policy 6.1 – Country Coastal Planning Policy.
- EPA Guidance Statement No. 33 (B5-1 Determining foreshore reserves).
- Water and Rivers Commission (2001b) Determining Foreshore Reserves. Report RR16.
- Water and Rivers Commission (2001c) Determining Foreshore Reserves. Water Note 23.
- Water and Rivers Commission (2002) Statewide Foreshore Policy 1.

5.4.3 Existing Environment

The eastern boundary of the Plan for Development area abuts a foreshore reserve on Oyster Harbour for approximately 500m (Figure 13). The Reserve is unmanaged crown land (UCL) and comprises a steep scarp of shallow grey sand over laterite. The existing foreshore reserve is between 10 and 40 m wide. The cliff rises steeply from sea level up to 32m AHD over a distance of 65m (grade of almost 50%). The scarp contains intact native vegetation and in terms of coastal erosion risk, is considered to be stable due to its rocky and consolidated nature. Oyster Harbour is also acknowledged to have a significantly less dynamic wave action along its coastline than the open ocean and King George Sound (MP Rogers and Associates, 2007).

The area adjacent to the existing foreshore reserve contains native vegetation that is in very good to excellent condition. This vegetation comprises a closed forest of *Eucalyptus marginata*, *Allocasuarina fraseriana*, and occasional *Banksia grandis* over *Agonis theiformis*, *Melaleuca thymoides*, *Petrophile heterophylla* and *Daviesia preissii* over *Lepidosperma gladiatum*, *L. squamatum* and *Xanthosia rotundifolia*

Western ring-tail possums and Black-Cockatoos have been recorded in the proposed foreshore area (see Section 5.3) and it is considered that the vegetation forms a significant north-south link along the edge of Oyster Harbour.

At the top of the steep escarpment, there is a house with a cleared area around it, firebreaks and an eroded track which leads down the escarpment to the waters edge. There is currently no active management of the foreshore area.

5.4.4 Potential Impacts

Development adjacent to foreshore areas can lead to higher visitation levels, disturbance of native vegetation and fauna, weed invasion, erosion and impacts from invasive species. Insufficient foreshore widths, especially for low-lying or unstable coastlines can lead to future risk from storm surge and sea level rise or an insufficient area to accommodate ecological and recreation functions. Poor management of water resources can lead to decreased water quality in the receiving water body. Water and Rivers Commission (2001b, 2001c and 2002) have outlined biophysical criteria that should be considered to determine adequate foreshore reserve areas, including: vegetation, hydrology, soil type, erosion risk, geology, topography, function, habitat, climate, land use and heritage.

The Plan for Development will result in a significant increase in the width of the foreshore reserve which will result in better protection and more sustainable community use.

5.4.5 Management Strategies

WAPC (2003) State Coastal Planning Policy 2.6 objectives are to:

- Protect, conserve and enhance coastal values, particularly in areas of landscape, nature conservation, indigenous and cultural significance;
- Provide for public foreshore areas and access to these on the coast;
- Ensure the identification of appropriate areas for the sustainable use of the coast for housing, tourism, recreation, ocean access, maritime industry, commercial and other activities; and
- Ensure that the location of coastal facilities and development takes into account coastal processes including erosion, accretion, storm surge, tides, wave conditions, sea level change and biophysical criteria.

With respect to coastal setbacks, the Policy provides guidelines to assist in determining the physical setback requirement to protect facilities on the coast from the impact of coastal processes over a 100-year time frame. The formula for determining the setback depends on the type of coastline (e.g. sandy or rocky), and the short and long-term coastal processes that are happening or may happen in the future (i.e. sea level rise due to the greenhouse effect).

A rock shoreline is defined as a coast where the highest visible impact of sea action is in direct contact with lithified material. Based on site-specific investigations carried out on the coastline of the Plan for Development area, the Plan for Development has incorporated a minimum setback distance of 50m to development based on coastal stability, impact of severe storms, allowance for climate change, a factor of safety and inclusion of ecological/recreational requirements.

The Plan for Development proposes to augment the existing foreshore reserve so that it has a minimum width of 50m and maximum of 190m (Figure 13) to incorporate mature vegetation and

significant habitat features including Western Ring-tail Possum and Black Cockatoo habitat. Except for provision of essential infrastructure (e.g. emergency and recreation access), existing vegetation in the proposed foreshore will be retained, with existing cleared areas used to incorporate passive recreation node(s) and access ways. Retention of vegetation will ensure that the visual amenity of the area will not change from strategic view points around Oyster Harbour. It is proposed that a road and Dual Use Path (DUP) will separate the foreshore reserve from the residential component of the developed area.

Due to the steepness of the scarp forming the coastline, consideration has been given to the need for an adequate level area on top of the plateau to allow for incorporation of infrastructure including services, access for recreational and emergency purposes.

It is recommended that a Foreshore Management Plan (FMP) be prepared to examine the foreshore reserve/development interface through an examination of landform and vegetation characteristics, proposed land uses, potential recreation demands and infrastructure requirements. The FMP will provide clear guidelines for the future management of the foreshore reserve to address issues such as treatment of current erosion on tracks in existing UCL. Recommended management measures can then be refined to provide specifications for on ground infrastructure (car parks, look outs, passive recreation nodes etc.).

Items to be addressed in the FMP include:

- Access,
- Recreation nodes;
- Weed and fire management;
- Maintenance of fauna corridor function; and

Treatments of foreshore/development interface.

5.5 Wetlands

5.5.1 EPA's Objective

To maintain the integrity, ecological functions and environmental values of wetlands.

5.5.2 Applicable Legislation, Criterion or Guidance

- State Planning Policy 2.0 – Environment and Natural Resources Policy (WAPC, 2003a).
- Government of Western Australia (1997) Wetlands Conservation Policy for Western Australia.
- DEC (2007c) Framework of Mapping, Classification and Evaluation for Wetlands in Western Australia.
- Department of Water (2007) *The South Coast Wetland Mapping, Classification and Evaluation Project*. This evaluation methodology has not yet been endorsed by the State Wetlands Coordinating Committee.
- EPA (2004d) Position Statement No. 4 - Environmental Protection of Wetlands.
- EPA (2005) Draft Guidance Statement 33 – Environmental Guidance for Planning and Development and its references, including;
- Hill, A.L., Semeniuk, C. A., Semeniuk, V. & Del Marco, A. 1996a and b *Wetlands of the Swan Coastal Plain Volumes 2a and 2b Wetland Mapping, Classification and Evaluation* Department of Environmental protection (DEP) and Water and Rivers Commission (WRC), Perth
- Semeniuk, V & C Research Group 1998b *Preliminary Delineation of Consanguineous Wetland Suites between Walpole and Fitzgerald Inlet, Southern Western Australia* unpublished report prepared for WRC, Perth
- A Directory of Important Wetlands in Australia (Environment Australia, 2001b)
- Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998 (Government of Western Australia 1998b).
- WAPC (2006) State Planning Policy 2.9 - Water Resources.
- WRC (2001) Water and Rivers Commission Position Statement: Wetlands.

5.5.3 Existing Environment

An assessment of wetlands in the Plan for Development area has been carried out (Coffey Environments 2008b, Technical Appendix E), following the methodology described by DoW (2007) in the South Coast Wetland Mapping Classification and Evaluation Project. It should be noted that the methodology used by DoW has not yet been endorsed by the State Wetlands Coordinating Committee, but was considered appropriate for use, in consultation with DoW, Albany.

The following investigations have been undertaken:

- Refinement of wetland mapping to determine the extent of additional wetland areas within and adjacent to the Plan for Development area with reference to methodology and assessments undertaken by DoW (2007);

- Mapping and classification of the wetlands in accordance with Framework for Mapping, Classification and Evaluation for Wetlands in Western Australia (DEC, 2007c);
- Identification and assessment of the function and significance of the wetlands in a local, regional and state context;
- Identification of wetland hydrological processes including determination of which wetlands are groundwater dependant or perched (refer to Section 5.6 for wetland/hydrology relationships);
- Description and assessment of the potential direct and indirect impacts including clearing of wetland vegetation arising from the proposed development on wetlands;
- Description and assessment of potential direct and indirect impacts upon any wetlands in the Plan for Development area as a result of any changes to the local hydrology arising from the proposed development;
- Description of appropriate management mechanisms that may be implemented to ensure the integrity, functions, environmental values and long term viability of significant wetlands in the event that they may be impacted by the proposed development. These mechanisms may include but are not limited to; buffer requirements and setbacks, stormwater management, drainage, effluent management, rehabilitation and restoration, access and use, fencing and management plans;
- Description of appropriate contingency plans which may include (but are not limited to) further investigations and monitoring, consultation with DEC and DoW officers and changes to mitigation and management regimes; and
- Liaison with Albany DoW officers.

Wetlands in the Plan for Development area have been evaluated (Figure 14) and placed in the following management categories:

- Conservation (C),
- Resource Enhancement (R); and
- Multiple Use (M).

A ‘Quick Assessment Criteria’ as described in DoW (2007) was also used in the assessment. This allowed for key criteria, such as the presence of threatened species to automatically place the wetland in the Conservation category.

Development of appropriate management methodologies for the South Coast was outside the scope of the South Coast Wetland Mapping, Classification and Evaluation Project (DoW, 2007). In the absence of a specific management methodology for the South Coast, the management objectives for the Swan Coastal Plain developed by the Water and Rivers Commission (2001a) has been used. Table 15 outlines the various management categories and objectives for wetlands on the Swan Coastal Plain.

Table 15
Wetland Management Categories and Management Objectives

Management Category	General Description	Management Objectives
C – Conservation (incorporates EPA Bulletin 686 categories H and C)	Wetlands support a high level of ecological attributes and functions.	Highest priority wetlands. Objective is preservation of wetland attributes and functions through various mechanisms including: • Reservation in national parks, crown reserves and State owned land, • Protection under Environmental Protection Policies, and • Wetland covenanting by landowners. These are the most valuable wetlands and the Commission will oppose any activity that may lead to further loss or degradation. No development.
R - Resource enhancement (incorporates EPA Bulletin 686 categories O and R)	Wetlands which may have been partially modified but still support substantial ecological attributes and functions.	Priority wetlands. Ultimate objective is for management, restoration and protection towards improving their conservation value. These wetlands have the potential to be restored to conservation category. This can be achieved by restoring wetland structure, function and biodiversity. Protection is recommended through a number of mechanisms.
M - Multiple use (aligned with EPA Bulletin 686 category M)	Wetlands with few important ecological attributes and functions remaining.	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through land care. Should be considered in strategic planning (e.g. drainage, town/land use planning).

Water and Rivers Commission (2001a)

Eleven wetlands (Figure 14) are present in the Bayonet Head Plan for Development area (Coffey Environments, 2008b) and comprise the Bayonet Head and Oyster Harbour suites (DoW, 2007). The wetland types are summarised in Table 16. The wetland on Lot 1 Yatana Road was not previously identified by DoW and has been referred to in this SEA as wetland 'D'.

Wetland types (DoW, 2007; Table 16) are defined as:

- Lake – Permanently inundated basin;
- Sumpland – Seasonally inundated basin;
- Dampland – Seasonally waterlogged basin; and
- Paluslope – Seasonally waterlogged slope.

- **TABLE 16**
- **WETLAND TYPE, LOCATION AND MANAGEMENT CATEGORY**

Wetland Id and Name	Wetland Type and Suite	Location	Management Category	DOW Management Category (2007)
14 - Oyster Harbour Lake	Lake (originally Sumpland) – Oyster Harbour Suite	Lot 500 Alison Parade (outside SEA area)	Conservation (Automatic Designation for Cultural and Social Purposes, Priority Fauna Recorded)	Conservation
44 – Lower King Sumpland	Sumpland – Oyster Harbour Suite	Northern portion of Pt Lot 38 Elizabeth Street	Conservation (Automatic designation due to scarcity of Sumpland in this wetland suite)	Conservation
63 – Metcalf Sumpland	Sumpland	Lot 286 Alison Parade	Multiple Use	Multiple Use
62 – Elizabeth Heights Wattie Swamp	Dampland – Oyster Harbour Suite	Lot 15 Hooper Road and the southern portions of Lot 38 and Pt Lot 39 Elizabeth Street	Resource Enhancement	Resource Enhancement
8 – Bayonet Head Dampland Central (linked to No 57)	Paluslope – Bayonet Head Suite	Eastern portion of Loc 476 Sibbald Road	Conservation (Automatic Designation as Priority Fauna Recorded)	Conservation
29 – Bayonet Head West Paluslope	Paluslope – Bayonet Head Suite	Southern portion of Lot 1001	Conservation (Automatic Designation due to Aboriginal Heritage Site and Priority Fauna Recorded)	Conservation
31 – Bayonet Head North West 2 (linked to No. 40)	Paluslope - Bayonet Head Suite Perched Groundwater	Northern portion of Lot 1000	Conservation (Automatic Designation due to Priority Flora and Fauna Recorded)	Resource Enhancement
40 - Bayonet Head North	Paluslope - Bayonet Head	Northern portion	Conservation	Resource

Wetland Id and Name	Wetland Type and Suite	Location	Management Category	DOW Management Category (2007)
West 1 (linked to No. 31)	Suite Perched Groundwater	of Lot 1000		Enhancement
41 – Bayonet Head North	Paluslope – Bayonet Head Suite	North-western portion of Lot 1 Yatana Road	Resource Enhancement	Resource Enhancement
57 – Bayonet Head Paluslope East (linked to No. 8)	Paluslope – Bayonet Head Suite	Eastern portion of Loc 476 Sibbald Road	Conservation	Conservation
D	Paluslope Perched Groundwater	Central eastern portion of Lot 1 Yatana Road	Conservation (Priority Fauna Recorded)	Not identified by DoW

The wetland and hydrological assessments (Section 5.6) have clarified the nature and extent of wetland and assisted in determining how the ecological and hydrological functions and human use values may be managed in the Plan for Development area. It should be noted that wetlands were mapped using a combination of vegetation association mapping and perched groundwater expressing at ground surface. Wetland mapping is generally consistent, or includes larger areas that those mapped by DoW (2007).

A description of the hydrological function of the wetlands is summarised in Section 5.6.3 (Groundwater Levels) and Technical Appendix H.

The hydrological study (Crisalis International, 2008) indicates that a buffer zone of 30-50m around wetland 29 (Lot 1000) would allow a sufficient area to collect rainfall to maintain the groundwater levels for the paluslope vegetation. This is because the vegetation associated with the paluslope wetlands 31, 40 and D on the plateau on the upper reaches of the catchment derive water from localised perched shallow aquifers, with water being present over summer periods in these areas in sands above a relatively thick (1-1.5m) layer of clay. These areas appear to be recharged periodically by summer rainfall, although there is insufficient data to confirm this (Crisalis, 2008). Natural recharge from rainfall falling on the inferred areas of perched water rapidly recharges the perched groundwater zones above what appears to be thicker clay soils than elsewhere on the plateau. Although there is likely to be slow leakage through the clays to the deep groundwater system and lateral drainage down the hydraulic gradient, it seems likely that there is sufficient water retained within the perched zones or within the thicker clay soils to maintain the paluslope wetland vegetation over summer periods. Crisalis (2008) predicts that urban development would be unlikely to impact on recharge rates, if development was kept outside a relatively small buffer zone (e.g. 30-50m) from the wetland areas.

A buffer zone of between 30m and 50m is considered to be appropriate for wetlands 8 and 57 (Figure 17) as these wetlands already have adjacent urban development. In addition, an unmade road reserve and sewer pipelines associated with it bisects the wetland and has degraded the area significantly.

Wetland buffers based on the hydrological study (Crisalis, 2008) are shown in Figure 3. The EPA (2008a) generally requires a minimum buffer of 50m around wetlands with the exact buffer width dependent on wetland values, proposed activities, and threats.

5.5.4 Potential Impacts

Development of the Plan for Development area for residential purposes has the potential to directly and indirectly impact on the wetlands through activities which may include the following:

- Altered hydrological regimes (ground and surface water flow);
- The application of nutrients and use of chemicals in the catchment associated with future land uses;
- Erosion and the export of sediment through vegetation clearing and construction activities;
- Inappropriate stormwater management;
- Introduction of weed and pest species;
- Dumping of rubbish and increased fire frequency; and
- Increased human activity in wetland areas.

5.5.5 Management Strategies

All Conservation Category wetlands are proposed to be retained in the Plan for Development. The development may involve modification or clearing of wetlands with a Resource Enhancement or Multiple Use management category.

The following elements have been incorporated in the Plan for Development (Figure 3):

- A buffer distance of 30 - 50m around wetland dependent vegetation depending on hydrological requirements (Section 5.6).
- All areas of good quality native vegetation within Conservation category wetlands and their buffers will be managed for their ecological values, while allowing for integration into an urban landscape as conservation POS.
- Passive recreation opportunities (such as boardwalks, lookout/decking etc) are considered acceptable within degraded areas in close proximity to wetlands.
- Direct drainage from any future subdivision areas into wetlands will not occur. Treated stormwater may need to be directed into wetland areas if catchment areas are developed, to maintain pre development water levels. Treatment may include detention or infiltration swales, filter strips and nutrient stripping features.
- Degraded portions of wetlands and buffers (e.g. Multiple Use wetland 63, Resource Enhancement wetland 62) are proposed to contain stormwater management infrastructure (such as swales and detention basins) depending on more detailed planning at the subdivision stage. It is proposed that the areas be rehabilitated to enhance the condition and function of these areas.

- A stormwater basin is proposed to be placed in the relatively degraded southern area of Conservation Category wetland 29 in POS 13 (Figure 3). DoW has supported this particular stormwater treatment in past meetings (DoW pers. comm. 2008) as it would lead to rehabilitation of the area and perform a significant water management function.

Other Management strategies will include:

- The principles of water sensitive urban design will be implemented in the future development of the Plan for Development area through the preparation of a Local Water Management Strategy. This will involve the maintenance of ground water and surface water levels that maintain the values of the Conservation Category wetlands.
- Maintain pre-development hydrological regime.
- Passive recreation activities are considered suitable within the wetland areas and buffers if undertaken in a sensitive and controlled manner.
- Any areas disturbed during the construction of paths, boardwalks or other infrastructure within the wetland buffers, and existing disturbed or cleared areas within the wetland areas will be rehabilitated using local native species.
- Degraded areas within conservation POS will be rehabilitated.
- Pocket parks and similar passive and/or active recreational facilities will be incorporated into disturbed areas of POS.
- Weed management for species such as Sydney Golden Wattle and Taylorina (e.g. Wetland 29).

A monitoring program will be implemented to gather baseline information and monitor post-development impacts. The monitoring program will include monitoring of the following:

- Groundwater in the local vicinity;
- Changes in vegetation within the wetlands and buffers; and
- Rehabilitation success.

A POS and Wetland Management Plan will be prepared at the subdivision stage. The POS and Wetland Management Plan will be prepared in accordance with *EPA Environmental Guidance for Planning and Development, Guidance Statement 33* (EPA, 2008a) (Attachment B4-5 – Preparing a Wetland Management Plan) and *Guidelines checklist for preparing a wetland management plan* (DEC, 2008). Both these documents are included in Appendix 4.

5.6 Surface and Groundwater Quantity and Quality

5.6.1 EPA's Objective

To maintain the quantity of water (surface and ground) so that existing and potential environmental values, including ecosystem maintenance, are protected.

To ensure that the quality of water emissions (surface, ground, and marine) does not adversely affect environmental values or the health, welfare and amenity of people and land uses, and meets statutory requirements and acceptable standards.

5.6.2 Applicable Legislation, Criterion or Guidance

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, October 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000a);
- Australian Guidelines for Water Quality Monitoring and Reporting, National Water Quality Management Strategy, October 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000b);
- Australian Guidelines for Urban Stormwater Management, National Water Quality Management Strategy, 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000c);
- Department of Water (2004 - 2007) Stormwater Management Manual for Western Australia, 2004 - 2007;
- Department of Environment (2005) Decision Process for Stormwater Management in W.A.;
- EPA (2008b) Guidance Statement 33 – Environmental Guidance for Planning and Development;
- Australian Drinking water Guidelines (2004);
- Metropolitan Water Supply, Sewerage and Drainage Act, 1909, or Country Towns Sewerage Act, 1914;
- WAPC (2003) State Planning Policy 2 - Environment and Natural Resources Policy;
- WAPC (2006) State Planning Policy 2.9 - Water Resources; and
- Department of Water (2008) Urban Water Management Plans.

5.6.3 Existing Environment

An assessment of the surface water flow has been undertaken for the Plan for Development area by PPK Environment (2000), Technical Appendix G. A hydrology assessment in the southern portion of the Plan for Development area has been undertaken by Crisalis Pty Ltd (Crisalis, 2008) in Technical Appendix H.

There is little historical information on regional groundwater beneath the Bayonet Head area (Crisalis, 2008), although bores identified on low lying land to the south of the Plan for Development area are possibly associated with a regional groundwater table in dune sands. The shallow groundwater levels in these bores at elevations just above sea level indicate that groundwater associated with the Bayonet Head paluslope wetlands has little direct connection with groundwater on the lower lying ground around Oyster Harbour (the shallow groundwater system beneath the site is a separate and distinct hydrological system, localised to the higher ground). The thin sands and laterite on the site were not considered to be prospective for groundwater supplies by Moncrieff (1992) because of their thin and discontinuous nature. However, shallow perched water tables were identified as occurring within the sands on higher ground in the landscape above the regional water table. These areas have been mapped as wetlands where wetland vegetation occurs (DoW, 2007). There are no permanent surface water courses on the site, although there is evidence that a seasonal creek runs south from a wetland in Lot 1000. A large permanent lake exists on Lot 500 Alison Parade, with an associated wetland on Lot 38 Elizabeth Street.

Surface Water

A drainage study was undertaken for the Bayonet Head area by PPK Environment and Infrastructure in 2000 (PPK, Technical Appendix G) and has been adopted by the City of Albany for use in the development of the Bayonet Head Outline Development Plan area. This study identifies:

- Infiltration capacity of the soil types;
- Extent of sub-catchments;
- Wetland areas;
- Drainage analysis;
- 100 year ARI (Average Recurrence Interval) flood route;
- Calculation of sizes required for drainage basins;
- Mechanisms to ensure that stormwater flows were restricted to pre-development volumes; and
- Mechanisms to minimise nutrient and sediment impacts on Oyster Harbour.

The Plan for Development area largely drains to Oyster Harbour via the lake on Lot 500 Alison Parade. This catchment, known as the Bayonet Head Greater Catchment (BHGC) is made up of sub-catchments B, C, D, F and H (Figure 15 and Table 17). This catchment slopes down to the north from the top of the plateau around Lot 1001 Lower King Road. The catchment discharges from the lake on Lot 500 Alison Parade and along Elizabeth Street to Oyster Harbour via and open and piped drainage system.

Sub-catchment A (38.6ha on Lots 1000 and 1001 Lower King Road), drains to Oyster Harbour via Yakamia Creek. Sub-catchment E (23.5ha) drains north-west adjacent to Lower King Road and is largely outside the Plan for Development Area (Figure 16).

As shown in Figure 15, the BHODP area contains three main catchments with 10 sub-catchments (PPK, 2000). Table 17 shows calculations for pre and post development flows for selected subcatchments. The Plan for Development area contains parts of all these sub-catchments. Wetland areas were generally considered in PPK (2000) to ensure that water management design excluded direct drainage into areas of wetlands that were considered to have high conservation values.

The lake on Lot 500 (sub-catchment J) is significant in terms of water function (storage capacity and nutrient cycling) as well as social and environmental values. The lake is largely outside the Plan for Development area, but is an important component of the water management system to attenuate and treat peak flows. The drainage system has been designed to limit peak flows to the lake by detaining stormwater further up in the catchment using treatments at Lot, road reserve and landscape level with appropriately sized stormwater basins and drainage paths.

Table 17:

Sub-catchments for Bayonet Head Outline Development Plan Area (Wood and Grieve, 1999)

Sub-catchment	Area (ha)	Runoff Coefficients[1]		Equivalent Impervious Area (Undeveloped)	Equivalent Impervious Area (Developed)	1/10 Year Flow Undeveloped (l/s)	1/10 Year Flow Developed (l/s) [2]
		Undeveloped 'C'	Developed 'C'				
A[3]	38.6	0.12	0.47	4.92	19.25	540	2080
B[4]	30.4	0.14	0.45	3.64	11.7	450	1430
C[4]	29.6	0.12	0.48	4.06	14.05	430	1630
D[4]	55.4	0.22	0.49	14.52	32.1	1400	3080
E[5]	23.5	0.28	0.45	8.32	11.7	900	1420
F[4]	26.5	0.18	0.51	11.16	31.5	1070	3060
H[4]	36.7	0.23	0.49	6.25	12.25	720	1510

Coefficients calculated in accordance with the Australian Rainfall and Runoff (Institute of Engineers Australia, 1987) and Storm Drainage Design in Small Urban Catchments (Australian Road Research Board, 1987).

[2] Based on t_c (time of concentration) from undeveloped catchments and for guidance purposes only.

[3] This subcatchment flows to Yakamia Creek and then Oyster Harbour.

[4] This sub-catchments B, C, D, F, H and J Collectively make up the Bayonet Head Greater Catchment (BHGC) with water flows to Oyster Harbour via lake, Lot 500 Alison Parade.

[5] This subcatchment flows to the north-west, adjacent to Lower King Road.

Hydrological and hydraulic analysis of the Bayonet Head Outline Development Plan area has been carried out using XP-UDD (Urban Drainage Design software) as described in PPK (2000; Technical Appendix F) to model for pre and post development conditions and determine water volume and flow (Table 17 above). This has allowed for the identification of mechanisms to manage large rainfall events (100 year ARI) and flooding risk.

Calculations for detention basins are based on a one in ten year ARI, with one in ten batters and maximum water depths of 1.0m to 1.2m (PPK, 2000; Technical Appendix F). These structures are proposed to be incorporated into road reserves, active and disturbed areas of conservation POS. Initial design parameters have been calculated and are subject to specific site planning. Water management storage nodes that are proposed for incorporation in conservation POS include:

- A 1.0 ha area is proposed for the southern area of POS 13 that predominantly contains weeds such as Sydney Golden Wattle and has been assigned a vegetation condition rating of 'Good' (definition see Figure 9 and Technical Appendix C). In reality, the area of infrastructure is likely to be significantly less than 1ha. Placement of this infrastructure has been the subject of long term discussion with the Department of Water in Albany.
- A 0.5 ha basin in the central portion of POS 9 that has a vegetation condition rating of 'completely degraded' and already contains a dam.

The pipe system is designed for a one in five year ARI with greater ARI events to be accommodated by overland flow on the road system (as per Australian Institute of Municipal Engineers, 1998). Increased capacity of the Alison Parade culvert has been recommended (from 600mm ∅ Reinforced Concrete Pipe (RCP) to 900mm ∅ RCP) to cater for one in ten year ARI events. More detailed design will allow for the incorporation of features such as biofiltration systems once at the subdivision stage.

Assessment of one in 100 ARI storm events has been undertaken to determine the magnitude and route of flooding. Modelling based on the post development hydrological model and the pre-development hydraulic network has been calculated (PKK, 2000), presuming that the storage capacity of the area was saturated and the pipe system had failed, resulting in the majority of the run off being overland flow through overland flow channels and the road system. In this case, the lake on Lot 500 Alison Parade will be the dominant water storage facility. Recommendations have been made for infrastructure to cope with these flows, including a 1500mm ∅ RCP between Alison Parade and Elizabeth Street and 1500mm x 1200 mm rectangular concrete box (RCB) from Elizabeth Street to Oyster Harbour.

The road layout within the Plan for Development area has been designed to act as an overland flow path for large storm events.

The PPK (2000) study indicates that detention basins, piped systems and overland flow channels can be designed and incorporated at the subcatchment level to manage water quantities at predevelopment levels and address nutrient sequestration. A conceptual design has been prepared (Figure 15) which includes approximate locations of water resource management infrastructure.

Hydrological Study

A hydrogeological investigation has been undertaken for the southern half of the Plan for Development area, specifically to determine ground water levels and quality in relation to the Conservation category Wetlands (Figures 16 -18, Technical Appendix H and I). Monitoring of ground water levels occurred from March 2008 to May 2009 using a network of 20 monitoring bores which were installed at the site in May 2008. Bores (Figure 16) included:

- Four sets of two nested bores within each paluslope wetlands 31/40, 41, 8/57 and the wetland on Part Lot 1 Yatana Road, and one deeper bore in wetland 29 for monitoring water level changes beneath the wetlands. Bore screens were set approximately 2-3m below surface in shallow bores for identifying and monitoring "perched" groundwater close to the surface above any clay or low permeability horizon. Deeper bores (including the one bore at wetland 29) were drilled to identify and monitor any deeper groundwater;
- Eleven additional 50mm bores were emplaced mostly outside of the paluslope wetlands with screens set at 2-3m below ground level or as appropriate to below groundwater level outside of the

identified paluslope wetland areas, for assessment of the extent of any perched groundwater around the wetlands;

- Two of the above deeper bores at paluslope wetlands 29 and D were fitted with automatic water level recorders and loggers for assessment of response of groundwater levels to rainfall events (i.e. to determine how rapidly infiltration of water takes place).

'Slug' tests were carried out on bores at wetland 29 and the wetland on Part Lot 1 Yatana Road to assess hydraulic conductivities of soils in the area, using the water level probes and loggers to determine groundwater level recoveries over time after introducing a "slug" of water to raise water levels in each bore. Slug test data analysis was carried out using Hvorslev method (Freeze and Cherry, 1979).

Two rounds of groundwater sampling were undertaken for nine of the monitoring bores. There were also 11 piezometers used for the collection of groundwater levels and pH measurements. Continuous water level monitoring was conducted at two locations using capacitive water level data loggers. The results of this investigation have been used to establish baseline groundwater quality.

Groundwater Levels

Standing groundwater levels were monitored by Coffey Environments and data was provided to Crisalis for the development of the hydrological and hydrogeological report for the site. A detailed assessment of this study is included in the *Bayonet Head Outline Development Plan Southern Area Hydrogeology and Hydrology* (Crisalis, 2008; Technical Appendix H).

The soil profile in the study area generally comprises fine grained silty sands and a layer of low permeability silty clays at a depth of approximately 2.5m below ground level. This has resulted in the presence of the locally perched water table over the regional groundwater table (Figure 17). The perched groundwater does not intersect the ground surface except for at the mapped wetland areas. The groundwater level data from the site indicates two distinct aquifer systems (Figures 16, 17 and 18). The first is associated with shallow perched groundwater on clay soils on the plateau, associated with wetlands 31 and 40 and D, where groundwater was mostly within 1-2m of the surface above elevations of 40m AHD from May to early August 2008. The second deeper system has an inferred elevation of ~30m AHD beneath the plateau, decaying to elevations of around 20m AHD to the northeast around wetland 41, to the southwest around wetland 29 and either side of the catchment divide. There is a more subdued gradient to the east towards wetlands 8 and 15. Groundwater levels at the site broadly follow surface topography.

The results show that both the shallow perched groundwater and the deeper groundwater respond rapidly to individual rainfall events before slowly declining to a lower water level (Figure 18). Ground water elevation at location MB-A reached the average 2008 winter maximum of approximately 500mm below ground level late in July and maintained a relatively constant level with decline in the beginning of October 2008. At location MB-A the peak water elevation of 270mm below ground level was reached between 20 November 2008 and 27 November 2008 following an extreme rainfall event during which 114mm of rain fell over a 24-hour period, followed by sustained rainfall during the following week.

The available data shows that the perched water table reached its average 2008 winter high in early August. The highest perched water level in 2008 was recorded in late November immediately following the extreme rainfall event.

Hydrology

Monitoring was used to measure and predict the following parameters:

- Possible hydrogeological linkages between paluslope wetlands and linkages between paluslope wetlands and surface drainages / creek lines;
- Responses of groundwater levels to rainfall events;
- The nature and depth of any impervious layers within the soil profiles and possible perching of groundwater within shallow soils;
- A conceptual model of groundwater flow to assess potential impacts of land development and to determine possible land management practices to minimise impacts and protect vulnerable paluslope wetland areas.

The vegetation associated with the paluslope wetlands 31 and 40 and D on the plateau on the upper reaches of the catchment derives water from localised perched shallow aquifers, with water being present over summer periods in these areas in sands above a relatively thick (1-1.5m) layer of clay. This layer is likely to be recharged periodically by summer rainfall, although there is insufficient data to confirm this. Natural recharge from rainfall falling on the inferred areas of perched water rapidly recharges the perched groundwater zones above what appears to be thicker clay soils than elsewhere on the plateau. Although there is likely to be slow leakage through the clays to the deep groundwater system and lateral drainage down hydraulic gradient, it is probable that there is sufficient water retained within the perched zones or within the thicker clay soils to maintain the paluslope wetland vegetation over summer periods. The urban development here would be unlikely to impact recharge rates, if development remains outside a relatively small buffer zone (30-50m) from the wetland areas (Crisalis, 2008).

The wetlands on the slopes around the plateau (29, 41, 8 and 57) are associated with the deep groundwater table, where this comes closer to the surface at break-in-slope areas within the shallow valleys, or to poorly developed perched water tables as at wetlands 8 and 57. The relatively low hydraulic conductivity of the soils allows maintenance of high hydraulic gradients. There is an overall rise in the deep water table over time from winter recharge and a rapid response of the deep groundwater table to rainfall events at wetland 29 and slow decay of the peaks between rainfall events. It is considered likely that rapid groundwater recharge through unsaturated soils within the area is caused by infiltration through preferred pathways such as root channels. The perched and deeper groundwater systems respond rapidly to rainfall events, when groundwater levels rise sharply. A major rainfall event in November 2008 (114mm on 21 November) resulted in the annual maximum of groundwater level being recorded at this time.

The deep groundwater table did not intercept the surface at any point within the site over the monitoring period. However, it is possible that this occurs off the study site and down-gradient within the valleys, forming spring-lines which would provide base flow for water courses, such as Yakamia Creek to the south of Bayonet Head. It is likely any groundwater discharge is some considerable distance from the site boundaries, and the development at Bayonet Head would provide only a part of base flow to this and other creeks, proportional to the development drainage area.

The shallow and deep groundwater systems at Bayonet Head are distinct from groundwater system on low lying land between the site and Oyster Harbour. Given the separation of these groundwater systems it is concluded that any changes in recharge to the Bayonet head site due to development

would have negligible influence on groundwater system on the dune sands, or on the hydrology of Oyster Harbour.

Groundwater Quality

Monitoring of pH, electrical conductivity and a suite of chemical analysis was undertaken to capture winter (June 2008) and summer (February 2009) base line data for metals, nutrients and physical parameters (for details see Technical Appendix I).

The groundwater analytical results are shown in detail in Technical Appendix I, with a summary table in Appendix 5 of this document. Bore locations are shown in Figure 16. Results have been compared with ANZECC and ARMCANZ (2000) assessment criteria for Fresh Waters and Short Term Irrigation (STI), and DEC (2009) indicators of acidification.

A summary of the results show that the natural back ground levels of some parameters exceed the ANZECC and ARMCANZ criteria for Fresh Water (Wetlands) and Short Term Irrigation. It should be noted that the criteria are included for reasons of comparison and the results of the monitoring that exceed the criteria are not an indication that there is an environmental or public health issue. Rather, the results reflect natural levels on the site and are not caused by human activities. As such, the results are not an environmental concern in terms of the proposed development and should be used as baseline information for future comparison. There are no guideline values published by DEC for any of the cations that were analysed.

The topography of the site includes a plateau feature (along the northern boundary of Lot 1001 Lower King Road) from which the localised ground water flows off-site to neighbouring areas. The locally perched groundwater systems situated along the main ridge are all recharged from catchments within the site boundaries which are uncleared. Therefore the water quality data for these areas can be assumed to represent the natural groundwater quality, unimpacted by external influences.

During bore installation, the soils on site were logged as fine grained silty sands. The fine silt/clay particles in the soil profile are considered to be the source of the elevated concentrations of both total aluminium and total iron in groundwater. The dissolved concentrations of these two metals are considerably lower. The concentrations of most dissolved metals is higher in the results from the June monitoring round than the February monitoring round which may be an indication of the release of dissolved metals from the soils with a low pH higher up in the profile following the onset of winter rains.

There is a considerable range in both total acidity and alkalinity values recorded at the site with a pattern of higher values recorded in June and a decreasing trend in values recorded in February. This trend is consistent across all of the bores. Notably, bore MB-D had a higher total acidity (110mg $CaCO_3$/L), a low alkalinity (<5mg $CaCO_3$/L), a pH of 3.7, and an alkalinity:sulfate ratio less than 5. These results, in combination with the concentration of dissolved aluminium greater than 1mg/L (2.8mg/L) suggest that groundwater in this area is being affected by the oxidation of sulfides. This monitoring bore is located near the highest point of the site and was the only bore that contained water in the winter but dried up in the summer. This indicates a greater degree of seasonal wetting and drying of the soil horizon than in other areas of the site. The locally perched groundwater flows from this location to the other areas of perched groundwater. Assessment of the buffering capacity of the groundwater indicates that it does not have a high buffering capacity to maintain stable pH levels (DEC, 2009).

Given that the site consists of uncleared native vegetation and forms its own catchment for both surface water and the locally perched ground waters, it is believed that the elevated nutrient concentrations reflect the natural background groundwater quality for the area.

5.6.4 Potential Impacts

Surface Water

Increased levels of nutrients, pesticides, pathogens, irrigation and stormwater run-off may impact upon surface water, groundwater and marine water quality of the surrounding area.

Potential changes to hydrology arising from the proposal may impact wetlands and other groundwater dependent ecosystems inside and outside of the project area.

Groundwater

Any changes in recharge to the deeper groundwater system could potentially impact wetlands 29, 41, 8 and 57. This could occur by raising groundwater levels over the area if recharge increases as a result of increased surface drainage onto soils from roof areas and roadways/paths, reduced losses by evaporation and reduced transpiration if vegetation is removed from the developed areas.

Alternatively, if stormwater is exported off-site, recharge rates would decrease substantially and groundwater levels in the deep aquifer system would fall, potentially impacting vegetation associated with the wetlands and base flow to creeks such as Yakamia Creek to the south.

Increased infiltration and recharge in summer as a result of development would be unlikely to be problematic, as groundwater level declines (which typically occur in summer) would be reduced. The main problem would be in winter, through significant increases in recharge.

Water quality at MB-D (Wetland D) naturally exceeds the DEC trigger values for acidity in terms of ASS management. Therefore, when on site works begin and monitoring commences, these values will need to be considered as the baseline. It also means as there is potentially sulfidic material in the area and any changes to the hydrology could lead to higher acidification and possible downstream impacts.

The silty grey sands have a relatively poor natural buffering capacity. These soil types will need to be managed through neutralisation with lime sand where disturbance is required during development. The ground water flows to other areas of the site and potential acidification of this area will require monitoring and management. This site would need to be a focal point of any works based monitoring programs that are undertaken.

Potential changes to hydrology may impact on wetlands and other groundwater dependent ecosystems, both within and outside the project area.

5.6.5 Management Strategies

The Proponents commit to prepare a Local Water Management Strategy for the Plan for Development area. This planning will:

- Formalise the conceptual water management design (Figure 15);
- Identify the specific locations and detailed specifications of infrastructure;
- Identify best management practice for water resource management;

- Outline strategies for water reuse, waste minimisation and conservation;
- Outline contingencies for hydrological changes to wetlands;
- Outline contingencies for accidents and pollution mitigation; and
- Outline evaluation and monitoring plans for groundwater and surface water quality and quantity;

The Local Water Management Strategy will be based on principles outlined in *Better Urban Water Management* (Essential Environmental Services, 2007) to meet the Department of Water (2004 – 2007) Stormwater Management Manual guidelines. This strategy would be most appropriate to occur after finalisation of the Plan for Development and SEA process at the rezoning stage.

Water quality results shown in Appendix 5 will be used as baseline data for future monitoring at the site. The results from this report will be used to assist development of plans to maintain pre-development groundwater flows to wetlands associated with the shallow (perched) aquifer. The data will also be used as a baseline against which post-development water monitoring results are considered, in order to assess the impacts of development on groundwater quality.

It is important to consider that groundwater measured in the area already displays a relatively high level of acidity which indicates that management of groundwater levels will be an important component of preventing exposure of potential ASS.

Potential impacts on vegetation and wetlands will be avoided by maintaining groundwater levels and recharge rates at approximately current levels for maintenance of the wetland vegetation and the hydrologic environment generally. Significant possible groundwater level increases in winter will be managed through stormwater design systems.

Strategies such installation of 'plumbed in' residential rainwater tanks will be employed for collection of rain water. In this way, a significant proportion of influent rainfall will be diverted from the stormwater system and reduce flooding of wetlands during winter. The City of Albany has confirmed that they can enforce the installation of rainwater tanks at the building licence stage of development (Executive Director, Development Services, pers. comm.).

Monitoring of groundwater over time will be carried out detect any changes to groundwater levels, especially on paluslope wetland vegetation (e.g. Wetland 29). Activities during construction that will require additional monitoring of groundwater quality and quantity include dewatering and earthworks that will intersect with groundwater. This monitoring will be addressed in the Acid Sulfate Soil and Local Water Management Strategy.

5.7 Acid Sulfate Soils

5.7.1 EPA's Objective

To minimise the risk to the environment resulting from Acid Sulfate Soils, to be achieved by implementing appropriate detection and management strategies.

Applicable Legislation, Criterion or Guidance

- *Contaminated Sites Act 2003.*
- DoE (2003-2006) Department of Environment Draft Identification and Investigation of Acid Sulfate Soils - Acid Sulfate Soils Guideline Series.

- DoE (2003) Preparation of Acid Sulfate Soil Management Plan.
- DoE (2003) General guidance on managing Acid Sulfate Soils.
- DoE (2004) Guidance for groundwater management in urban areas on acid sulfate soils.
- DoE (2004) Is my house built on Acid Sulfate Soils (Draft).
- DoE (2004) Proposed Framework for Managing Acid Sulfate Soils.
- DoE (2004) Treatment and management of disturbed acid sulfate soils.
- DoE (2006) Draft Identification and Investigation of Acid Sulfate Soils.
- DEC (2006) Policy Position Acid Sulfate Soils and the *Contaminated Sites Act 2003.*
- WAPC (2009) *Planning Bulleting No. 64: Acid Sulfate Soils.*

Latest updates of the following:

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality, National Water Quality Management Strategy, October 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000a);
- Australian Guidelines for Water Quality Monitoring and Reporting, National Water Quality Management Strategy, October 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000b); and
- Australian Guidelines for Urban Stormwater Management, National Water Quality Management Strategy, 2000, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (2000c).

5.7.2 Existing Environment

A desktop assessment has been carried out for the Plan for Development area (Coffey Environments, 2007, Technical Appendix J) following the methodology described in DEC (2006) and WAPC (2009).

The presence of Acid Sulfate Soils (ASS) has been a recognised issue of concern in Western Australia since 2003. The DEC and the WAPC have released guidance notes on ASS, covering the requirement for assessing sites and the management of sites where ASS are identified.

ASS investigations are commonly required as part of the conditions of subdivision and development, or as a requirement for a dewatering license application. Proponents of developments that involve the disturbance of soil or the change of groundwater levels in areas susceptible to ASS are required to conduct desktop and field based investigations. The objective of these investigations is to determine the extent and magnitude of ASS at the site. Adequate investigations are required prior to soil disturbance to determine the potential risks and to allow for the formulation of appropriate management strategies.

A preliminary desktop investigation for ASS has been carried out for the Plan for Development area (Figure 19), including:

- Review of published ASS risk information pertaining to the study area;

- Review of geological information pertaining to the study area;
- Review of aerial photographs; and
- A site visit to ground truth existing mapping and determine and significant indications of ASS.

WAPC Planning Bulletin 64 identifies the southern and eastern portion of study area as having 'no known risk of ASS occurring within 3m of natural soil surface (or deeper)' (WAPC, 2009). However, Lots 38 and 39 Elizabeth Street, Lot 15 Hooper Road (not included in the SEA), and parts of Lots 3 and 286 Alison Parade may have a 'high risk of actual acid sulfate soil and potential acid sulfate soil less that 3m from the ground surface' (Figure 19).

5.7.3 Potential Impacts

Disturbance of ASS through earthworks associated with the development of the subject land for residential purposes could result in generation of sulphuric acid and iron compounds. This could result in the release of other substances, including heavy metals, from the soil and into the environment, thereby impacting on environmental values and attributes associated with the study area. Disturbance of ASS could also result in the study area becoming classified as contaminated as per the *Contaminated Sites Act 2003.*

5.7.4 Management Strategies

An 'Acid Test', used to determine the ASS risk for the site according to methodology outlined in WAPC Planning Bulletin 64 (WAPC, 2009) has not been carried out for the Plan for Development area. This is because the boundaries of areas to be disturbed have not been finalised. However, it is recognised that where dewatering or extensive earthworks are proposed, further assessment will be required prior to development and should be completed at the subdivision stage.

The Proponents commit to the preparation of an ASS Management Plan for areas and activities that carry a risk of exposure of ASS. This plan would be prepared to the standards outlined by the DEC (2006).

5.8 Aboriginal Heritage

5.8.1 EPA's Objective

To ensure changes to the biophysical environment resulting from the proposal does not adversely affect Aboriginal heritage sites and/or and cultural associations within the area and comply with the requirements of relevant Aboriginal and heritage legislation.

Applicable Legislation, Criterion or Guidance

- Aboriginal Heritage Act 1972;
- *Native Title Act 1993*;
- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984; and*
- EPA (2004e*) Assessment of Aboriginal Heritage Guidance Statement No. 41.*

5.8.2 Existing Environment

An assessment of Aboriginal Heritage in the Plan for Development area has been carried out by Goode and Associates (2007, Technical Appendix K). The survey involved a review of records describing known sites, a survey of the property, and consultation with local Aboriginal people to determine whether any ethnographic sites were present. The local group consulted was the Albany Heritage Reference Group Aboriginal Corporation (AHRGAC). Sites are shown in Figure 20.

Before European settlement, it is estimated that Nyungar people of the Meananger (or Mineng) group inhabited the area around Albany for at least 18,000 years (City of Albany, 2006). In distant and more recent times, important resources and sites were used by Aboriginal people. Many of these sites have been listed for protection under the *Aboriginal Heritage Act 1972*.

The *Aboriginal Heritage Act 1972* defines Aboriginal sites and provides for the preservation of places and objects customarily used by or traditionally important to Aborigines, and prohibits the concealment, destruction or alteration of any Aboriginal sites.

The survey noted one previously recorded archaeological site (Site ID 5524 – Kylie Site) located in the south western portion of Lot 1000 Lower King Road (Figure 20). This site was reported by W. Ferguson in 1978 as a result of a survey conducted on behalf of the West Australian Museum and consists of a boomerang located among European debris as well as quartz and chert artefacts (Good and Associates, 2007). The site has been extensively disturbed by motorcycle riding and building activities and the majority of materials were collected at the time that the site was first recorded (Good and Associates, 2007). The site is listed on the 'Interim Register' under Section 5(a) of the *Aboriginal Heritage Act 1972.*

As a result of consultation with AHRGAC a new Aboriginal heritage site was reported (Mythological Site 24019). The site is related to the lake located adjacent to the Plan for Development area in Lot 500 Alison Parade. Part of the 250m radius of the site, from the centre of the lake extends onto Lot 3 Alison Parade and Lot 38 Elizabeth Street.

5.8.3 Potential Impacts

No known sites of significance will be disturbed in the Plan for Development area. Development may impact on unknown Aboriginal sites present within the site during development and ground-disturbing activities associated with it. Clearing of vegetation in the area will remove some Sheoak and other trees that were used in the manufacture of boomerangs.

5.8.4 Management Strategies

As required under the Act and in accordance with recommendations made by Goode and Associates and as a result of consultation with the Aboriginal community, approval has been sought and granted to use the land for urban purposes under Section 18 of the *Aboriginal Heritage Act 1972* (Appendix 6).

On the 27th June 2007, the Honourable Michelle Roberts MLA, Minister for Indigenous Affairs, granted consent for the land to be used for the purposes of residential subdivision. She further stated that the development of the land would not impact on Aboriginal sites within the meaning of section 5 of the *Aboriginal Heritage Act 1972*.

All of the Plan for Development area has been included in a Section 18 Consent, except for Lot 286 and 2 Alison Parade and Lot 476 Sibbald Road. No archaeological or ethnographic sites have been identified for these areas.

Any cultural material unearthed during the development process will be fully recorded and salvaged by an archaeologist. If cultural artefacts are found, further consultation with members of the Albany Heritage Reference Group Aboriginal Corporation (AHRGAC) will occur in order to decide how to appropriately curate the material.

The area proposed to be retained as POS in Lot 1000 contains the original Kylie site, and part of its buffer. It may be appropriate to include interpretation of Aboriginal use of the area in the POS. Any decisions on interpretation will need to be made in consultation with the AHRGAC.

6 SUMMARY OF PROPONENT COMMITMENTS

This SEA document provides information relating to the proposal to develop the Plan for Development area at Bayonet Head for residential purposes and associated infrastructure. The document includes a description of the project area, the characteristics of the proposal and identifies significant environmental issues.

Section 5 of this SEA document identified the key environmental factors of significance that may be impacted either during construction and/or once development has been completed. The SEA document also identifies how these impacts may be managed and specifies further studies or monitoring that will enable performance to be measured.

Table 2 presents a summary of the relevant environmental factors identified for this SEA, including identification of potential impacts and proposed management strategies. Agencies involved in various aspects of the development proposal are listed in Table 18.

TABLE 18

AUTHORITIES AND AGENCIES WITH RESPONSIBILITIES IN THE PROPOSED DEVELOPMENT OF THE SITE

Authorities / Agency	**Responsibilities**
Department of Environment Water, Heritage and the Arts (Commonwealth)	• Provides protection for matters of national environmental significance. • Joint assessment may be triggered if Commonwealth has jurisdiction. • Environment Australia and Commonwealth Environment Minister administer the Act.
City of Albany	• Maintains public infrastructure including roads. • Carries out strategic and statutory planning. • Manages and maintains public open space.
Department of Environment and Conservation (Western Australia)	• Assists the Environmental Protection Authority in the process of assessing proposals that may significantly affect the environment, including planning schemes. • Administers relevant control legislation. • Manage conservation reserves vested in the crown. This includes the: a) preparation of management plans; b) implementation of the management plan; c) co-ordination with other agencies; d) implementation of education and monitoring programs; e) wildlife research and management; f) management of nature-based tourism; and g) lead role in enforcement (non-fisheries issues).

Authorities / Agency	Responsibilities
Department of Health	• Has responsibility for public health and safety issues including the provision of safe drinking water supplies and mosquitoes.
Department of Planning and Western Australian Planning Commission	• Manages land use planning
Department of Transport	• Manages the provision of major transport infrastructure within and around the site.
Department of Regional Development and Lands	• Management of State Crown Land and UCL
Department of Water	• Has responsibility for providing advice on wetlands, groundwater, stormwater management and drainage issues.
Fire and Emergency Services Authority of Western Australia	• Provides advice on the protection of life and property from wildfires and other emergency situations.
Office of the Environmental Protection Authority	• Assesses reports and makes recommendations on proposals that may significantly affect the environment, including planning scheme amendments.
Department of Indigenous Affairs	• Protects relics and significant areas of land from undue interference, whilst at the same time leaving traditional Aboriginal cultural rights in relation to such objects or areas unaffected, in so far as they are not inconsistent with the provisions of the *Aboriginal Heritage Act 1972*. • Administers the Act.

6.1 Proponent Commitments

The following commitments are made by the proponents to ensure that potential impacts on the biological, physical and social surroundings of the Plan for Development area are mitigated during the process of development.

Native Terrestrial Vegetation, Flora, Fauna and Wetlands

Preparation of a Construction Management Strategy to address:

- Vegetation clearing protocols (including retrieval of hollows);
- Fauna management during clearing of native vegetation;
- Dieback hygiene and management;
- Dust management;
- Monitoring of groundwater and surface water quality; and
- Weed control and management.

Preparation of a POS and Wetland Management Plan to address:

- Management of DRF and Priority Flora,
- Dieback management;
- Weed management;
- Fire management;
- Access control;
- Signage and interpretation;
- Domestic and feral animal control;
- Pocket park location and management;
- Rehabilitation; and
- Monitoring of wetland and upland vegetation.

Landscape and Streetscape Planning to address:

- Use of suitable plant species to support the movement of significant fauna such as WRP.

6.1.1 Coastal Foreshore

Preparation of a Foreshore Management Plan to address:

- Selection and management of recreation nodes;
- Provision of public facilities;
- Access;
- Weed management;
- Erosion control and water management;
- Fire Management; and
- Treatment of foreshore and development interface.

6.1.2 Surface and Groundwater Quantity and Quality

Preparation of a Local Water Management Strategy to address:

- Water resource management including reuse, waste reduction and conservation;
- Water management infrastructure for water quantity and quality management;
- Best practice strategies for water management;
- Management of potentially acidic groundwater at Wetland D;
- Ground and surface water quality and quantity monitoring; and
- Contingencies for pollution and accident management.

6.1.3 Acid Sulfate Soils

Preparation of an Acid Sulphate Soil Management Plan to address:

- Areas proposed to be developed/disturbed that are likely to require management for ASS; and
- Testing of soils to determine treatment regimes and management.

6.1.4 Aboriginal Heritage

The proponents commit to appropriately manage any materials found during construction as required by the *Aboriginal Heritage Act 1972*.

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8 DISCLAIMER

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Figures

Bayonet Head - Plan for Development
Strategic Environmental Assessment (EPA Assessment No. 1758)

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 31-01-10 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F01.dgn

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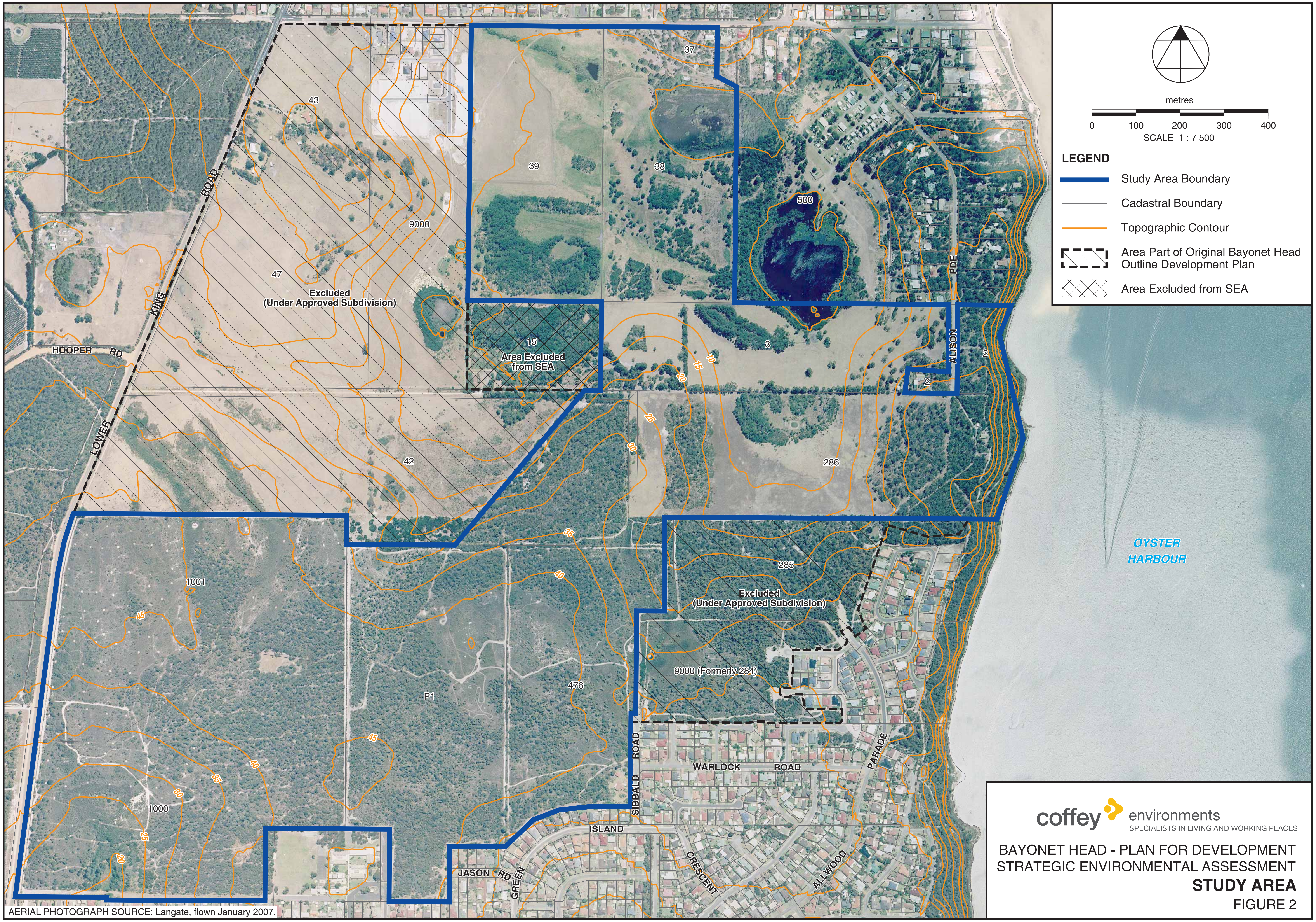
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

REGIONAL LOCATION

FIGURE 1



metres
0 100 200 300 400
SCALE 1 : 7 500
LEGEND
Study Area Boundary
Cadastral Boundary
Topographic Contour
Area Part of Original Bayonet Head Outline Development Plan
Area Excluded from SEA
Excluded (Under Approved Subdivision)
Area Excluded from SEA
OYSTER HARBOUR
KING ROAD
LOWER
HOOPER RD
ALISON PDE
SIBBALD ROAD
WARLOCK ROAD
PARADE
ISLAND
JASON RD
GREEN
CRESCENT
ALLWOOD
9000 (Formerly 284)
AERIAL PHOTOGRAPH SOURCE: Langate, flown January 2007.

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

STUDY AREA

FIGURE 2

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F02.dgn

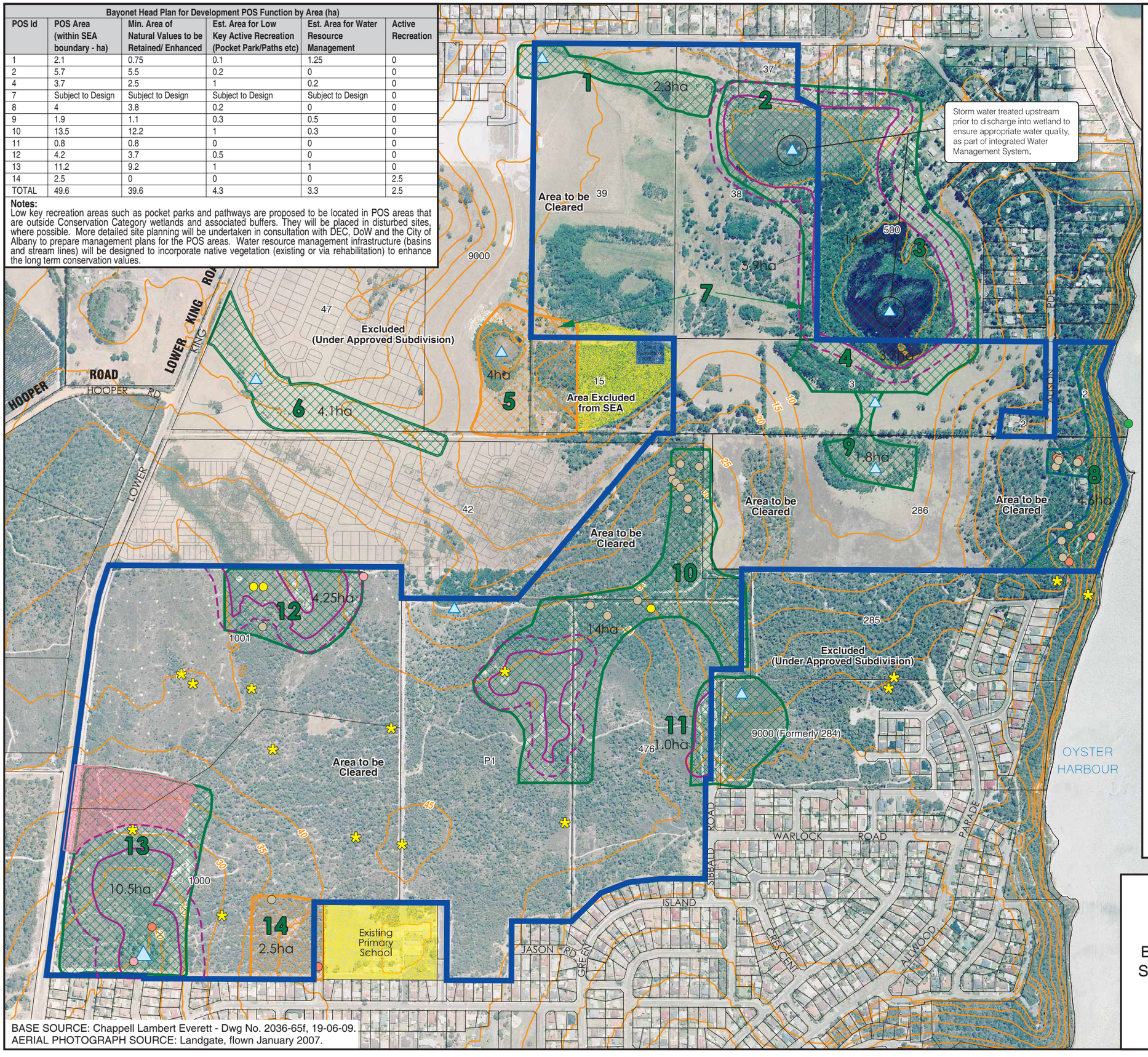
PRINTED: Thu 08 Apr 10

CHECKED: MP 08-04-10 DRAWN: GLM/CR 08-04-10 DATUM: MGA zn50 ENV//ALBA/00547AC/Reporting/EA2009-014F03.dgn

Bayonet Head Plan for Development POS Function by Area (ha)

POS Id	POS Area (within SEA boundary - ha)	Min. Area of Natural Values to be Retained/ Enhanced	Est. Area for Low Key Active Recreation (Pocket Park/Paths etc)	Est. Area for Water Resource Management	Active Recreation
1	2.1	0.75	0.1	1.25	0
2	5.7	5.5	0.2	0	0
4	3.7	2.5	1	0.2	0
7	Subject to Design	Subject to Design	Subject to Design	Subject to Design	0
8	4	3.8	0.2	0	0
9	1.9	1.1	0.3	0.5	0
10	13.5	12.2	1	0.3	0
11	0.8	0.8	0	0	0
12	4.2	3.7	0.5	0	0
13	11.2	9.2	1	1	0
14	2.5	0	0	0	2.5
TOTAL	49.6	39.6	4.3	3.3	2.5

Notes:
Low key recreation areas such as pocket parks and pathways are proposed to be located in POS areas that are outside Conservation Category wetlands and associated buffers. They will be placed in disturbed sites, where possible. More detailed site planning will be undertaken in consultation with DEC, DoW and the City of Albany to prepare management plans for the POS areas. Water resource management infrastructure (basins and stream lines) will be designed to incorporate native vegetation (existing or via rehabilitation) to enhance the long term conservation values.



metres

0 100 200 300 400 500

SCALE 1 : 8 000 @ A3

LEGEND

- Cadastral Boundary
- Topographic Contour
- Conservation Category Wetlands
- 30-50m Buffer from Wetland Boundary
- Vegetation of Significance to be retained
- Proposed Foreshore Reserve Boundary
- Water Management Node (refer Figure 15)
- POS Area - Natural Values/Passive Recreation
- POS Area - Active Recreation
- Primary School
- Waste Water Pump Station
- POS Identification
- Significant Flora Location (see Figure 8 for detail)

Fauna Locations in Public Open Space

- Western Ringtail Possum
- Drey
- Possum Hollow
- Osprey Nest (fallen down)
- Quenda caught at trapping site

NOTES:
The Environmental Protection Authority will not assess the proposed Plan for Development until the Strategic Environmental Assessment document has been prepared and submitted and public submissions have been received. It is expected that the Plan will be informed by the studies undertaken as well as the findings of the Albany Regional Vegetation Survey. Areas not shown as Public Open Space are proposed for urban development.

BASE SOURCE: Chappell Lambert Everett - Dwg No. 2036-65f, 19-06-09.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007.

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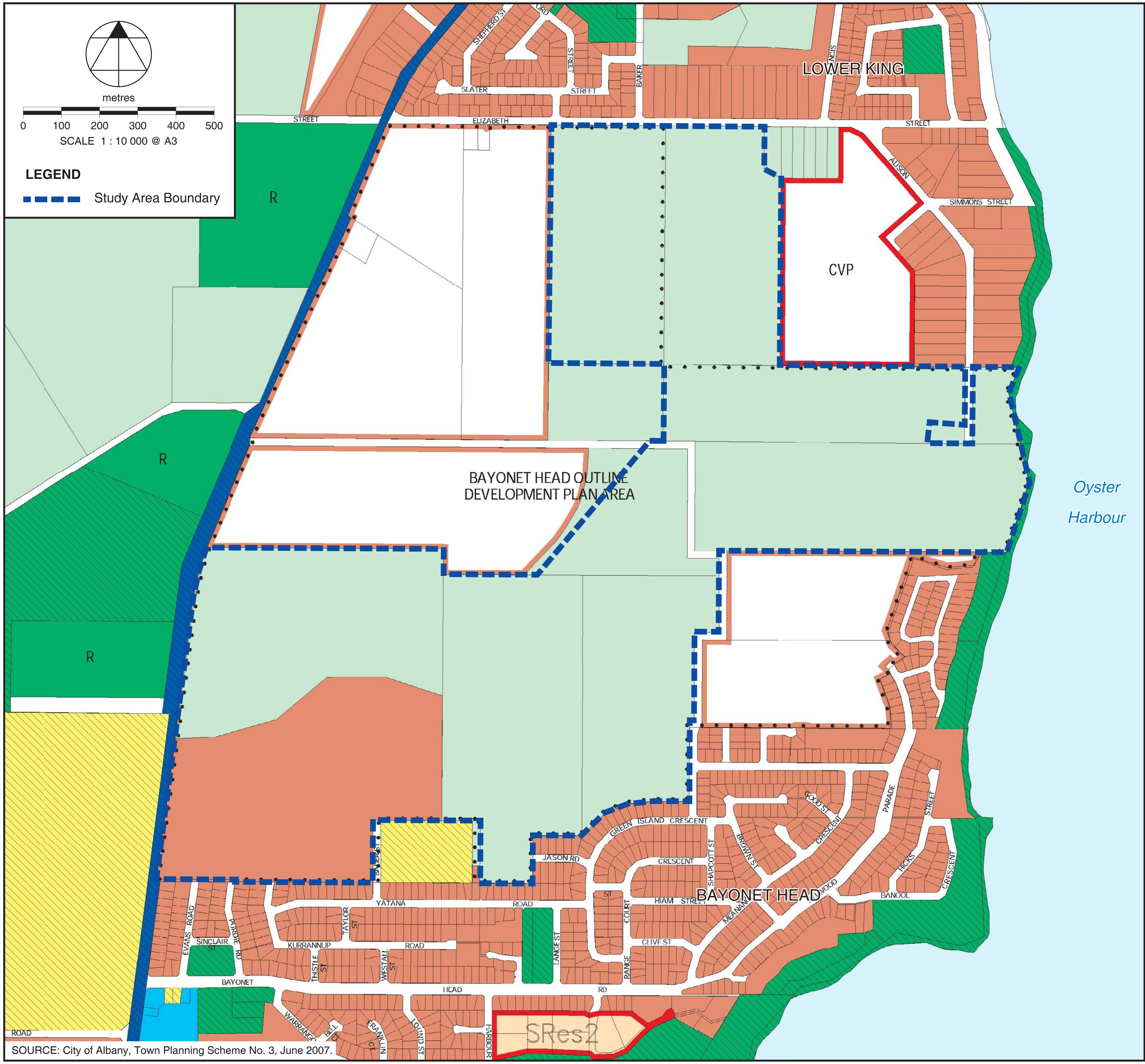
BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

BAYONET HEAD PLAN FOR DEVELOPMENT

FIGURE 3



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LEGEND

LOCAL SCHEME RESERVES

- AERODROME
- CIVIC AND CULTURAL
- IMPORTANT REGIONAL ROADS
- MAJOR HIGHWAYS
- PARKS AND RECREATION
- PARKS AND RECREATION
  - DENOTED AS FOLLOWS:
  - R RESTRICTED
- PUBLIC PURPOSES
- RAILWAY

ZONES

- RESIDENTIAL
- RESIDENTIAL DEVELOPMENT
- SPECIAL RESIDENTIAL
- COMMERCIAL
- LOCAL SHOPPING
- MIXED BUSINESS
- M MOTEL
- SERVICE STATION
- T TAVERN
- PLACES OF PUBLIC ASSEMBLY
- SPECIAL SITES
  - DENOTED AS FOLLOWS:
  - CVP CARAVAN PARK
  - HA HOLIDAY ACCOMMODATION
  - M MARINE MUSEUM
  - V VARIOUS (SEE SCHEME TEXT)
- SPECIAL USE
- SPECIAL USE
  - DENOTED AS FOLLOWS:
  - C CHALETS
- SPECIAL USE
  - DENOTED AS FOLLOWS:
  - CVP CARAVAN PARK
  - FP FOOD WHOLESALING/PLANT NURSERY
  - MA MUSEUM & AQUACULTURE
  - RIB RURAL-INDUSTRY BUFFER
  - V VARIOUS (SEE SCHEME TEXT)
  - ZG ZOOLOGICAL GARDEN
- PRIVATE CLUBS AND INSTITUTIONS
- GENERAL INDUSTRY
- LIGHT INDUSTRY
- NOXIOUS INDUSTRY
- SERVICE INDUSTRY
- SPECIAL INDUSTRY
- CONSERVATION
- LANDSCAPE PROTECTION
- RURAL
- SPECIAL RURAL

OTHER

- R20 R CODES
- A1 ADDITIONAL USES
- SCHEME BOUNDARY
- LOCAL GOVERNMENT BOUNDARY
- TOWNSITE -- LAND ACT
- SR3 SPECIAL RURAL AREA (SEE SCHEME TEXT)
- SRes11 SPECIAL RESIDENTIAL AREA (SEE SCHEME TEXT)
- CA1 CONSERVATION AREA (SEE SCHEME TEXT)
- BAYONET HEAD OUTLINE DEVELOPMENT PLAN AREA
- NO ZONE

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

LOCAL CONTEXT AND ZONING PLAN

FIGURE 4

PRINTED: Tue 16 Feb 10

metres

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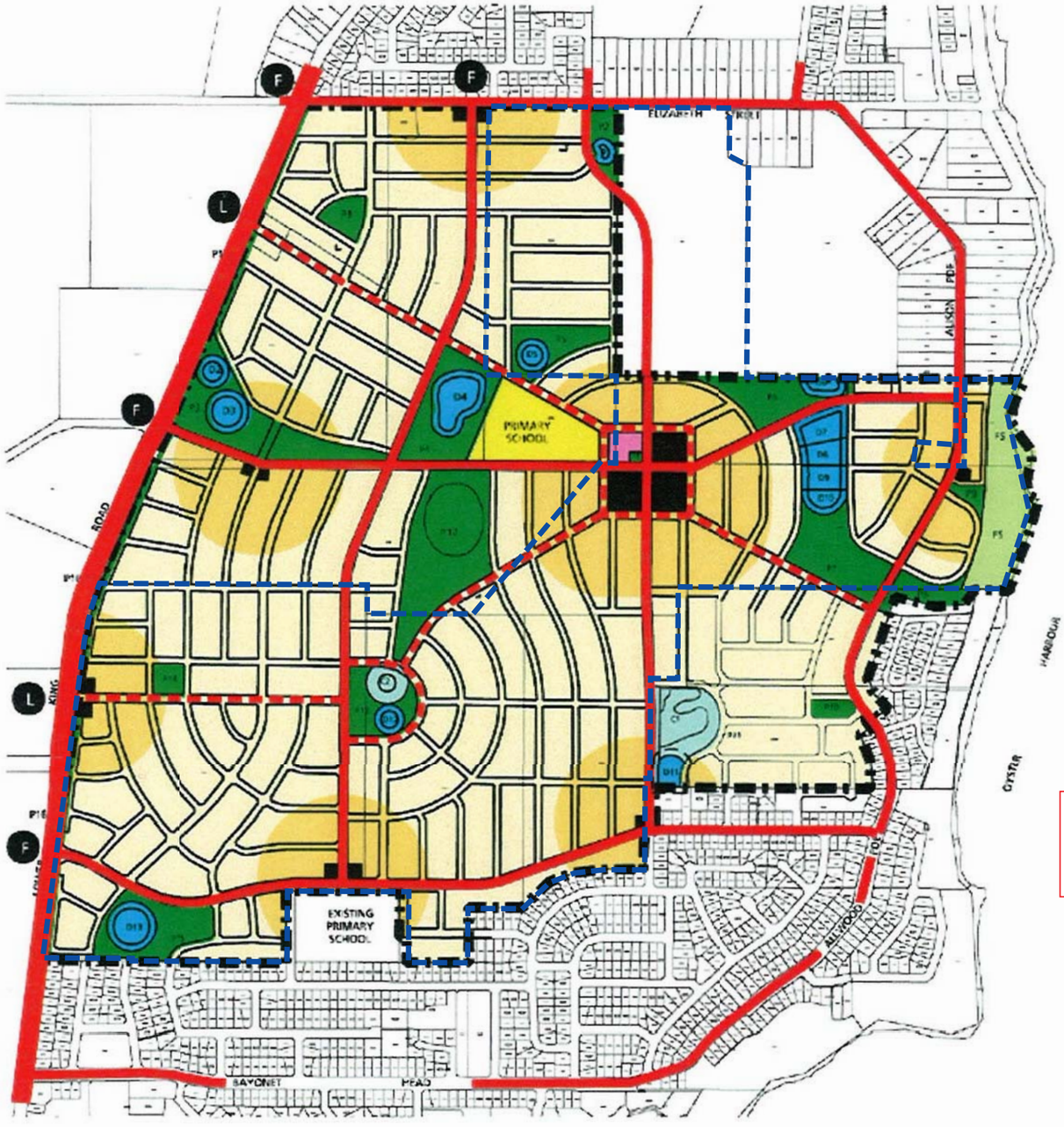
SCALE 1 : 12 500 @ A3

LEGEND

Study Area Boundary



LEGEND

- CDP BOUNDARY
- INTEGRATOR ARTERIAL
- NEIGHBOURHOOD CONNECTOR (INCL.DUP)
- MAJOR ACCESS STREET (INCL.DUP)
- ACCESS STREETS
- FULL MOVEMENT INTERSECTIONS
- LIMITED MOVEMENT INTERSECTIONS
- NEIGHBOURHOOD CENTRE
- NEIGHBOURHOOD NODE
- PRIMARY SCHOOL
- COMMUNITY PURPOSE
- RESIDENTIAL (R20)
- NEIGHBOURHOOD CORE RESIDENTIAL (R40)
- PUBLIC OPEN SPACE RESERVE
- FORESHORE RESERVE (INCL.DUP)
- DRAINAGE & DRAINAGE BUFFER RESERVE
- CONSERVATION WETLAND & BUFFER RESERVE

NOTE: DESIGN IS SUPERSEDED

SOURCE: TAYLOR BURRELL (2036-38A), (via CLE, March 2007).

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

HISTORICAL MAP - 2001 BAYONET HEAD OUTLINE DEVELOPMENT PLAN

FIGURE 5

ENVI/ALBA/00547AC/Reporting/EA2009-014F05.dgn DATUM: MGA zn50 DRAWN: GLM/CR 31-01-10 CHECKED: MP 15-02-10

PRINTED: Tue 16 Feb 10
ENV/ALBA/00547AC/Reporting/EA2009-014F06.dgn DATUM: MGA zn50 DRAWN: GLM/CR 31-01-10 CHECKED: MP 15-02-10

metres

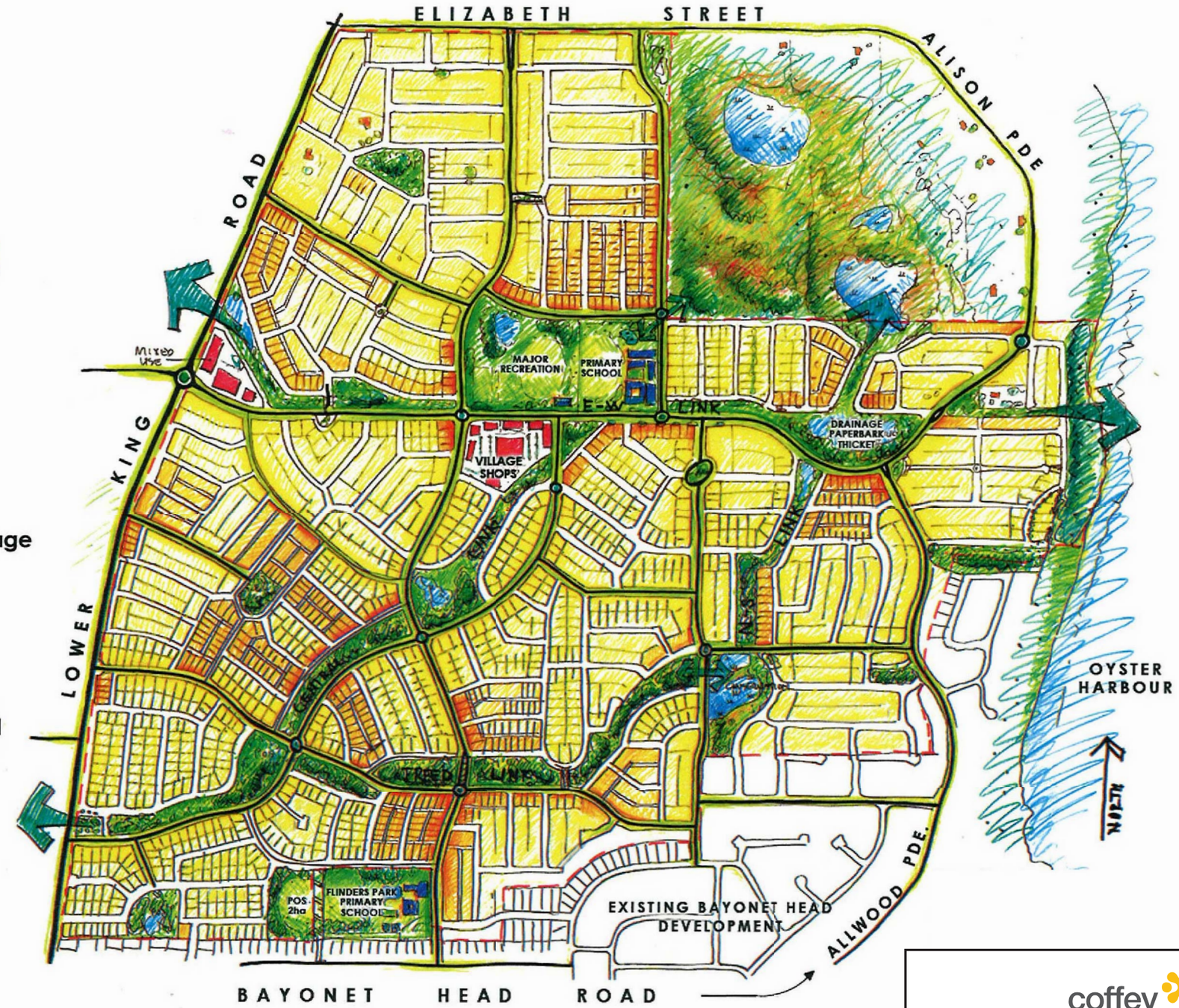
0 100 200 300 400 500

APPROX. SCALE 1 : 10 000 @ A3

PROPOSED OUTLINE DEVELOPMENT PLAN

Core Components

- Road Network
- Centrally located Village Centre
- Public Open Space
- Diversity of Residential Homesites



NOTE: DESIGN IS SUPERSEDED

SOURCE: Chappell Lambert Everett, June 2005.

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

HISTORICAL MAP - 2005 PROPOSED OUTLINE DEVELOPMENT PLAN CONCEPT

FIGURE 6

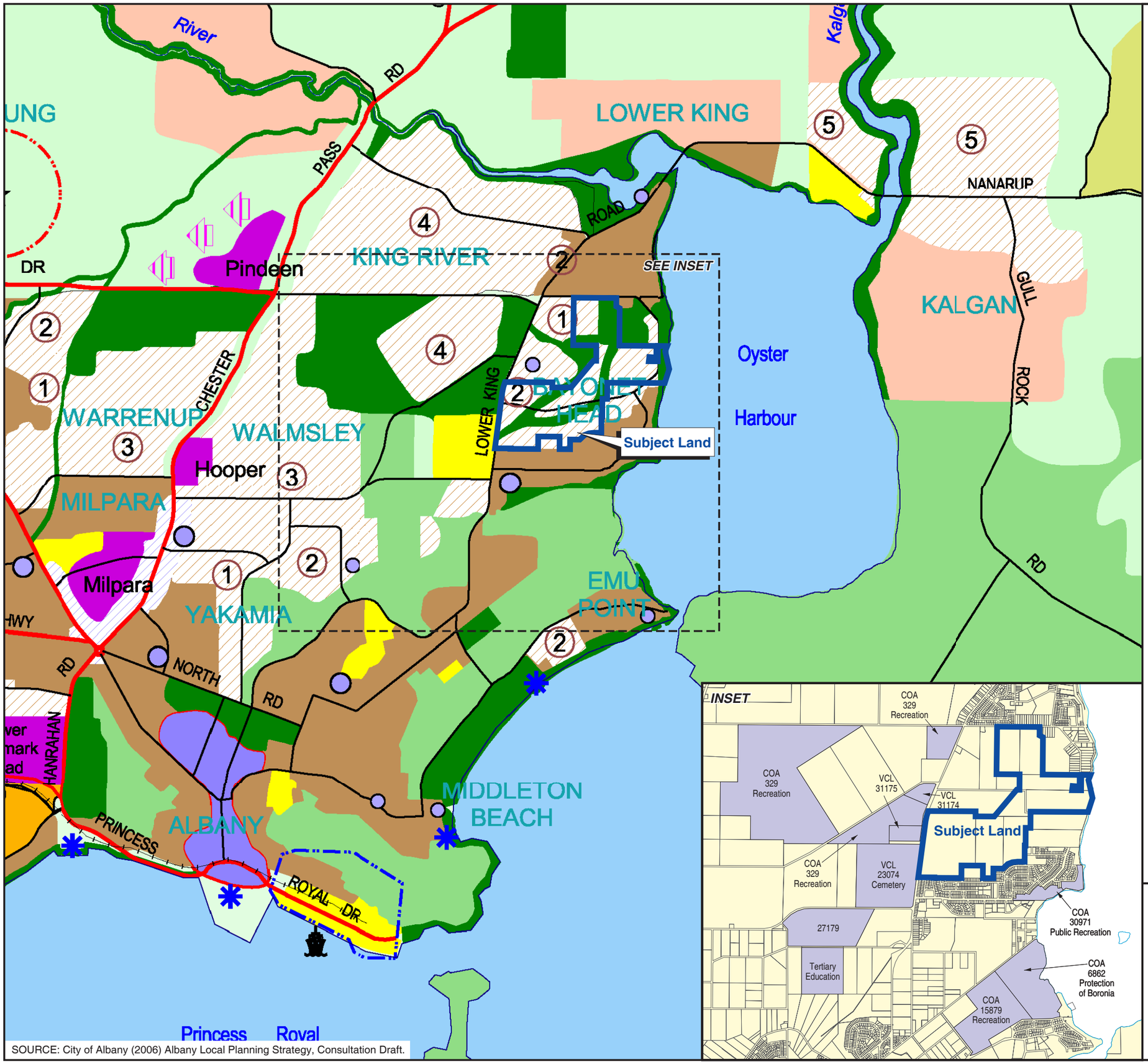
PRINTED: Fri 19 Mar 10

CHECKED: MP 18-03-10

DRAWN: GLM/CR 18-03-10

DATUM: MGA zn50

ENVI/ALBA/00547AC/Reporting/EA2009-014F07.dgn



SOURCE: City of Albany (2006) Albany Local Planning Strategy, Consultation Draft.

metres

0 500 1000 1500 2000 2500

SCALE 1 : 50 000 @ A3

LEGEND

- Existing Urban
- Future Urban
- Priority Development
- Regional Reserve
- Local Reserve
- Major Public Purpose Use
- Albany (Regional Centre)
- Neighbourhood Centre
- Local Centre
- Mixed Business
- Rural Residential
- Conservation
- General Agriculture
- Priority Agriculture
- Rural Small Holding
- Industry
- Future Industry
- Tourist Accommodation Node
- Airport noise buffer
- Speedway Noise Buffer
- Port Noise Buffer
- Water Treatment Plant Buffer
- Quarry Buffer
- Major Highway
- Local Distributor Road
- Railway
- Regional mine/quarry
- Albany Airport
- Albany Port
- Wind farm
- Subject Land

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

ADJACENT LAND USE AND TENURE

FIGURE 7

PRINTED: Tue 16 Feb 10

CHECKED: MP 15-02-10

DRAWN: CR 24-07-09

DATUM: MGA zn50

ENVI/ALBA/00547AC/Reporting/EA2009-014F08.dgn

metres

0 100 200 300 400

SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Area Part of Original Bayonet Head Outline Development Plan
- Area Excluded from SEA
- Vegetation Association Boundary
- Flora Quadrat Location
- Significant Flora Location
- Priority 1 Ecological Community - Open Low *Allocasuarina fraseriana* and *Eucalyptus staeri* Woodland in association with *Banksia coccinea*

Excluded (Under Approved Subdivision)

Area Excluded from SEA

Excluded (Under Approved Subdivision)

9000 (Formerly 284)

AERIAL PHOTOGRAPH SOURCE: Landgate, flown 2007.

VEGETATION ASSOCIATIONS LEGEND

AfEmOCF
Open to Closed *Allocasuarina fraseriana* and *Eucalyptus marginata* Forest over *Agonis theiformis, Bossiaea linophylla, Leucopogon racemulosus, Beaufortia decussata, Astartea scoparia, Xanthorrhoea brunonis* and *Dasypogon bromeliifolius* over *Anarthria scabra, Anarthria prolifera, Desmocladus fasciculatus* and *Lepidosperma squamatum*.

AfEsBc
Open *Eucalyptus staeri* and *Allocasuarina fraseriana* Woodland over *Banksia coccinea* over *Melaleuca thymoides, Leucopogon glabellus, Leucopogon obovatus* and *Dasypogon bromeliifolius* over *Lyginia imberbis, Anarthria scabra* and *Anarthria prolifera*.

AfEsNfOW
Open *Allocasuarina fraseriana, Eucalyptus staeri* and *Nuytsia floribunda* over *Melaleuca thymoides, Agonis theiformis, Jacksonia spinosa, Leucopogon glabellus, Dasypogon bromeliifolius, Leucopogon unilateralis, Pericalymma ellipticum* var. *ellipticum, Adenanthos obovatus, Sphenotoma squarrosum* and *Darwinia vestita* with occasional *Kingia australis* over *Evandra aristata, Lepidosperma gladiatum, Juncus pauciflorus, Mesomelaena graciliceps, Chordifex laxus, Hypolaena exsulca, Anarthria prolifera, Anarthria scabra* and *Lomandra sonderi*

AfEsOW
Open *Allocasuarina fraseriana, Eucalyptus staeri* and *Allocasuarina fraseriana* Woodland over *Agonis theiformis, Leucopogon glabellus, Jacksonia sternbergiana* and *Melaleuca thymoides* over *Anarthria scabra*.

AfNfBiBaOF
Open *Allocasuarina fraseriana, Nuytsia floribunda, Banksia ilicifolia* and *Banksia attenuata* Forest over *Astartea scoparia* and *Agonis theiformis* over weeds.

ClAf
Callistachys lanceolata with occasional *Agonis flexuosa* over *Pteridium esculentum*.

ClEm
Callistachys lanceolata and *Eucalyptus marginata* over *Melaleuca viminea* subsp. *viminea* over *Agonis theiformis* over *Lepidosperma gladiatum, Anarthria gracilis, Juncus pauciflorus, Chordifex laxus* and *Hypolaena exsulca*.

EmAfBgCF
Closed *Eucalyptus marginata, Allocasuarina fraseriana* Forest with occasional *Banksia grandis* over *Agonis theiformis, Melaleuca thymoides, Petrophile heterophylla, Daviesia preissii* and *Xanthosia rotundifolia* over *Lepidosperma gladiatum* and *Lepidosperma squamatum*.

EmAfF
Eucalyptus marginata and *Allocasuarina fraseriana* Forest over *Agonis theiformis, Acacia rostellifera* and *Kingia australis* (Severely Burnt).

EmAfNfOF
Open *Eucalyptus marginata, Allocasuarina fraseriana* and *Nuytsia floribunda* Forest over *Psoralea pinnata, Acacia myrtifolia, Hibbertia cuneiformis, Xanthorrhoea platyphylla* and *Zantedeschia aethiopica* over *Anthoxanthum odoratum, Sonchus oleraceus* and *Hypochaeris glabra*.

EmAfOCF
Open to Closed *Eucalyptus marginata* and *Allocasuarina fraseriana* Forest over *Agonis theiformis, Xanthorrhoea brunonis, Xanthorrhoea platyphylla, Acacia lateriticola, Dasypogon bromeliifolius, Gompholobium knightianum, Conostylis setigera, Leucopogon revolutus, Bossiaea linophylla, Xanthorrhoea platyphylla, Hibbertia cunninghamii, Tetratheca setigera, Opercularia vaginata* and *Sphenotoma squarrosum* over *Chordifex laxus, Anarthria scabra, Desmocladus fasciculatus, Lepidosperma gladiatum, Lepidosperma squamatum, Anarthria prolifera, Tetraria capillaris* and *Hypolaena exsulca*.

EmAfOF
Open *Eucalyptus marginata* and *Allocasuarina fraseriana* Forest with occasional *Eucalyptus staeri* over *Agonis theiformis, Astartea fasciculatus, Allocasuarina humilis, Melaleuca thymoides, Xanthorrhoea brunonis, Conostylis setigera* and *Leucopogon propinquus* over *Mesomelaena tetragona, Anarthria scabra, Anarthria prolifera* and *Schoenus nitens*.

EmAfW
Eucalyptus marginata and *Allocasuarina fraseriana* Woodland over *Jacksonia furcellata, Melaleuca thymoides, Leucopogon glabellus, Dasypogon bromeliifolius, Adenanthos obovatus* and *Xanthosia rotundifolia* over *Lepidosperma gladiatum, Chordifex laxus* and *Hypolaena* sp.

HfCrOH
Open *Homalospermum firmum* and *Cosmelia rubra* Heathland over *Xyris lacera* and *Hypolaena exsulca*

MpEsW
Melaleuca preissiana and *Eucalyptus staeri* Woodland over *Taxandria linearifolia, Astartea fascicularis, Acacia rostellifera, Gompholobium villosum, Dasypogon bromeliifolius, Sphenotoma squarrosum* and *Dampiera linearis* over *Chordifex laxus, Mesomelaena graciliceps* and *Hypolaena exsulca*.

MpLW
Low *Melaleuca preissiana* Woodland over *Astartea scoparia* over *Hypolaena exsulca*.

AfLCF
Low Closed *Allocasuarina fraseriana* Forest over *Agonis theiformis, Jacksonia furcellata* and *Xanthosia rotundifolia* over *Lepidosperma gladiatum* and *Lepidosperma squamatum*.

AsCITOS
Tall Open *Astartea scoparia* and *Callistachys lanceolata* Scrub over *Juncus kraussii, Baumea articulata, Lepidosperma gladiatum* and *Hypolaena exsulca*.

Pp
Psoralea pinnata

C/P
Cleared/Pasture

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT
VEGETATION ASSOCIATIONS
FIGURE 8

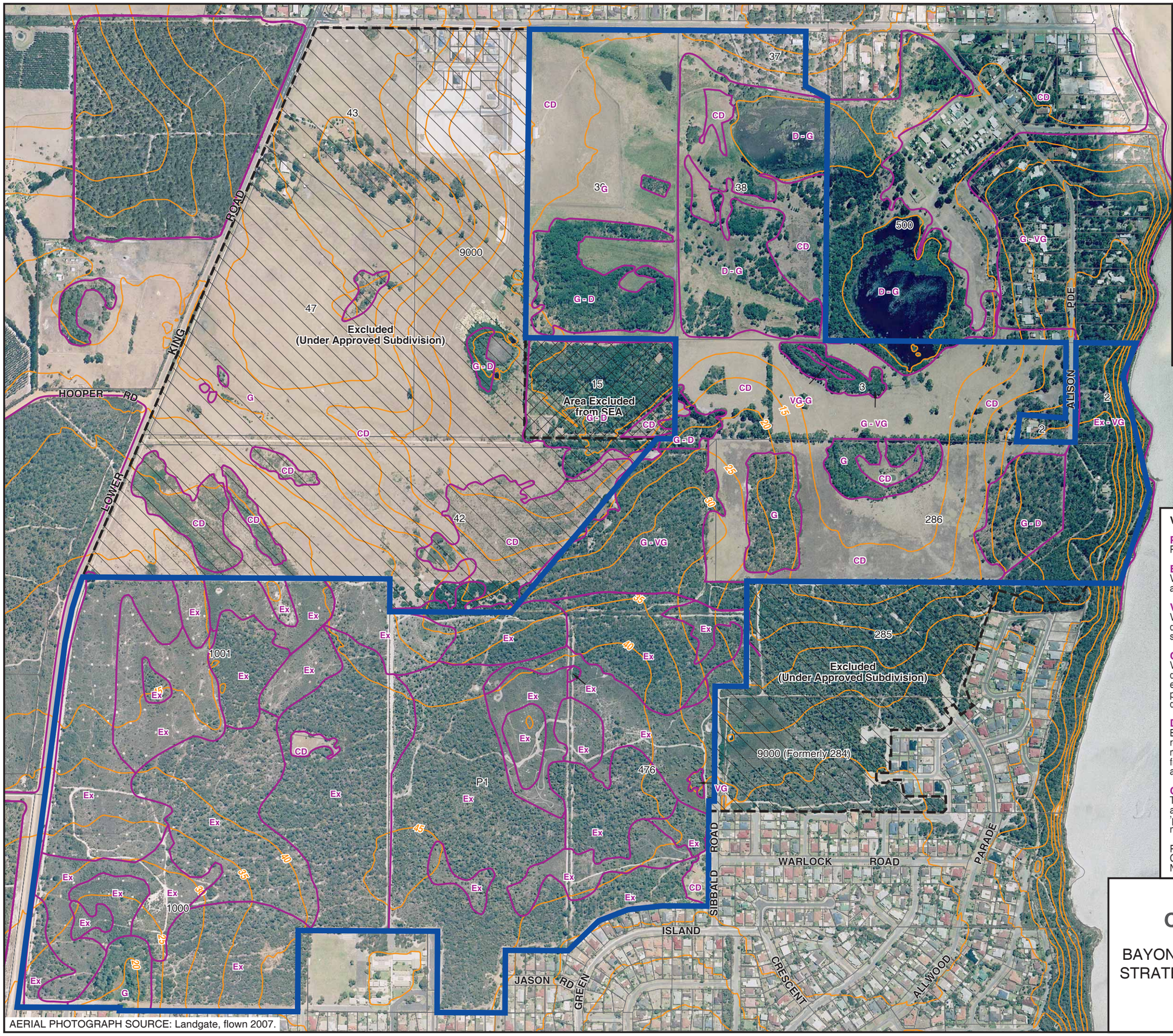
PRINTED: Tue 16 Feb 10

CHECKED: MP 15-02-10

DRAWN: CR 31-01-10

DATUM: MGA zn50

ENVI/ALBA/00547AC/Reporting/EA2009-014F09.dgn



AERIAL PHOTOGRAPH SOURCE: Landgate, flown 2007.

metres

0 100 200 300 400

SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Topographic Contour
- Area Part of Original Bayonet Head Outline Development Plan
- Area Excluded from SEA
- Vegetation Condition Boundary

VEGETATION CONDITION LEGEND

P - Pristine (1)
Pristine or nearly so, no obvious signs of disturbance

Ex - Excellent (2)
Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

VG - Very Good (3)
Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

G - Good (4)
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

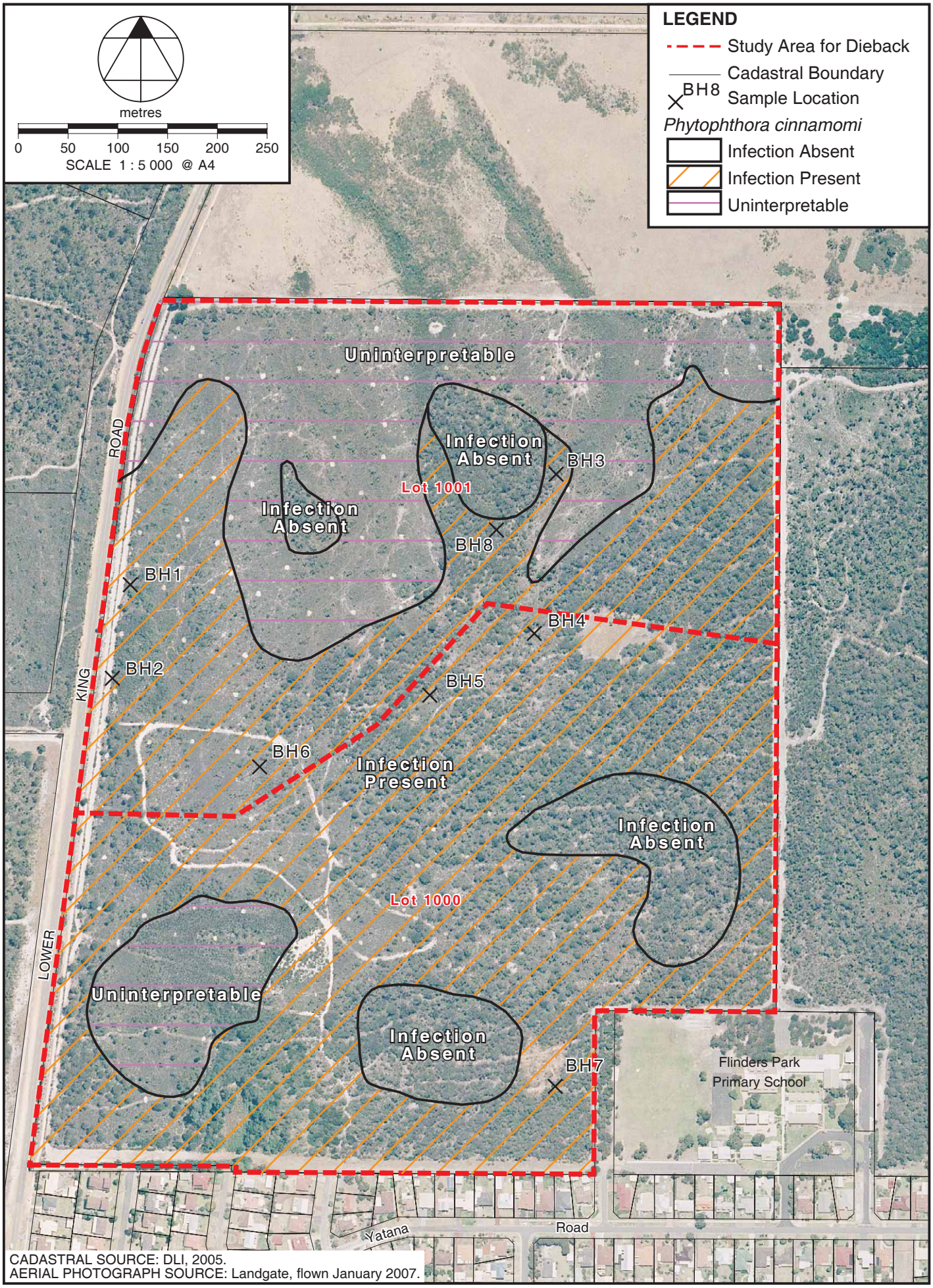
Deg - Degraded (5)
Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

CD - Completely Degraded (6)
The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Reference: Keighery, BJ (1994) Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc), Nedlands, Western Australia

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT
VEGETATION CONDITION
FIGURE 9



PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: GLM/CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F10.dgn

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT
***Phytophthora cinnamomi* PRESENCE/ ABSENCE AND SAMPLE LOCATIONS**
FIGURE 10

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F11.dgn

metres

0 100 200 300 400

SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Fauna Habitat Boundary
- Western Ringtail Possum Location
- Drey Location
- Osprey Location
- Possibly Suitable Possum Hollow
- Possibly Suitable Black-Cockatoo Hollow
- Quenda Caught at Trapping Location
- Trapping Site Location
- Areas of High Faunal Values particularly for Conservation Significant Species

FAUNA HABITAT TYPES

JSW
Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*) woodland over shrubland of species such as *Agonis theiformis*, *Astartea fascicularis*, *A. humilis*, *Melaleuca thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland with occasional shelterbelt of *E. globulas* and *A. flexuosa*.

HS
Heath containing species such as *A. theiformis*, *Leucopogon glabellus*, *Lepidosperma gladiatum*, *Melaleuca thymoides*, *Melaleuca bracteosa*, *Pericalymma ellipticum var. ellipticum* and *Beaufortia decussata* with occasional Albany Blackbutt (*Eucalytpus staeri*).

WM
Wetland mosaic of Peppermint (*Agonis flexuosa*) and *Callistachys lanceolata* woodland over *Pteridium esculentum*.

CP
Cleared/Pasture with occasional tree/shrub

AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

FAUNA HABITAT TYPES AND TRAP SITE LOCATIONS

FIGURE 11

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F12.dgn

metres

0 100 200 300 400

SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Fauna Habitat Boundary
- Western Ringtail Possum Location
- Drey Location
- Osprey Location
- Possibly Suitable Possum Hollow
- Possibly Suitable Black-Cockatoo Hollow
- Quenda Caught at Trapping Location
- Trapping Site Location

FAUNA HABITAT QUALITY

- 1 High Quality Fauna Habitat
- 2 Very Good Fauna Habitat
- 3 Good Fauna Habitat
- 4 Disturbed Fauna Habitat
- 5 Highly Degraded Fauna Habitat

Excluded (Under Approved Subdivision)

Area Excluded from SEA

Excluded (Under Approved Subdivision)

9000 (Former 284)

KING ROAD

LOWER KING ROAD

HOOPER RD

ALISON PDE

SIBBALD ROAD

WARLOCK ROAD

PARADE

ISLAND CRESCENT

JASON RD GREEN

ALLWOOD

BH1 BH2 BH3 BH4 BH5 BH6 BH7 BH8 BH9 BH10 BH11 BH12 BH13 BH14

AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

FAUNA HABITAT QUALITY

FIGURE 12

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F13.dgn

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SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

COAST LINE

FIGURE 13

PRINTED: Tue 16 Feb 10
CHECKED: MP 15-02-10
DRAWN: CR 23-07-09
DATUM: MGA zn50
ENVI/ALBA/00547AC/Reporting/EA2009-014F14.dgn

metres
0 100 200 300 400
SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Wetland Boundary
- 40 — Department of Water Wetland Mapping (DoW, 2007)

WETLAND EVALUATION CATEGORIES

- Conservation
- Resource Enhancement
- Multiple Use

KING ROAD
LOWER KING ROAD
HOOPER RD
ALISON PDE
JASON RD
GREEN ISLAND CRESCENT
SIBBALD ROAD
WARLOCK ROAD
PARADE
ALLWOOD

43
37
44
39
38
500
14
9000
47
Excluded (Under Approved Subdivision)
62
15
Area Excluded from SEA
3
2
2
63
42
286
31
40
41
1001
D
285
Excluded (Under Approved Subdivision)
57
8
476
P1
9000 (Former 284)
29
1000

OYSTER HARBOUR

AERIAL PHOTOGRAPH SOURCE: Landgate, January 2007.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT
WETLAND BOUNDARIES
FIGURE 14

PRINTED: Tue 16 Feb 10

metres

0 100 200 300 400 500

SCALE 1 : 10 000 @ A3

H
36.7ha

J
19.8ha

I
43.8ha

E
23.5ha

F
26.5ha

D
55.4ha

G
39.4ha

B
30.4ha

C
29.6ha

A
38.6ha

1 2 3 4 5 6 7 8 9 10 11 12 13 14

LEGEND

- ODP Boundary
- Major Catchment Boundary
- Sub-Catchment Boundary
- Approximate Flow Path
- Water Management Storage Node
- Proposed POS
- 8 Proposed POS Reference
- A Catchment Area Reference

SOURCE: Chappell Lambert Everett - Dwg No. 2036-65f, 19-06-09.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

DRAFT DRAINAGE CONCEPT PLAN

FIGURE 15

ENVI/ALBA/00547AC/Reporting/EA2009-014F15.dgn DATUM: MGA zn50 DRAWN: GLM/CR 14-07-09 CHECKED: MP 15-02-10

PRINTED: Tue 16 Feb 10

metres
0 100 200 300 400 500
SCALE 1 : 7 500 @ A3

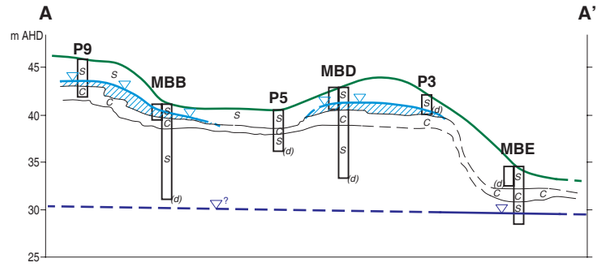
Excluded (Under Approved Subdivision)
Area Excluded from SEA
Excluded (Under Approved Subdivision)
9000 (Former 284)
HOOPER RD
LOWER KING ROAD
WARLOCK ROAD
SIBBALD ROAD
ISLAND
JASON RD
GREEN CRESCENT
ALLWOOD
P1 P3 P4 P5 P6 P8 P9 P10 P11 P12
MB-A MB-B MB-C MB-D MB-E
A A’ B

LEGEND

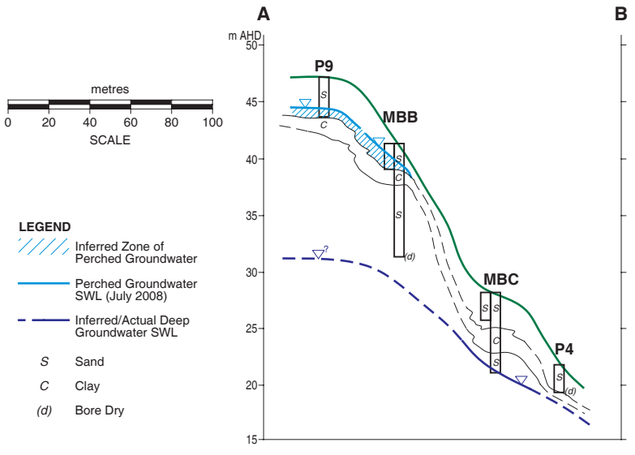
- Study Area Boundary
- Cadastral Boundary
- Wetland Boundary
- Department of Water Wetland Mapping (DoW, 2007)
- 40 Topographic Contour
- Monitoring Bore Location

WETLAND EVALUATION CATEGORIES

- Conservation
- Resource Enhancement
- Multiple Use



VERTICAL SECTION A - A’



VERTICAL SECTION A - B

SOURCE: Crisalis, 2008.

CADASTRAL SOURCE: DLI, 2005
AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007.

ENV/ALBA/00547AC/Reporting/EA2009-014F16.dgn DATUM: MGA zn50 DRAWN: CR 23-07-09 CHECKED: MP 15-02-10

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BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

HYDROLOGICAL - MONITORING BORES AND CROSS SECTIONS

FIGURE 16

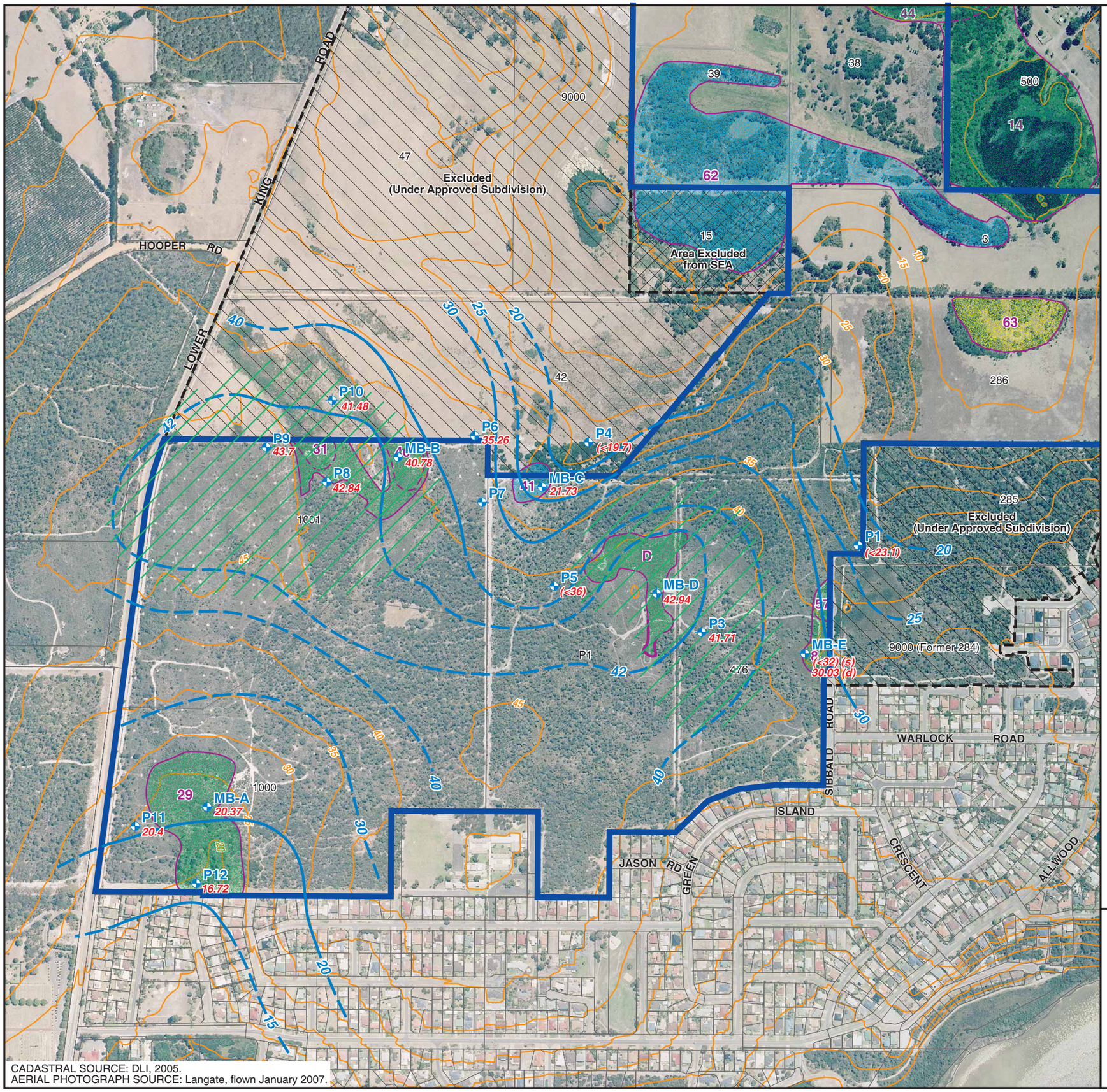
PRINTED: Tue 16 Feb 10

CHECKED: MP 15-02-10

DRAWN: CR 23-07-09

DATUM: MGA zn50

ENVI/ALBA/00547AC/Reporting/EA2009-014F17.dgn



CADASTRAL SOURCE: DLI, 2005.
AERIAL PHOTOGRAPH SOURCE: Langate, flown January 2007.

metres
0 100 200 300 400 500
SCALE 1 : 7 500 @ A3

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Topographic Contour
- Monitoring Bore Location
- 21.73 Groundwater Level (m AHD)
- Groundwater Level Contour - Verified (m AHD)
- Groundwater Level Contour - Inferred (m AHD)
- Perched Groundwater

WETLAND EVALUATION CATEGORIES

- Wetland Boundary
- 40 Department of Water Wetland Mapping (DoW, 2007)
- Conservation
- Resource Enhancement
- Multiple Use

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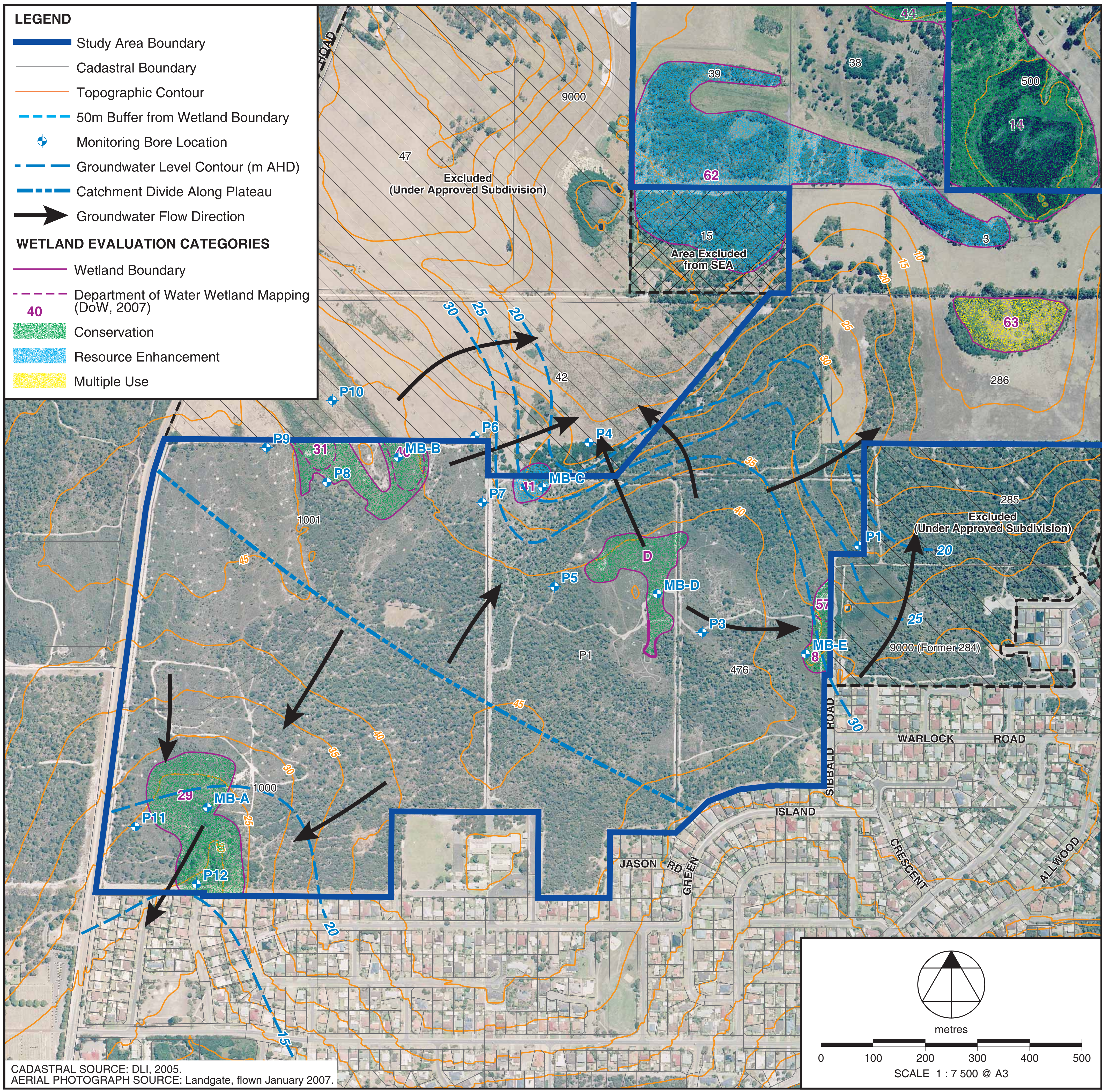
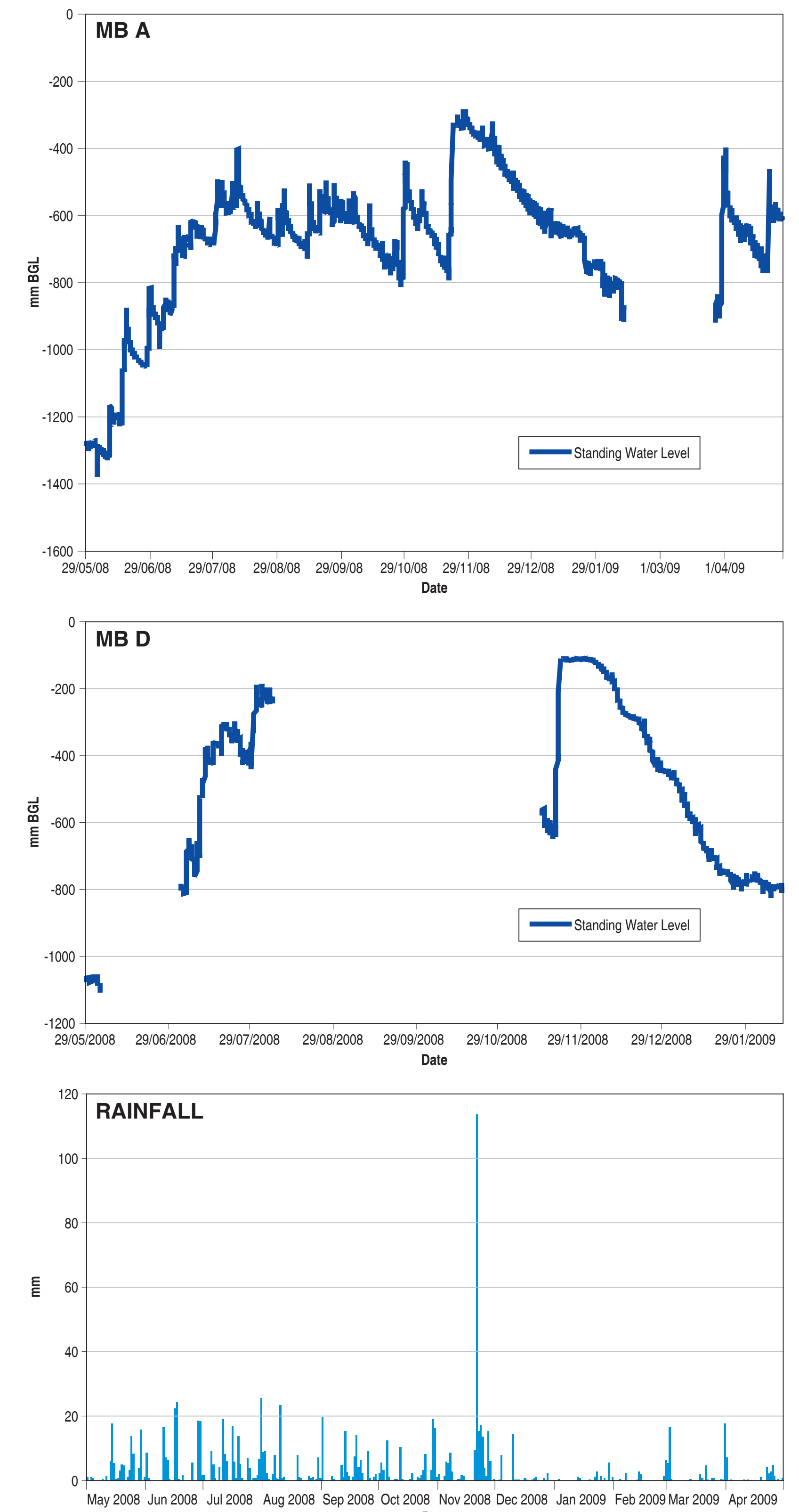
BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

GROUNDWATER LEVEL CONTOURS

FIGURE 17


LEGEND
Study Area Boundary
Cadastral Boundary
Topographic Contour
50m Buffer from Wetland Boundary
Monitoring Bore Location
Groundwater Level Contour (m AHD)
Catchment Divide Along Plateau
Groundwater Flow Direction
WETLAND EVALUATION CATEGORIES
Wetland Boundary
Department of Water Wetland Mapping (DoW, 2007)
40
Conservation
Resource Enhancement
Multiple Use
Excluded (Under Approved Subdivision)
Area Excluded from SEA
9000 (Former 284)
P1
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
MB-A
MB-B
MB-C
MB-D
MB-E
SIBBALD ROAD
WARLOCK ROAD
ISLAND
JASON RD
GREEN
CRESCENT
ALLWOOD
ROAD
metres
0 100 200 300 400 500
SCALE 1 : 7 500 @ A3
CADASTRAL SOURCE: DLI, 2005.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007.



NOTE:
- Bore MB-A is Wetland 29 (deep groundwater).
- Bore MB-D is Wetland D (Perched groundwater).
- Standing water levels correlate strongly with rainfall.
- There was an extreme rain event on 21 November 2008 which caused a significant spike in groundwater levels.

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SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

CONCEPTUAL MODEL
DEEP GROUNDWATER FLOW

FIGURE 18

PRINTED: Tue 16 Feb 10 CHECKED: MP 15-02-10 DRAWN: CR 23-07-09 DATUM: MGA zn50 ENVI/ALBA/00547AC/Reporting/EA2009-014F18.dgn

PRINTED: Tue 16 Feb 10
CHECKED: MP 15-02-10
DRAWN: CR 23-07-09
DATUM: MGA zn50
ENVI/ALBA/00547AC/Reporting/EA2009-014F19.dgn

metres
0 100 200 300 400
SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Area Part of Original Bayonet Head Outline Development Plan
- Area Excluded from SEA
- Acid Sulfate Soil Risk Mapping Boundary

ACID SULFATE SOILS RISK MAPPING

- **HIGH** — High risk of actual acid sulfate soil (AASS) & potential acid sulfate soil (PASS) <3m from surface
- **MOD** — Moderate to low risk of AASS and PASS occuring generally at depths of >3m (Not applicable to this figure)
- **NO** — Low to no risk of AASS and PASS occuring generally at depths of >3m

HIGH RISK
NO RISK
Excluded (Under Approved Subdivision)
Area Excluded from SEA
Excluded (Under Approved Subdivision)
NO RISK
NO RISK
NO RISK
OYSTER HARBOUR
KING ROAD
LOWER KING ROAD
HOOPER RD
ALISON PDE
WARLOCK ROAD
SIBBALD ROAD
PARADE
ISLAND CRESCENT
ALLWOOD
JASON RD
GREEN

AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007; ASS SOURCE: WAPC Planning Bulletin No. 64, July 2004.

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SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT
ACID SULFATE SOIL RISK AREA
FIGURE 19

PRINTED: Tue 16 Feb 10

CHECKED: MP 15-02-10

DRAWN: CR 23-07-09

DATUM: MGA zn50

ENVI/ALBA/00547AC/Reporting/EA2009-014F20.dgn

metres

0 100 200 300 400

SCALE 1 : 7 500

LEGEND

- Study Area Boundary
- Cadastral Boundary
- Area Part of Original Bayonet Head Outline Development Plan
- Area Excluded from SEA
- DIA Site
- Site Recorded During Field Survey

Site 22554
Alfred Knapp's
Seasonal Camp

Site 5524
Kylie Site

Site 636
Oyster Harbour
(total)

Oyster Harbour
Caravan Park Lake
(250m radius from centre of lake)

Excluded
(Under Approved Subdivision)

Area Excluded
from SEA

Excluded
(Under Approved Subdivision)

9000 (Former 284)

OYSTER
HARBOUR

NOTE:
Lots that have identified archaeological and/or ethnographic significance are subject to a Section 18 Notice under the *Aboriginal Heritage Act 1972* to grant consent for use of the land for residential development. The Section 18 notice covers Lots 1000 and 1001 Lower King Road, Lots 47, 42 and 43 Lower King Road, Part Lot 1 Yatana Road, Lot 38 and 37 Elizabeth Street and Lot 3 Alison Parade. Lots 286 and 2 Alison Parade, and Lot 476 Sibbald Road are not subject to the notice. While no sites of significance were identified on these areas, they are subject to the *Aboriginal Heritage Act 1972* if material is found.

AERIAL PHOTOGRAPH SOURCE: Landgate, flown January 2007; ABORIGINAL SITES SOURCE: Brad Goode & Assoc., January 2007.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

BAYONET HEAD - PLAN FOR DEVELOPMENT
STRATEGIC ENVIRONMENTAL ASSESSMENT

ABORIGINAL SITES

FIGURE 20

Appendix 1
Bayonet Head Flora Species List

Bayonet Head - Plan for Development
Strategic Environmental Assessment (EPA Assessment No. 1758)

Appendix 1: Bayonet Head Flora Species List (by Vegetation Type)

Family Code	Family Name	Naturalised	Species Name	Conservation Code	Floristic Group Type					
					1	2	5a	5b	6	7
011C	Dennstaedtiaceae		*Pteridium esculentum*							X
011D	Lindsaeaceae		*Lindsaea linearis*						X	
031	Poaceae		*Amphipogon amphipogonoides*						X	
		*	*Anthoxanthum odoratum*				X			
		*	*Avena fatua*							X
		*	*Briza maxima*							
		*	*Briza minor*							
			Poa poiformis		X					
032	Cyperaceae		*Cyathochaeta equitans*		X				X	
			Evandra aristata		X	X			X	
			Lepidosperma gladiatum		X	X	X		X	
			Lepidosperma gracile		X					
			Lepidosperma pubissquamatum						X	
			Lepidosperma squamatum		X				X	
			Lepidosperma tenue						X	
			Mesomelaena graciliceps		X			X		
			Mesomelaena tetragona						X	
			Schoenus caespititius		X				X	
			Schoenus discifer		X					
			Schoenus efoliatus		X	X				
			Schoenus nitens						X	
			Schoenus subfascicularis		X					
			Tetraria capillaris						X	
			Tetraria octandra						X	
			Tricostularia neesii						X	
035	Araceae	*	*Zantedeschia aethiopica*				X			
039	Restionaceae		*Anarthria gracilis*				X		X	
			Anarthria prolifera		X				X	
			Anarthria scabra		X				X	
			Chordifex laxus		X		X	X		
			Desmocladus fasciculatus				X		X	
			Desmocladus flexuosus						X	
			Hypolaena exsulca		X	X	X	X	X	
			Laxmannia jamesii	P4						
			Lepyrodia hermaphrodita				X			
			Loxocarya cinerea		X				X	
			Lyginia barbata		X					
			Lyginia imberbis		X	X			X	
			Platychorda applanata		X				X	
042	Xyridaceae		*Xyris lacera*		X	X				
			Xyris lanata			X				
052	Juncaceae		*Juncus pauciflorus*		X	X	X			
054C	Dasypogonaceae		*Dasypogon bromeliifolius*		X	X	X	X	X	
			Kingia australis		X				X	
			Lomandra sonderi		X		X		X	
054D	Xanthorrhoeaceae		*Xanthorrhoea brunonis*				X		X	
			Xanthorrhoea gracilis						X	
			Xanthorrhoea platyphylla				X		X	
			Xanthorrhoea sp.		X					
054F	Anthericaceae		*Johnsonia lupulina*		X					
			Johnsonia teretifolia		X					
			Thysanotus multiflorus				X		X	
054J	Colchicaceae		*Burchardia congesta*		X				X	
			Wurmbea dioica							
055	Haemodoraceae		*Anigozanthos humilis*							
			Conostylis serrulata		X				X	
			Conostylis setigera		X		X		X	
060	Iridaceae		Iridaceae sp. Folded Albany						X	
			Patersonia occidentalis						X	
			Patersonia umbrosa						X	
		*	*Watsonia sp.*							
066	Orchidaceae		*Caladenia flava*		X			X		
			Caladenia longiclavata							
			Drakaea micrantha	DRF	X#					
			Elythranthera brunonis		X	X			X	
			Lyperanthus serratus							
			Pyrorchus forrestii							
			Pterostylis recurva							
			Pterostylis vittata		X					
070	Casuarinaceae		*Allocasuarina fraseriana*		X		X		X	
			Allocasuarina humilis						X	
090	Proteaceae		*Adenanthos cuneatus*		X					
			Adenanthos obovatus		X	X			X	
			Banksia attenuata							
			Banksia illicifolia							
			Banksia coccinea		X					
			Banksia grandis		X				X	
			Conospermum caeruleum		X				X	
			Conospermum caeruleum subsp. *caeruleum*						X	
			Conospermum capitatum						X	
			Grevillea bipinnatifida						X	

Appendix 1: Bayonet Head Flora Species List (by Vegetation Type)

Family Code	Family Name	Naturalised	Species Name	Conservation Code	Floristic Group Type					
					1	2	5a	5b	6	7
			Grevillea pulchella subsp. *pulchella*						X	
			Hakea elliptica						X	
			Hakea ceratophylla						X	
			Hakea ruscifolia						X	
			Isopogon attenuatus						X	
			Persoonia longifolia		X				X	
			Petrophile heterophylla				X		X	
			Petrophile rigida						X	
			Petrophile serruriae		X					
			Synaphea gracillima							
			Synaphea media		X				X	
092	Santalaceae									
			Leptomeria scrobiculata							
			Leptomeria squarrulosa			X			X	
097	Loranthaceae									
			Nuytsia floribunda		X		X			
113	Caryophillaceae									
		*	*Petroryhagia dubia*				X			
131	Lauraceae									
			Cassytha sp.					X		
143	Droseraceae									
			Drosera erythrorhiza		X				X	
			Drosera fimbriata	P4	X#					
			Drosera macrantha		X	X			X	
			Droser menziesii		X				X	
			Drosera microphylla							
			Drosera neesii subsp. *neesii*		X			X		
			Drosera platypoda		X					
			Drosera stolonifera		X				X	
	Cephalotaceae		*Cephalotus follicularis*							
152	Pittosporaceae									
			Billardiera heterophylla		X					
			Marianthus candidus		X	X			X	X
161	Rosaceae									
		*	*Rosa rubiginosa*							X
163	Mimosaceae									
			Acacia browniana						X	
			Acacia chrysocephala		X					
			Acacia cyclops				X		X	
			Acacia drummondii subsp. *elegans*				X			
		*	*Acacia longifolia*							
			Acacia myrtifolia				X		X	
			Acacia pulchella						X	
			Acacia rostellifera				X	X		
			Acacia saligna subsp. *lindleyi* ms		X					X
165	Papilionaceae									
			Bossiaea linophylla				X		X	
			Callistachys lanceolata				X			X
			Chorizema cordatum						X	
			Chorizema reticulatum	P3						
			Chorizema rhombeum							
			Daviesia preissii						X	
			Gompholobium knightianum				X		X	
			Gompholobium marginatum						X	
			Gompholobium scabrum		X				X	
			Gompholobium venustum						X	
			Gompholobium villosum					X		
			Hardenbergia comptoniana							
			Hovea chorizemifolia		X		X		X	
			Jacksonia furcellata		X				X	
			Jacksonia spinosa		X					
			Kennedia coccinea				X		X	
			Latrobea diosmifolia		X					
			Latrobea genistoides		X					
		*	*Ornithopus compressus*							
		*	*Psoralea pinnata*				X			
			Sphaerolobium alatum						X	
			Sphaerolobium drummondii		X	X			X	
			Sphaerolobium grandiflorum		X				X	
			Sphaerolobium macranthum		X	X	X		X	
168	Oxalidaceae									
		*	*Oxalis purpurea*							
169	Tropaeolaceae									
		*	*Tropaeolum majus*							
175	Rutaceae									
			Boronia crenulata							
			Boronia crenulata subsp. *crenulata*		X	X			X	
			Boronia fastigiata		X				X	
			Boronia sp.		X	X				
			Boronia spathulata		X					
182	Tremandraceae									
			Tetratheca affinis						X	
			Tetratheca hirsuta		X				X	
			Tetratheca setigera						X	
183	Polygalaceae									
			Comesperma confertum				X			
			Comesperma flavum					X		
185	Euphorbiaceae									
			Amperea ericoides		X				X	
226	Dilleniaceae									
			Hibbertia amplexicaulis						X	
			Hibbertia cuneiformis				X		X	
			Hibbertia cunninghamii						X	
			Hibbertia inconspicua							
263	Thymelaeaceae									
			Pimelea longiflora subsp. *longiflora*		X				X	
273	Myrtaceae									

Appendix 1: Bayonet Head Flora Species List (by Vegetation Type)

Family Code	Family Name	Naturalised	Species Name	Conservation Code	Floristic Group Type 1	2	5a	5b	6	7
			Actinodium cunninghamii		X					
			Agonis flexuosa						X	X
			Agonis theiformis		X		X		X	
			Astartea fascicularis			X		X	X	
			Astartea scoparia		X	X			X	
			Beaufortia decussata		X	X			X	
			Beaufortia elegans		X					
			Beaufortia sparsa		X	X				
			Corymbia calophylla							
			Darwinia vestita		X					
			Eucalyptus marginata		X		X		X	
			Eucalyptus staeri		X	X				
			Homalospermum firmum			X				
		*	*Leptospermum laevigatum*						X	
			Melaleuca bracteata		X					
			Melaleuca preissiana					X		
			Melaleuca thymoides		X				X	
			Melaleuca viminea subsp. *viminea*				X			
			Pericalymma ellipticum		X	X			X	
			Pericalymma ellipticum var. *ellipticum*		X					
			Taxandria linearifolia			X		X		
281	Apiaceae									
			Actinotus omnifertilis							
			Apiaceae sp.				X			
			Daucus glochidiatus		X				X	
			Trachymene pilosa		X					
			Xanthosia candida				X			
			Xanthosia huegelii		X					
			Xanthosia rotundifolia		X	X	X		X	
			Xanthosia tasmanica				X			
288	Epacridaceae									
			Andersonia caerulea		X				X	
			Andersonia depressa	P3						
			Andersonia jamesii	P1	X#					
			Cosmelia rubra			X				
			Leucopogon altissimus	P3						
			Leucopogon glabellus		X				X	
			Leucopogon obovatus		X					
			Leucopogon propinquus						X	
			Leucopogon racemulosus		X				X	
			Leucopogon revolutus		X				X	
			Leucopogon unilateralis		X				X	
			Leucopogon verticillatus						X	
			Lysinema ciliatum		X					
			Needhamiella pumillo							
			Sphenotoma capitata			X				
			Sphenotoma gracile		X	X				
			Sphenotoma squarrosum		X			X	X	
302	Loganiaceae									
			Logania serpyllifolia						X	
331	Rubiaceae									
			Opercularia echinocephala						X	
			Opercularia hispidula						X	
			Opercularia vaginata				X		X	
341	Goodeniaceae									
			Dampiera linearis		X	X		X	X	
			Goodenia pulchella		X				X	
			Velleia trinervis			X				
343	Stylidiaceae									
			Stylidium amoenum				X			
			Stylidium luteum subsp. *luteum*		X		X			
			Stylidium plantagineum	P4					X#	
			Stylidium schoenoides		X				X	
			Stylidium sp.		X			X	X	
345	Asteraceae									
		*	*Arctotheca calendula*				X			
		*	*Hypochaeris glabra*		X					
			Rhodanthe citrina		X					
		*	*Sonchus oleraceus*				X			
		*	*Sonchus oleraceus*		X					

Introduced Species	17
Native Species	205
Total Species	**222**

- Floristic Group inferred based on the DEC ARVS mapping (Sandiford & Rathbone, 2008)

Floristic Grouping - 10 Group Level

Wetland

Floristic Group 1 - *Allocasuarina fraseriana* and/or *Eucalyptus staeri/Eucalyptus marginata* on Sandy Gravel to Heavy Wet Soils

Floristic Group 2 - *Homalospermum firmum* over Sedgeland Species

Floristic Group 3 – *Melaleuca preissiana* - *Kunzea ericifolia* and/or *Callistachys lanceolata*

Floristic Group 4a – Mixed *Eucalyptus* species over *Xanthorrhoea* species

Floristic Group 4b – *Melaleuca preissiana* /*Eucalyptus staeri* over *Kingia australis*

Floristic Group 5a – *Eucalyptus marginata* and *Allocasuarina fraseriana* on Wet/Transitional Habitats

Floristic Group 5b – *Melaleuca preissiana* and *Eucalyptus staeri*

Upland

Floristic Group 6 – *Eucalyptus marginata* and *Allocasuarina fraseriana* over *Agonis theiformis* on Dry Upland Habitats

Near Coastal

Floristic Group 7 – *Agonis flexuosa* over *Pteridium esculentum*

Floristic Group 8 – *Spinifex hirsutus* Foreshore Dunes

Floristic Group 9a – *Agonis flexuosa* over *Spyridium globulosum*

Floristic Group 9b – *Agonis flexuosa* - *Allocasuarina fraseriana* Open Forest

Floristic Group 10 - *Agonis flexuosa* over *Acacia littorea* - *Spyridium globulosum*

Appendix 2
Amphibians, Reptiles and Mammals Recorded in the Project Area, Yakamia and Emu Point Surveys

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APPENDIX 2: AMPHIBIANS, REPTILES AND MAMMALS RECORDED IN THE PROJECT AREA, YAKAMIA AND EMU POINT SURVEYS

Taxa/Family	Species	Jarrah/Sheoak Woodland Habitat																	Heath Shrubland Habitat								Wetland Mosaic						Grand Total
		BH1	BH2	BH6	BH7	BH14	Yk1	Yk2	Yk3	Yk4	Yk5	Yk6	Yk7	Yk8	Yk9	Yk10	Yk11	Yk12	BH3	BH10	BH13	EP1	EP2	EP3	EP4	EP5	BH4	BH5	BH8	BH9	BH11	BH12	
Amphibian:																																	
Hylidae	*Litoria adelaidensis*																													1	1		2
	Litoria moorei										1	1	1											1	1	2		1	1	4	6	1	20
Limnodynastidae	*Heleioporus eyrei*	5	5	13	5	11	1	4		2	8	11	13	2	3	1		1	11	14	17	17	13	14	8	12	4	75	1	5	2	14	292
	Limnodynastes dorsalis	3		8	6	1	2	4	1	2	5	3	6	4	2	2		5	1	1	1	1				1	1	4	4	2	3	3	76
Myobatrachidae	*Crinia georgiana*	5	1	4	4	7	11	7	4	1	14	4		1	20	6	5	1		20	7						1	21	7	27	10	15	203
	Crinia pseudinsignifera												2					1		2	2				2			1	1	1		12
	Crinea subinsignifera																																
	Geocrinia leai																			1		1	1	2				1					6
Reptile																																	
Elapidae	*Echiopsis curta*		2																														2
	Elapognathus coronatus	1	2							1				6	5	3	4	6	2	1	1	8	7		7	4	2			1			61
	Notechis scutatus			1									1										3		1	1	1						8
	Rhinoplocephalus bicolor														1	1																	2
Gekkonidae	*Christinus marmoratus*	1	1	1	1		5	2	4	1	1			1	3	2	7					2						1					33
Pygopodidae	*Aprasia striolata*											1			3		1				1	1			1	2			1				11
Scincidae	*Acritoscincus trilineatum*	5	5	6	7	6	4	6	3	2	5	6	4	18	7	4	9	8	11	10	11	6	12	7	10	6	12	11	15	11	17	5	249
	Ctenotus catenifer	2	1	5		1						1					2	1	10	4	6	20	19	13	22	8	11	6	3	10	1	2	148
	Ctenotus labillardieri	1	1	1																													3
	Egernia kingii										2					1			3	5	2		1	1							1	1	17
	Egernia luctuosa															2													3	1	5		11
	Egernia napoleonis	8	7	3	2	4	5	2				1	3		10	12	1	1	1	2	1	2					5	1		3			74
	Egernia pulchra		1	1	1	3		4				5	1			2	1	1	2	5	8	1	7		2	4			1	3		2	55
	Glaphyromorphus gracilipes				1	1										2			2	1				1	3	1	4	3	5	3	9	1	37
	Hemiergis initialis															2		1			1										1		5
	Hemiergis peronii	7	9	5	14	13	20	10	5	15	16	5	15	7	12	10	15	6	5	12	8	9	7	2	2	7	3	10	3	4	6	11	273
	Lerista microtis	2	1	1	1	1		1	1	3	6	7	1	14		3	1	6	4	1	2	13	23	16	18	14		12	1	3	3	7	166
	Menetia greyii	1												2				2		1							1				1	1	9
	Morethia obscura																		1	1	1			2								1	6
	Tiliqua rugosa			4				1	2		1		2		4	1	1			2	1						8	5	1	4	7	4	48
Varanidae	*Varanus rosenbergi*							1			1		1				1															1	5
Mammal																																	
Dasyuridae	*Sminthopsis griseoventer*						3	10	7	5	11	19	3			1		1				10	2	5	2	7							86
Muridae	*Mus musculus*	1	1	4	2		1	4		3	5	1	1	9	11	6	1	10	2			1	2	3			5	2					75
	Rattus fuscipes	25	62	27	7	43	55	37	10	12	14	27	59	1	33	27	24	7	38	49	49	19	46	41	49	27	63	6	31	21	43	52	1004
	Rattus rattus							1				2						2							1								6
Peramelidae	*Isoodon obesulus*		1										2						2	1			1										7
Tarsipedidae	*Tarsipes rostratus*		1	4	6	1												1	4	3		11	4	2	2	5	4		3	2		1	54
Vespertilionidae	*Chalinolobus gouldii*																																*
	Falsistrellus mackenziei																																*
	Nyctophilus sp.																																*
	Vespadelus regulus																																*
Molossidae	*Tadarida australis*																																*
Pseudocheiridae	*Pseudocheirus occidentalis*																																38
Canidae	*Vulpes vulpes*																																+
Felidae	*Felis catus*																																+
Leporidae	*Oryctolagus cuniculus*																																+
Number of individuals		67	101	88	57	92	107	94	37	47	90	94	115	65	114	88	73	61	99	136	119	122	148	110	129	103	125	159	81	106	117	122	3066
Number of species		14	16	16	13	12	10	15	9	11	14	15	16	11	13	19	14	18	16	20	17	16	15	14	15	16	15	15	16	18	17	17	42

* recorded by echolocation calls; + tracks and scats

Note: BH – Bayonet Head; Yk – Yakamia; EP – Emu Point

Appendix 3
Avifauna Recorded in the Project Area, Yakamia and Emu Point Surveys

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Appendix 3: Avifauna Recorded in the Project Area, Yakamia and Emu Point Surveys

Family	Species	Common Name	BH	EP	Yak
Casuariidae	*Dromaius novaehollandiae*	Emu	0	0	1
Phasianidae	*Coturnix pectoralis*	Stubble Quail	1	0	0
Anatidae	*Tadorna tadornoides*	Australian Shelduck	1	0	0
	Chenonetta jubata	Australian Wood Duck	2	0	0
	Anas gracilis	Grey Teal	1	0	0
	Anas superciliosa	Pacific Black Duck	3	0	12
Columbidae	*Streptopelia senegalensis*	Laughing Dove	44	4	21
	Phaps chalcoptera	Common Bronzewing	306	34	117
	Ocyphaps lophotes	Crested Pigeon	15	1	0
Podargidae	*Podargus strigoides*	Tawny Frogmouth	1	0	2
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	4	0	2
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	3	0	0
	Phalacrocorax sulcirostris	Little Black Cormorant	1	0	0
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	6	3	1
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	12	0	4
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	21	8	8
	Threskiornis spinicollis	Straw-necked Ibis	44	0	4
	Platalea flavipes	Yellow-billed Spoonbill	3	1	0
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	7	2	1
	Lophoictinia isura	Square-tailed Kite	0	0	2
	Haliastur sphenurus	Whistling Kite	3	0	1
	Accipiter fasciatus	Brown Goshawk	0	0	5
	Accipiter cirrocephalus	Collared Sparrowhawk	4	0	0
	Circus approximans	Swamp Harrier	1	0	2
	Hieraaetus morphnoides	Little Eagle	7	0	1
	Pandion haliaetus	Osprey	10	2	0
Falconidae	*Falco cenchroides*	Nankeen Kestrel	23	0	3
	Falco longipennis	Australian Hobby	1	0	0
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	3	0	0
	Fulica atra	Eurasian Coot	3	0	0
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	0	0	2
Laridae	*Larus pacificus*	Pacific Gull	0	4	0
	Chroicocephalus novaehollandiae	Silver Gull	8	50	13
Cacatuidae	*Calyptorhynchus banksii*	Red-tailed Black-Cockatoo	54	0	9
	Calyptorhynchus latirostris / baudinii	Black-Cockatoo (combined)	15	12	150
	Eolophus roseicapillus	Galah	22	21	0
Psittacidae	*Eolophus sp.*		2	0	0
	Glossopsitta porphyrocephala	Purple-crowned Lorikeet	63	25	46
	Polytelis alexandrae	Princess Parrot	2	0	0
	Platycercus icterotis	Western Rosella	160	8	32
	Barnardius zonarius	Australian Ringneck	0	13	24
	Purpureicephalus spurius	Red-capped Parrot	339	51	96
	Neophema elegans	Elegant Parrot	18	13	10
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	0	0	3
	Chalcites lucidus	Shining Bronze-Cuckoo	19	0	8
	Cacomantis flabelliformis	Fan-tailed Cuckoo	5	1	1
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	87	0	16
	Todiramphus sanctus	Sacred Kingfisher	1	0	2
Climacteridae	*Climacteris rufa*	Rufous Treecreeper	4	0	0
Maluridae	*Malurus splendens*	Splendid Fairy-wren	471	71	279
	Malurus elegans	Red-winged Fairy-wren	853	36	295
	Stipiturus malachurus	Southern Emu-wren	451	21	9
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	466	10	107
	Gerygone fusca	Western Gerygone	609	9	140
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	157	0	21
	Acanthiza inornata	Western Thornbill	17	24	43
	Acanthiza apicalis	Inland Thornbill	659	29	120
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	73	0	2
	Pardalotus striatus	Striated Pardalote	3	0	0
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill	626	34	97
	Anthochaera carunculata	Red Wattlebird	145	16	49
	Epthianura albifrons	White-fronted Chat	1	0	11
	Lichmera indistincta	Brown Honeyeater	19	0	19
	Phylidonyris novaehollandiae	New Holland Honeyeater	770	249	363
	Melithreptus lunatus	White-naped Honeyeater	3	0	0
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	8	0	0
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike	61	0	1
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	334	6	131
	Colluricincla harmonica	Grey Shrike-thrush	49	16	31
Artamidae	*Cracticus torquatus*	Grey Butcherbird	0	7	0
	Cracticus tibicen	Australian Magpie	311	23	75
	Strepera versicolor	Grey Currawong	7	0	19
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail	756	19	293
	Rhipidura leucophrys	Willie Wagtail	21	0	0
Corvidae	*Corvus coronoides*	Australian Raven	159	15	79
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark	33	2	4
Petroicidae	*Petroica multicolor*	Pacific Robin	60	0	5
	Eopsaltria griseogularis	Western Yellow Robin	17	0	0
	Eopsaltria georgiana	White-breasted Robin	40	0	33
Timaliidae	*Zosterops lateralis*	Silvereye	1459	375	1531
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	162	3	6
	Petrochelidon nigricans	Tree Martin	231	0	53
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail	41	0	34
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit	4	0	0

Appendix 4
Preparing a Wetland Management Plan

Bayonet Head - Plan for Development
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APPENDIX 4: Preparing a Wetland Management Plan. From EPA Guidance Statement 33 (2008)

Attachment B4-5
Preparing a wetland management plan

For each protected wetland, preparing and implementing a wetland management plan is recommended. Wetland management plans may vary considerably depending on the issues involved. However, each should contain the basic elements outlined in Attachment A1-2 and in the example below. Two examples of an outline for a management plan are provided in this guidance statement. One is described below, and the second is in Attachment B2-4 together with references to assist the preparation of a management plan.

EXAMPLE OF CONTENTS FOR A WETLAND MANAGEMENT PLAN

The main sections of this model are as follows:

• summary of management commitments
• introduction
• natural environment
-- climate
-- geology, landform, landscape and soils
-- hydrology
-- vegetation and flora
-- fauna
• cultural use and appreciation
-- historical use
-- community use
• administration, implementation and review
• appendices.

These sections are described below.

Summary of management commitments

This section provides a summary of all the objectives, strategies and key performance indicators described in the document. This may be provided in a table format.
Objectives are broad overarching statements (for example, to conserve flora and vegetation communities).
Strategies are the actions designed to achieve the objectives (for example, monitor the impacts of feral animals on flora values).
Key performance indicators are measurable criteria, which indicate the effectiveness of the management plan (for example, density of understorey vegetation is increased from current levels).

Introduction

This section provides a succinct description of the site, its key values, contextual information, and the purpose of the management plan:

• location, name and description of the site
• current ownership/vesting and management arrangements, zoning, use and infrastructure within and adjacent to the site

• significance of the wetland and surrounds based on conservation, scientific, educational, recreational, commercial, cultural and heritage values in a regional and local context. May outline the history and the sense of place associated with the site (Tizard 2000, Seddon 1972)
• the wetland classification (wetland type), and, if applicable, the assigned wetland management category
• regional, sub-regional and catchment plans which may provide context for the management plan
• legislation or policies that apply to the site (for example, *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*, Wildlife Conservation Act 1950, Bush Forever)
need for the wetland management plan (incorporating threats, community desire, corporate citizenship)
• purpose and overarching objectives of the plan
• parties participating in the development and administration of the wetland management plan.

Natural environment

This section describes the natural environment, and identifies values, threats, objectives, priorities, criteria for indicating the effectiveness of the management plan, and detailed actions to meet objectives.

• Climate

• Geology, landforms and soils

-- include any information about soil disturbance, dredging, major earthworks, mining, filling, quarrying,
-- contamination, acid sulfate soils, soil amendment
-- landscape and landforms values
-- threats (for example, erosion, mining, grazing)
-- objectives, strategies, priorities and key performance indicators (as applicable)

• Hydrology

-- key catchment characteristics and processes
-- groundwater and wetland hydrology (baseline studies of water quantity can be discussed here)
-- current and future stormwater management
-- current and future water quality including nutrient levels, algae, botulism, heavy metals, and pollutants (baseline studies of water quality can be discussed here)
-- pollution risk management, emergency response, contingency plan-threats to hydrology
-- objectives, strategies, priorities and key performance indicators (as applicable)

• Vegetation and flora

-- mapping of vegetation or ecological communities and vegetation condition
-- ecological linkage value
-- identify the boundary of the wetland vegetation
-- flora surveys (see EPA Guidance Statement No. 51) which may be reported in an appendix
-- significant flora, threatened ecological communities
-- dominant weed species and their distribution and vectors (for example, garden dumping,
-- neighbouring properties, birds, animals, mining activities). If applicable, develop a weed management plan outlining manual, chemical and biological weed removal strategies and methods and schedule including information on any chemicals to be used (which may be placed in an appendix)
-- dieback and other diseases presence and distribution. If applicable, develop a dieback mapping and dieback management plan (which may be placed in an appendix)
-- fire history, impact and role of fire, location of firebreaks. If applicable, develop a fire management
-- plan (which may be placed in an appendix)
-- introduced fauna impact (for example, rabbits, camels, cattle, goats)
-- threats to flora-objectives, strategies, priorities and key performance indicators (as applicable)

• Fauna

presence of -- fauna (for example, water birds, terrestrial birds, amphibians, reptiles, mammals, fish and invertebrates, including mosquitos and midges)
-- fauna survey (see EPA Guidance Statement No. 56) which may be reported in an appendix
-- significant fauna
-- important areas for fauna habitat
-- issues concerning human interaction with fauna (for example, feeding of gulls, kangaroos, parrots, swans)
-- current and potential wildlife corridors
-- presence of introduced fauna (for example, cats, rabbits, foxes, camels, Argentine ants, ducks, mosquito fish, sheep, cattle, horses, goats, rats/mice, dogs, donkeys)
-- threats to fauna-objectives, strategies and key performance indicators (as applicable).

Cultural use and appreciation

This section describes human use and appreciation issues, and identifies values, threats, objectives, priorities, criteria for indicating the effectiveness of the management plan, and detailed actions to meet objectives.
-- historical use and management
-- Aboriginal heritage significance (include ethnographic and archaeological surveys and reports in appendix)
-- European and other heritage significance (include research reports in an appendix)- objectives, strategies and key performance indicators (as applicable)

• Community use

-- current passive and active recreational uses of the site, resource-based uses (for example, quarrying, firewood collection) -community groups active on the site and the potential for active community groups to look after the site
-- planned future uses such as passive recreation, active recreation, education, heritage site, scientific research (include any community survey results and public consultation results) showing consideration of the natural landscape, hydrology, flora and fauna of the site, and exposure to risks such as snake bite, accidents and crime (consider liability and insurance). A recreation plan and education plan may be included in an appendix
-- implications for conservation objectives
-- access control and location of facilities required (for example, road access, access and facilities for people with disabilities, walk trails, boardwalks, dog walking access and facilities, bridle trails, rubbish bins, seating, signage, toilets, water taps, car parks, picnic facilities, food facilities, lighting, educational facility, interpretive signage, perimeter and internal fencing, turnstiles, fire breaks, emergency vehicle access, maintenance vehicle access, supply vehicle maintenance, utility maintenance access [for example, Water Corporation access to maintain and inspect drains], monitoring stations, groundwater monitoring bores), showing consideration of the natural landscape, hydrology, flora and fauna of the site
-- objectives, strategies and key performance indicators (as applicable).

Administration, implementation and review of wetland management plan

• agency or group with overall responsibility for the wetland management plan
• consultation with community and key stakeholders: process, length, feedback and negotiation
• membership of implementation coordinating committee/working groups
• procedures for adoption of the wetland management plan
• term of the wetland management plan
• procedures for interim evaluation of the wetland management plan
• procedures for review of the wetland management plan
• management agency or agencies responsible for individual recommendations/ commitments
• funding and staff; volunteers to be utilised
• include a funding plan
• implementation schedule based on, for example, priorities of recommendations, seasonal determinants, funding, receiving necessary approvals
• community liaison and involvement in implementation (include communication plans in an appendix)
• performance reporting, assessment, audit and review procedures.

Appendices

Consider:
aerial photographs water pollution contingency plan
consultation program
maps
dieback management plan
list of stakeholders
recreation plan
management plan action calendar (for example in Gantt chart)
education plan
fauna reintroduction plan
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funding plan glossary
fire management plan
evaluation plan and evaluation form
references
construction management plan
news clippings
acronyms

APPENDIX 4: Preparing a Wetland Management Plan. From EPA Guidance Statement 33 (2008)

Attachment B4-5
Preparing a wetland management plan

For each protected wetland, preparing and implementing a wetland management plan is recommended. Wetland management plans may vary considerably depending on the issues involved. However, each should contain the basic elements outlined in Attachment A1-2 and in the example below. Two examples of an outline for a management plan are provided in this guidance statement. One is described below, and the second is in Attachment B2-4 together with references to assist the preparation of a management plan.

EXAMPLE OF CONTENTS FOR A WETLAND MANAGEMENT PLAN

The main sections of this model are as follows:

• summary of management commitments
• introduction
• natural environment
-- climate
-- geology, landform, landscape and soils
-- hydrology
-- vegetation and flora
-- fauna
• cultural use and appreciation
-- historical use
-- community use
• administration, implementation and review
• appendices.

These sections are described below.

Summary of management commitments

This section provides a summary of all the objectives, strategies and key performance indicators described in the document. This may be provided in a table format.
Objectives are broad overarching statements (for example, to conserve flora and vegetation communities).
Strategies are the actions designed to achieve the objectives (for example, monitor the impacts of feral animals on flora values).
Key performance indicators are measurable criteria, which indicate the effectiveness of the management plan (for example, density of understorey vegetation is increased from current levels).

Introduction

This section provides a succinct description of the site, its key values, contextual information, and the purpose of the management plan:

• location, name and description of the site
• current ownership/vesting and management arrangements, zoning, use and infrastructure within and adjacent to the site

• significance of the wetland and surrounds based on conservation, scientific, educational, recreational, commercial, cultural and heritage values in a regional and local context. May outline the history and the sense of place associated with the site (Tizard 2000, Seddon 1972)
• the wetland classification (wetland type), and, if applicable, the assigned wetland management category
• regional, sub-regional and catchment plans which may provide context for the management plan
• legislation or policies that apply to the site (for example, *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*, Wildlife Conservation Act 1950, Bush Forever)
need for the wetland management plan (incorporating threats, community desire, corporate citizenship)
• purpose and overarching objectives of the plan
• parties participating in the development and administration of the wetland management plan.

Natural environment

This section describes the natural environment, and identifies values, threats, objectives, priorities, criteria for indicating the effectiveness of the management plan, and detailed actions to meet objectives.

• Climate

• Geology, landforms and soils

-- include any information about soil disturbance, dredging, major earthworks, mining, filling, quarrying,
-- contamination, acid sulfate soils, soil amendment
-- landscape and landforms values
-- threats (for example, erosion, mining, grazing)
-- objectives, strategies, priorities and key performance indicators (as applicable)

• Hydrology

-- key catchment characteristics and processes
-- groundwater and wetland hydrology (baseline studies of water quantity can be discussed here)
-- current and future stormwater management
-- current and future water quality including nutrient levels, algae, botulism, heavy metals, and pollutants (baseline studies of water quality can be discussed here)
-- pollution risk management, emergency response, contingency plan-threats to hydrology
-- objectives, strategies, priorities and key performance indicators (as applicable)

• Vegetation and flora

-- mapping of vegetation or ecological communities and vegetation condition
-- ecological linkage value
-- identify the boundary of the wetland vegetation
-- flora surveys (see EPA Guidance Statement No. 51) which may be reported in an appendix
-- significant flora, threatened ecological communities
-- dominant weed species and their distribution and vectors (for example, garden dumping,
-- neighbouring properties, birds, animals, mining activities). If applicable, develop a weed management plan outlining manual, chemical and biological weed removal strategies and methods and schedule including information on any chemicals to be used (which may be placed in an appendix)
-- dieback and other diseases presence and distribution. If applicable, develop a dieback mapping and dieback management plan (which may be placed in an appendix)
-- fire history, impact and role of fire, location of firebreaks. If applicable, develop a fire management
-- plan (which may be placed in an appendix)
-- introduced fauna impact (for example, rabbits, camels, cattle, goats)
-- threats to flora-objectives, strategies, priorities and key performance indicators (as applicable)

• Fauna

presence of -- fauna (for example, water birds, terrestrial birds, amphibians, reptiles, mammals, fish and invertebrates, including mosquitos and midges)
-- fauna survey (see EPA Guidance Statement No. 56) which may be reported in an appendix
-- significant fauna
-- important areas for fauna habitat
-- issues concerning human interaction with fauna (for example, feeding of gulls, kangaroos, parrots, swans)
-- current and potential wildlife corridors
-- presence of introduced fauna (for example, cats, rabbits, foxes, camels, Argentine ants, ducks, mosquito fish, sheep, cattle, horses, goats, rats/mice, dogs, donkeys)
-- threats to fauna-objectives, strategies and key performance indicators (as applicable).

Cultural use and appreciation

This section describes human use and appreciation issues, and identifies values, threats, objectives, priorities, criteria for indicating the effectiveness of the management plan, and detailed actions to meet objectives.
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Appendix 5
Groundwater Quality Results Summary

Bayonet Head - Plan for Development
Strategic Environmental Assessment (EPA Assessment No. 1758)

APPENDIX 5: GROUNDWATER QUALITY RESULTS SUMMARY

Bayonet Head Baseline Groundwater Quality - Metals

		Total Aluminium	Dissolved Aluminium	Dissolved Arsenic	Dissolved Cadmium	Dissolved Chromium	Dissolved Copper	Total Iron	Dissolved Iron	Dissolved Manganese	Dissolved Nickel	Dissolved Selenium	Dissolved Zinc	Sodium	Calcium	Magnesium	Potassium
	Units	mg/L															
Assesment Criteria																	
Fresh Water-Wetlands		0.055	0.055	0.024	0.0002	0.01	0.014	NV	NV	500	11	5	8	NV	NV	NV	NV
Short term irrigation		20	20	2	0.05	1	5	10	10	10	2	0.05	5	NV	NV	NV	NV
ASS Indicators		>1	>1	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV	NV
Location	Date																
MBA	Jun-08	9.2	1.3	0.001	0.0001	0.011	0.002	2.1	1.3	0.28	0.004	0.001	0.13	45	4.6	5.7	1.3
MBA	Feb-09	2.6	0.9	0.001	0.0001	0.002	0.006	3.3	2.2	0.04	0.001	0.001	0.011	33	2.5	4.0	1.5
MBB shallow	Jun-08	40	3.2	0.004	0.0001	0.014	0.012	48	2.4	0.83	0.038	0.001	2.9	70	11	10	2.2
MBB shallow	Feb-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MBC deep	Jun-08	420	0.4	0.056	0.0001	0.82	0.015	25	8.7	3.3	0.13	0.001	0.35	64	21	9.8	4.0
MBC deep	Feb-09	11	0.4	0.001	0.0001	0.002	0.005	1.4	0.06	0.19	0.001	0.001	0.005	40	6.7	5.9	2.0
MBD shallow	Jun-08	20	2.8	0.005	0.0001	0.014	0.014	27	2.7	0.33	0.001	0.001	0.18	120	9.6	29	1.2
MBD shallow	Feb-09	5.5	2.2	0.001	0.0001	0.005	0.035	11	3.1	0.20	0.002	0.001	0.066	100	7.4	21	1.7
MBE deep	Jun-08	940	2.1	0.033	0.0019	0.27	0.19	900	51	7.3	0.022	0.001	6.5	310	52	69	3.5
MBE deep	Feb-09	46	0.2	0.001	0.0001	0.004	0.006	14	0.62	0.25	0.001	0.001	0.005	300	11	55	1.9

Bayonet Head Baseline Groundwater Quality - Nutrients

		Ammonia-N	Total Kjeldahl Nitrogen	NOx-N	Total Nitrogen	Reactive Phosphorous	Total Phosphorus
	Units	mg/l					
Assesment Criteria							
Fresh Water-Wetlands		0.04	NV	0.1	1.5	0.03	0.06
Short term irrigation		NV	NV	NV	25-125	NV	0.8-12
ASS Indicators		NV	NV	NV	NV	NV	NV
Location	Date						
MBA	Jun-08	0.2	1.4	0.10	1.5	0.01	0.12
MBA	Feb-09	0.2	2	0.01	2	0.01	0.07
MBB shallow	Jun-08	0.2	1.9	0.15	2.1	0.03	0.28
MBB shallow	Feb-09	-	-	-	-	-	-
MBC deep	Jun-08	0.5	15	0.13	15	0.03	0.09
MBC deep	Feb-09	0.2	0.4	2.5	2.9	0.01	0.26
MBD shallow	Jun-08	0.2	1.8	0.16	2.0	0.03	0.24
MBD shallow	Feb-09	0.2	2.9	0.01	2.9	0.01	0.15
MBE deep	Jun-08	0.3	14	0.13	14	0.04	0.13
MBE deep	Feb-09	0.5	4.6	0.01	4.6	0.01	1.1

Bayonet Head Baseline Groundwater Quality - Misc Inorganics

		pH	Conductivity	Alkalinity	Total Acidity	Bicarbonate	Carbonate	Hydroxide	Dissolved Oxygen	Chloride	Hydrogen Sulphide	Sulphate	Total Dissolved Solids	Redox potential	Sulphate to Chloride ratio	Alkalinity to Sulfate ratio
	Units	#	mS/cm	mg $CaCO_3$/l					mg/l					mV	-	-
Assessment Criteria																
Fresh Water-Wetlands		7.5-8.5	0.3-1.5	NV	NV	NV	NV	NV	NV	NV	0.0005	NV	1000	NV	NV	NV
Short term irrigation		4.5-9	0.8	NV	NV	NV	NV	NV	NV	700	NV	500	NV	NV	NV	NV
ASS Indicators		<5	NV	NV	40	NV	NV	NV	NV	NV	NV	NV	NV	NV	>0.5	<5
Location	Date															
MBA	Jun-08	5.4	0.27	9	73	9	<5	<5	6.6	51	2.0	3	270	310	0.059	3.000
MBA	Feb-09	5.1	0.32	<5	47	<5	<5	<5	3.5	67	0.8	3	230	143	0.045	1.667
MBB shallow	Jun-08	5.5	0.52	14	92	14	<5	<5	7.6	140	0.5	10	630	299	0.071	1.400
MBB shallow	Feb-09	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MBC deep	Jun-08	5.9	0.48	63	240	63	<5	<5	0.4	300	2	31	1000	290	0.103	2.032
MBC deep	Feb-09	5.6	0.43	18	55	18	<5	<5	4.5	80	0.6	24	390	141	0.300	0.750
MBD shallow	Jun-08	3.7	1.0	<5	110	<5	<5	<5	7.9	110	2	37	670	350	0.336	0.135
MBD shallow	Feb-09	4.0	0.91	<5	96	<5	<5	<5	3.4	290	0.5	4	710	264	0.014	1.250
MBE deep	Jun-08	5.8	2.0	78	270	78	<5	<5	8.4	660	2	25	1800	266	0.038	3.120
MBE deep	Feb-09	5.0	2	12	150	12	5	5	2.0	660	0.5	77	1500	226	0.117	0.156

Appendix 6
Section 18 Notice
Aboriginal Heritage Act 1972

Bayonet Head - Plan for Development
Strategic Environmental Assessment (EPA Assessment No. 1758)

Department of Indigenous Affairs
Government of Western Australia

Memorandum

TO:	MINISTER FOR INDIGENOUS AFFAIRS	DATE:	16 May 2007
FROM:	A/DIRECTOR GENERAL	YOUR REF:	11-9988
SUBJECT:	Section 18 Ministerial - Lowe Pty Ltd	OUR REF:	56602 - 07/0219

ISSUE

The possible grant of conditional consent under section 18(3) of the *Aboriginal Heritage Act 1972* to Lowe Pty Ltd, Department of Housing and Works, Lorenzo Giuseppe Mirco, Phyllis Irene Mirco and Richard Edmund Fenny for a residential subdivision and associated infrastructure on Lots 1000 and Lot 1001 Lower King Road; Lots 47, 42 and 43 Lower King Rd; Lot 1, Jason Road; Lot 3 and 500, Alison Pde; Lot 40, Elizabeth Street.

Background

Under section 18(2) of the *Aboriginal Heritage Act 1972* ("AHA"), the Aboriginal Cultural Material Committee ("ACMC") is required to submit to you any notice received from the owner of any land within the meaning of the AHA together with its recommendations in writing as to whether you should consent to the use of the land for a purpose which, unless your consent is obtained, may result in a breach of section 17 of the AHA.

Current Status

A section 18 notice dated 7 March 2007 (received by the Department Indigenous Affairs ("DIA") on 9 March 2007) together with supporting information ("the Notice") was received from Lowe Pty Ltd, acting on behalf of all listed Landowners ("Landowner"), and is **Attachment 1**.

The ACMC considered the Notice at its meeting held on 2 May 2007. An extract from the Minutes of the meeting is **Attachment 2**.

Attachment 3 is a briefing note provided to the ACMC by staff within the Heritage and Culture Branch of the DIA. The notes are provided to assist the ACMC with its deliberations under section 18(2) of the AHA.

Details of Notice

Landowners:	Lowe Pty Ltd, Department of Housing and Works, Lorenzo Giuseppe Mirco and Phyllis Irene Mirco and Richard Edmund Fenny.
Proponent:	Lowe Pty Ltd
Land:	Lots 1000 and 1001 Lower King Road; Lots 47, 42 and 43 Lower King Rd; Lot 1, Jason Road; Lots 3 and 500, Alison Pde; Lot 40, Elizabeth Street.

Purpose: Residential subdivision to create 2300 lots covering approximately 200 hectares and developing all infrastructure including roads, sewer, water, stormwater, electricity and telecommunications.

The ACMC resolved (Resolution: 2007/065) to recommend to the Minister that consent be granted to Lowe Pty Ltd and Department of Housing and Works, Lorenzo Giuseppe Mirco and Phyllis Irene Mirco and Richard Edmund Fenny to use the land described in Schedule 1 of the Notice, for the purpose described in Schedule 2 of the Notice.

On current knowledge the Purpose will not impact upon any Aboriginal sites within the meaning of section 5 of the AHA ("Site") on the Land.

Action Required

Attached for your consideration is a suggested letter to advise Lowe Pty Ltd of your decision under section 18(3) of the AHA.

Should you wish to make a different decision using your powers under section 18(3), appropriate documentation can be drafted in response to your direction.

RECOMMENDED ACTION

That you:

(1) Note the contents of this brief and the attached documents.
(2) Consider the draft response to Lowe Pty Ltd.

LEX McCULLOCH
A/DIRECTOR GENERAL

Att.

1. Section 18 Notice with supporting material from Lowe Pty Ltd.
2. Extracts of minutes from the 2 May 2007 ACMC meeting.
3. Briefing notes provided to the ACMC.

Noted /
Approved /
Not Approved ..... / /
Minister for Indigenous Affairs

(I:\idms\minister\open\rgl\may 2007 acmc ministerials\rgl0024m.doc)

Prepared by	Roz Lipscombe - 9235 8067	Date:	/ /
Asst Director Signature		Date:	/ /
Director Signature		Date:	21 / 05 / 07

56602.

MINISTER FOR HOUSING AND WORKS; HERITAGE; INDIGENOUS AFFAIRS; LAND INFORMATION

Our Ref: 11-9988

Mr Brian Newman
Lowe Pty Ltd (Heath Development Company)
PO Box 381
COTTESLOE WA 6911

Dear Mr Newman

Introduction

I refer to the Notice dated 7 March 2007 (received by the Department of Indigenous Affairs on 9 March 2007) submitted by Lowe Pty Ltd, acting on behalf all listed Landowners to the Aboriginal Cultural Material Committee ("ACMC") pursuant to section 18(2) of the *Aboriginal Heritage Act 1972* ("AHA").

The Notice advised that you require to use the land described in Schedule 1 of the Notice as Lots 1000 and 1001 Lower King Road; Lots 47, 42 and 43 Lower King Rd; Lot 1, Jason Road; Lots 3 and 500, Alison Parade; and Lot 40, Elizabeth Street ("the Land"), for the purpose described in Schedule 2 of the Notice as residential subdivision to create 2300 lots covering approximately 200 hectares and developing all infrastructure including roads, sewer, water, stormwater, electricity and telecommunications ("the Purpose").

In accordance with my powers under section 18(3) of the AHA and following consideration of recommendations from the ACMC, I hereby grant consent to the use of the Land for the Purpose.

I am advised that based on current knowledge the Purpose will impact upon no Aboriginal sites within the meaning of section 5 of the AHA on the Land.

If you have any queries in relation to your application, please contact Susan Allia, DIA Heritage Assessment Officer, on telephone 9235 8112.

Yours sincerely

Michelle Roberts

HON MICHELLE ROBERTS MLA
MINISTER FOR INDIGENOUS AFFAIRS

27 JUN 2007

13th Floor, Dumas House, 2 Havelock Street, West Perth, Western Australia 6005
Telephone: (08) 9213 6600 Facsimile: (08) 9213 6601 Email: michelle-roberts@dpc.wa.gov.au

Technical Appendices
Volume II on CD - Rom

Bayonet Head - Plan for Development
Strategic Environmental Assessment (EPA Assessment No. 1758)