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**PROPOSED BIBRA LAKE GENERAL INDUSTRIAL  
ESTATE - LOT 502 NORTH LAKE, SUDLOW AND  
PHOENIX ROADS BIBRA LAKE**

**PUBLIC ENVIRONMENTAL REVIEW**



**Prepared for  
LandCorp  
by Welker Environmental Consultancy**

**September 2002**

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NORTH LAKE, SUDLOW AND PHOENIX ROADS BIBRA LAKE**

**PUBLIC ENVIRONMENTAL REVIEW**

Welker Environmental Consultancy  
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September 2002

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### **Client: LandCorp**

Report	Version	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
Draft Report	V1	WM,CW	CW	1	24/4/02
Draft Report	V2	WM, CW	CW	1	17/7/02
Draft Report	V3	WM, CW	CW, client	4	8/8/02
Final Report	V4	WM,CW	CW	2	11/9/02

## **AN INVITATION TO COMMENT ON BIBRA LAKE INDUSTRIAL ESTATE PUBLIC ENVIRONMENTAL REVIEW**

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

This Public Environmental Review (PER) proposes the development of a general industry subdivision at Lot 502 North Lake, Sudlow and Phoenix Roads in Bibra Lake. The proponent for the proposal is LandCorp. In accordance with the requirements of the *Environmental Protection Act*, 1986 a PER has been prepared which describes this proposal and its likely effects on the environment. The PER is available for public review for four weeks from 16 September to 14 October 2002.

Comments from Government agencies and from the public will help the Environmental Protection Authority (EPA) to prepare an assessment report in which it will make recommendations to the Government.

### **Why write a submission?**

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approaches. It is useful if you indicate any suggestions you have to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless received in confidence subject to the requirements of the *Freedom of Information Act*, and may be quoted in full or in part in the EPA's report.

### **Why not join a group?**

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the work for an individual or group, as well as increasing the pool of ideas and information. If you form a small group (up to ten people) please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

### **Developing a submission**

You may agree or disagree with, or comment on, the general issues discussed in the PER or with the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal more environmentally acceptable.

When making comments on specific elements of the PER:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable; and
- suggest recommendations, safeguards or alternatives.

### **Points to keep in mind**

By keeping the following points in mind, you will make it easier for your submissions to be analysed:

- attempt to list points so that the issues raised are clear. A summary of the submission is helpful.
- refer each point to the appropriate section, chapter or recommendation in the PER.
- if you discuss different sections of the PER, keep them distinct and separate, so there is no confusion as to which section you are considering.
- attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

### **Remember to include:**

- your name;
- your address;
- the date; and
- whether you want your submission to be confidential.

The closing date for submission is 14 October 2002

Submissions should be addressed to:

Environmental Protection Authority  
8<sup>th</sup> Floor, Westralia Square  
141 St Georges Terrace  
PERTH WA 6000

Attention: Maxine Dawson



## EXECUTIVE SUMMARY

### INTRODUCTION

LandCorp proposes to subdivide 89 ha of land for industrial and mixed business purposes on Lot 502 North Lake, Phoenix and Sudlow Roads, Bibra Lake approximately 17 km south of Perth. LandCorp is seeking to develop the estate to assist in replacing the diminished short-term supply of industrial land.

The land is immediately west of South Lake. South Lake is subject to the provisions of the Environmental Protection (Swan Coastal Plain Lakes) Policy and is part of Beeliar Regional Park. Lot 502 contains extensive areas of native vegetation, some of which is affected by past waste disposal and land uses such as grazing.

### PREVIOUS ASSESSMENT

The Western Australian Planning Commission submitted the proposal to the Department of Environmental Protection (DEP) as a subdivision application in May 2000. The DEP subsequently referred it to the Environmental Protection Authority (EPA) for consideration under Part IV of the *Environmental Protection Act 1986*. The EPA set the level of assessment at EPA-initiated Environmental Protection Statement (EPS) in accordance with the *Environmental Impact Assessment Administrative Procedures Amendment 1999*. The EPS and the EPA's report and recommendations in Bulletin 999 were released in November 2000 (EPA 2000a).

The EPA determined that the proposal could be implemented in an environmentally acceptable manner such that it would be unlikely that the EPA's objectives would be compromised, provided there was a satisfactory implementation by the proponent of its commitments. The EPA also stated in Bulletin 999 that it did not consider the proposal of magnitude warranting a full environmental impact assessment.

In August 2001, following submission of public appeals arising from the level of assessment set and the report and recommendations of the EPA, the Minister for the Environment decided to uphold appeals and determined that the proposal demanded a higher level of assessment. The Minister's determination was that the EPA had not adequately recognised native vegetation to be an environmental factor. The Minister further advised although the site had been examined through the Bushplan process and rejected, this could not be effectively substituted for a formal environmental assessment of the proposed development and a closer examination of the value of the bushland was warranted. It was also acknowledged the proponent had undertaken community consultation as part of the EPS process but more extensive community consultation was required. The Minister required that the proposal be more fully and publicly assessed. The proposal is now being assessed at the level of Public Environmental Review (PER) with a four-week public review period.

These aspects of the Ministerial determination and subsequent relevant guidelines supplied by the EPA have been addressed in the PER process by:

- implementing an intensive community consultation program involving an independent facilitator, responding to issues concerning stakeholders, and examining the feasibility of several development options;
- conducting further flora and fauna and cost benefit investigations; and
- examining in detail the significance of Lot 502 in terms of floral and faunal abundance and diversity both on a regional and local scale.



## NEED FOR PROPOSAL

An estimated additional 1100 hectares of general industrial land will be required between 2002 and 2026 in the southern suburbs of Perth. Within the next ten years, around 467 hectares will be needed in the south west and east corridors of the metropolitan area. There is currently around 262 hectares of land to match this demand, excluding Henderson and Bibra Lake. The Hope Valley/Wattleup industrial area is not likely to be available for some time and is a solution for demand in the long term. As there is a definite market need for such land in the southern metropolitan area, the development of industrial land at Bibra Lake is required to address a potential shortage in general industrial land in the short to medium term.

The establishment of the estate is anticipated to generate 1115 employment positions directly with another 1086 jobs created indirectly elsewhere, with a total employment effect of 2201. The direct employment is estimated to generate nearly \$50 million in wages and salaries in the estate and a further \$53 million elsewhere, with a total of \$103 million in wages and salaries generated as a result of this proposal.

## COMMUNITY CONSULTATION

The emphasis of the consultation program was to inform stakeholders of the proposal as early as possible and arrange meetings or mail out information with a request for stakeholders to express their views and concerns regarding the proposal. The consultation program involved the following:

- briefings and discussions by LandCorp with key Government agencies and the Cockburn City Council and officers;
- briefings and intensive one-on-one interaction with key community stakeholders, using an independent facilitator, to address the concerns raised previously; and
- mail out to the residents of St Paul's Estate, north of Lot 502.

There were three main bodies of opinion presented in the community consultation sessions from those who had concerns about the proposal:

1. No development - the view was none of the area should be cleared;
2. Limited development – the view was the site should only be developed west of the ridgeline, as a “garden” estate; or
3. Development with best environmental practice in place with consideration of adjacent conservation areas.

The main issues raised by stakeholders relating to the development of an industrial estate on Lot 502 were the:

- current need for industrial land;
- regional significance of the vegetation;
- importance of the area as habitat for fauna;
- effect of the development on local landscape values;
- noise and dust generation during construction of the estate; and
- potential impact on aboriginal sites.

LandCorp has addressed these issues in this PER consolidating information gained through the engagement of various specialised consultants who conducted investigations into each of the factors concerned.



## THE PROPOSAL

The proposed subdivision consists of 180 industrial lots and associated roads over approximately 78 ha, and also sets aside approximately 11 ha for Public and Regional Open Space. The development will also result in the installation of other infrastructure such as power lines, stormwater drains, and utility services.

The development of the industrial estate will be in stages, with areas sequentially cleared of vegetation and earthworks to create contours suitable for industrial lots. Approximately 64 ha of native vegetation in degraded to very good condition will be required to be cleared. Earthworks will also be required to build a bund along the western boundary of the South Lake buffer.

Enterprises expected to establish in the estate would be similar to those in the Canning Vale Industrial Estate. Such enterprises include food manufacturing, packaging and wholesalers, machine and vehicle servicing and sales, engineering and construction, and wholesalers and distribution centres.

Potential impacts on important local ecological functions and values of the vegetation of Lot 502 will be avoided or mitigated by including the following measures in the subdivision design:

- retention and rehabilitation of a 150 m wide 'buffer strip' west of South Lake;
- establishment of native gardens throughout the estate along road verges, lot frontages and newly established Public Open Space; and
- a requirement for enterprises in the estate to landscape their lots, as far as practicable, using native plant species.

## ENVIRONMENTAL IMPACT ASSESSMENT

The following environmental factors and issues were identified as being potentially affected by the development of the Bibra Lake Industrial Estate at Lot 502:

- Vegetation and flora – impact from clearing and earthworks.
- Terrestrial fauna - impact from clearing and earthworks and operation of estate.
- Visual amenity – impact of clearing of vegetation and earthworks and establishment of buildings in the estate on local landscape values.
- South Lake – impact of development of general industrial estate in proximity to wetland.
- Soil and groundwater contamination – impact of previous landuse and operation of estate.
- Dust and particulates – impact of site development.
- Noise – impact of site development and operation.
- Traffic and safety – impact of site development and operation.
- Aboriginal heritage – impact of site development.

### ***Vegetation and flora***

The development of the Bibra Lake Industrial Estate will involve the gradual removal of 63 ha of *E. marginata* *B. attenuata* Closed Forest to Woodland and 0.9 ha of Shrubland of *Hakea prostrata*, *Jacksonia furcellata* and *Kunzea glabrescens*. Wherever practicable, vegetation will be retained along roadsides and lot boundaries. Some Tuarts will be retained in an area of Public Open Space in the southwest corner of Lot 502.



The vegetation communities are well represented regionally and are not communities that are considered rare, threatened or restricted in distribution. The clearing represents a decrease of less than 1.1% of the current extent of the Karrakatta Complex Central and South in the Perth Metropolitan Region, as mapped by Heddle *et al.* (1980). Lot 502 was not included for protection under Bush Forever. It did not meet the criteria for the selection of regionally significant bushland and/or was not included because of social and economic considerations.

Approximately 172 vascular plant taxa were recorded at Lot 502, 67 of which were weed species. There will be no significant impact on Declared Rare or Priority Flora populations, neither of which was recorded during three flora searches. There will be negligible effect on regional floral diversity as vegetation communities and individual species in Lot 502 are not regionally restricted. There will be a possible small decrease in local (South Lake and surrounds) floral diversity as a result of clearing a proportion of upland vegetation from the immediate area.

There were no *P. cinnamomi* or *A. luteobubalina* infestations detected within the survey area and the majority of the area was classified as uninfested with the exception being areas classified as uninterpretable. There is however substantial weed infestation throughout Lot 502 and the adjacent South Lake reserve. A Dieback and Weed Management Plan will be prepared and implemented to reduce the risk of spreading Dieback and control the spread of weeds to surrounding woodland.

The proponent will implement measures to restrict access to intact woodland in some areas to reduce the potential impact of increased human activity in the area on native vegetation.

LandCorp will rehabilitate degraded areas within the South Lake buffer consistent with the original vegetation communities present. This will restore and improve the condition of the *Eucalyptus rudis* *Banksia grandis* woodland surrounding South Lake, increasing its local representation, and the fringing upland *E. marginata* *B. attenuata* woodland in the buffer area. Native gardens will also be established throughout the estate on road verges and cleared Public Open Space and businesses within the estate will be encouraged to use native, preferably local, species as far as practicable in gardens established around their buildings.

LandCorp will establish a collaborative rehabilitation program with CALM to rehabilitate the southern area of the South Lake reserve. This would improve the condition of vegetation in this area, reduce the infestation of weeds, and enhance the wetland-upland continuum on the south side of the lake. LandCorp is investigating approximately 10 ha to be included in this program.

### **Terrestrial fauna**

There are possibly up to 147 vertebrate species, eleven of which are introduced species, utilising Lot 502. These possibly consist of eight species of frogs, 38 species of reptiles, 80 species of birds, and 16 species of mammals (11 native and five introduced).

The development of Lot 502 will result in the clearing of approximately 64 ha of upland (Jarrah-Banksia woodland) habitat. The sequential nature of the development will give sufficient time for some fauna to move into neighbouring remnant areas and occupy habitats in the rehabilitated areas and native gardens in the developed parts of the estate. The loss of upland vegetation will cause local decline in abundance and distribution of some local fauna in proportion to the area cleared, through loss of habitat and subsequent increased susceptibility to predation. It is possible that the proposal will result in a reduction in the numbers of Carnaby's Black Cockatoo, listed under the WA Wildlife Conservation Act and the EPBC Act, visiting the site. The reduction in habitat will also potentially result in a moderate to low reduction of the numbers of Quenda, CALM Priority 4 listed species, in the immediate area of Lot 502 and South Lake. There is a small possibility that the site is utilised by the Peregrine Falcon, listed under the WA Wildlife Conservation Act, and the Square-tailed Kite, a Priority 4 CALM listed species, and if so there will be a reduction in the area in which it can utilise at



Lot 502 and South Lake. The impact of the proposal on all species in a sub-regional context is of moderate to low significance. The removal of upland habitat from the area may theoretically increase the risk of disappearance of some species that occur in low population densities from the City of Cockburn and adjacent area. This risk will be reduced by the implementation of the described mitigation. No species are expected to be reliant on Lot 502 for their persistence in the region (Perth Metropolitan Region).

A Fauna Management Plan will be implemented to decrease the impact of the proposal on local and regional fauna values which will include fauna habitat restoration techniques for rehabilitation of the buffer and native gardens, and a Quenda relocation program (in consultation with CALM).

The establishment of native gardens in the estate will compensate for some of the clearing of habitat on Lot 502 and decrease the extent of local declines in species abundance, particularly for some species of birds, reptiles and frogs. Many species of reptiles and frogs are known to survive in urban gardens and hence should be able to exist in native gardens within the estate, particularly if they are linked with the remnant vegetation around South Lake. The rehabilitated buffer will have the potential to provide replacement habitat for the Quenda and Brush-tailed Possum.

LandCorp will revegetate the buffer strip east of South Lake and establish a collaborative rehabilitation program with CALM to restore woodland habitat within the southern area of the South Lake reserve. The potential benefits of these rehabilitation efforts to fauna would be similar. These include providing replacement habitat for significant birds and mammal species, restoring habitat in an area of potentially high importance to fauna, and improving habitat immediately east and south of South Lake benefiting fauna associated with the lake such as Rakali, Quenda and the Long-Necked Tortoise. The program would act to restore a buffer area on the eastern and southern side of South Lake increasing the protection of fauna associated with the lake. Initial discussions with CALM regarding the implementation of these programs have already taken place.

There is no potential for water quality to be affected by contaminated groundwater as a result of this proposal as drainage will be directed away from South Lake. There is no anticipated impact on fauna due to changes to water quality as a result of the estate development.

### ***Visual amenity***

Lot 502 is located immediately up-gradient of the western side of South Lake and is perceived as an important landscape “backdrop” to the lake and Beeliar Regional Park, particularly when viewed from the east and south-east. The clearing and landforming for site preparation will result in the gradual removal of some areas of woodland of high landscape quality (non-degraded woodland east of ridge). The visual impact of the removal of vegetation will be minimised by retaining remnant vegetation up to 150 m west of South Lake, which is highly visible, rehabilitating degraded areas within the buffer area, and retaining remnant vegetation along the north-eastern boundary. The potential rehabilitation of the southern area of the South Lake reserve would also improve the landscape value of this area.

Other measures to decrease the impact of the development on the landscape values of the area to be implemented as part of a Landscape Protection and Management Plan will include:

- retaining vegetation along roadsides wherever practicable;
- creating an elevated bund along the western boundary of the buffer area and revegetate to increase the density and height of screening vegetation between South Lake and the estate;
- managing the development so building heights are low on the east side of the ridge;
- managing building construction materials and colours to complement surrounding landscape; and
- establishing native gardens within the estate.



The impact of the estate on landscape quality and local visual amenity will be low in light of the existing surrounding urban environment and as a result of the described mitigation measures. The proposal will improve visual amenity immediately west and south of South Lake and secure a green belt entry statement to the Beeliar Regional Park along North Lake Road.

### **South Lake**

Lot 502 is located on the area upland of South Lake, an EPP wetland, which is part of the Beeliar Regional Park. The lake supports a range of flora and fauna, including the several frog species and the South West Long-necked Tortoise *Chelodina oblonga*. Some resident frogs of South Lake may be affected by the proposal due to removal of upland habitat.

The lake is to be afforded general protection from activities within the estate through the provision of a 150 m wide buffer zone between the high water mark of South Lake and the estate. This provision was established after consultation with the Department of Environmental Protection, the Wetlands Conservation Society, and Aboriginal groups, and several other key stakeholders.

Watertable rises associated with clearing of the site are expected to be minimal and will not affect water levels of South Lake due to Lot 502 being down gradient of the lake.

The lake water quality will not be affected by the development of the estate as the lake is primarily fed by an east to west groundwater flow. Hence its water quality depends on the quality of the aquifer not surface water flow. Surface water flow from the estate will either be diverted by the drainage design or percolate through the soil into the groundwater, which is flowing away from the lake. The steep hydraulic gradient on the western side of South Lake would prevent any potentially contaminated groundwater flowing east to the lake from Lot 502.

The rehabilitation of the buffer area and the addition of this vegetated land to the lake's reserve will increase the conservation value of South Lake consistent with EPA Bulletin 686. The rehabilitation of the southern area of the South Lake reserve would also increase the lake's conservation value and provide for further protection of its resident fauna.

### **Site contamination (soil and groundwater)**

The current and historical use of the site for paper manufacturing operations has resulted in some low levels of site contamination at some locations in Lot 502. This has occurred through the spray irrigation of effluent and paper pulp into storage areas, and the use of landfill and effluent storage ponds.

The proposal in itself is not anticipated to cause site contamination. A Site Contamination Management Plan will be prepared prior to development of the site, which will involve the eventual cessation of the landfill and wastewater ponds on the site. The plan will involve procedures for the following actions to be carried out prior to the development of the relevant areas of the estate:

- decommissioning of effluent ponds and landfill sites prior to development; and
- removal of solid waste and contaminated soil from previous landfill containing elevated levels of petroleum hydrocarbons and copper prior to estate development.

The ongoing use of the effluent ponds for the next five years is not expected to further degrade groundwater quality. Following the removal of the effluent ponds, the quality of the groundwater down gradient of the area and the oxygen deficient plume will self remediate over a short period of time.



The solid waste in the current landfill site will remain in-situ. The contamination from this source is not expected to exceed guideline levels over time.

Enterprises establishing in the new estate will transport, store and dispose of chemicals and solvents according to relevant legislation, regulations and license conditions, such that spills which could potentially cause soil and groundwater contamination are prevented.

### ***Dust and particulates***

Two residential areas, St Paul's estate (approximately 50 m north of the pan-handle northeast extreme of Lot 502 but 700 m north of the bulk of the lot) and Yangebup (approximately 600 m southeast of Lot 502) have the potential to be affected by dust generation from the site. The proximity of Adventure World, a privately owned amusement park, may make it susceptible to any dust generation on site during the summer months, when south westerly winds occur in the afternoons.

A Dust Management Plan will be implemented to control the generation of dust on the site during the estate development. This will include measures such as restricting vehicle speeds, restricting work on windy days, and dust suppression techniques. The implementation of the plan will ensure dust concentrations are unlikely to affect amenity and health in sensitive offsite areas.

The removal of vegetation on the ridgeline to the west is not expected to cause South Lake to be more susceptible to deposition of windborne dust. Rehabilitation of the 150 m buffer strip, revegetation of the constructed bunds and planting of native gardens will reduce the potential for dust deposition following the development of the estate. The rehabilitation of the southern area of the South Lake reserve will also progressively increase the protection of South Lake from windborne dust.

### ***Noise***

Current background noise within Lot 502 is relatively low. The principle noise sources are from traffic along North Lake, Phoenix, and Sudlow roads and Spearwood Avenue and operational noise from the Amcor Paper Recycling Mill. The estate is not expected to support tenants that will generate noise at nuisance levels but regardless, these enterprises will be subject to operational noise regulations.

The development of the Bibra Lake Industrial Estate is not expected to impact significantly on the amenity of nearby residents. The Noise Management Plan will contain measures to reduce noise during earthworks and site development including installation of appropriate noise control equipment, ensuring all equipment is in good working order; and providing noise attenuation screens as appropriate.

There will be a negligible noise increase to the St Paul's estate area resulting from trucks using Phoenix Road during construction of the estate. The establishment of the estate will reduce the frequency and volume of traffic noise currently experienced by the residents of St Paul's Estate. Much of the traffic currently using Phoenix Road will move through the estate between North Lake Road and Spearwood Avenue once roadways are completed.

### ***Traffic and safety***

Lot 502 is situated such that it has direct access to the major roads of North Lake Road, Phoenix Road and Spearwood Avenue. From these three roads, vehicles have access to major arterial roads such as the Kwinana Freeway and Stock Road.

Traffic volumes will be approximately halved along Phoenix Road following the development of the roads linking North Lake Road and Spearwood Avenue and Sudlow Road through the estate.



The degree of increase in road traffic during the development and operation of the estate is considered extremely low and is not predicted to have any substantial impacts in terms of safety and amenity on local road users or neighbouring land uses. A Traffic Management Plan will be implemented to minimise nuisance to surrounding road users and residents. The estate development is not perceived to represent a significant risk to public safety.

### **Aboriginal heritage**

The project area is located in an area that is subject to two Native Title Claims under review and registered with the Department of Indigenous Affairs (DIA). Representatives from these claimant groups were consulted during the planning of the estate to establish their heritage and environmental concerns. The measures described previously to mitigate the clearing of vegetation and habitat are consistent with requirements of the consulted Aboriginal groups to address their concerns over the inherent loss of native flora and fauna.

A campsite registered with the DIA is located within the proposed South Lake buffer area and will not be directly disturbed. The site will be protected during the estate development by ensuring its approximate location is known by contractors and earthworks are carried out in such a manner to avoid disturbing the site. The campsite will be permanently protected in Regional Open Space following the completion of works as part of the South Lake buffer area.

Six marked ("scarred") trees of some significance to the Nyoongar people consulted during the course of the assessment were also located during the heritage survey. An area of Public Open Space is to be retained in the southwest corner of Lot 502, in which four of the scar trees are located. LandCorp proposes to remove and preserve the other two scar trees and has the agreement of the representatives of key Aboriginal people and Section 18 approval under the Aboriginal Heritage Act.

A contingency plan will be in place in the event of further archaeological material being identified.

### **ENVIRONMENTAL MANAGEMENT PLAN**

The proponent will prepare a Development Environmental Management Plan to be implemented prior to the commencement of earthworks at Lot 502, which will contain a:

- Rehabilitation Plan;
- Dieback and Weed Management Plan;
- Landscape Protection and Management Plan;
- Fauna Management Plan;
- Drainage and Groundwater Management Plan;
- Site Contamination Plan;
- Dust Management Plan;
- Noise Management Plan; and
- Traffic Management Plan.

A Contingency Plan for uncovering of archaeological material will also be prepared.

Although the estate will not be under the management of LandCorp in the longer term, the Rehabilitation Plan, Landscape Protection and Management Plan and Site Contamination Plan will remain in place until the DEP and CALM agree that the objectives of these plans have been satisfied.



It is proposed a separate plan for the rehabilitation of the southern area of the South lake reserve will be prepared by CALM in consultation with LandCorp.

## CONCLUSION

The major environmental cost associated with the development of Bibra Lake Industrial Estate in Lot 502 is the clearing of 64 ha of mostly Jarrah-Banksia woodland, representative of the Karrakatta Complex - Central and South, west of South Lake. The clearing of vegetation will result in a decrease of 1.1% of the current extent of the Karrakatta Complex - Central and South in the Perth Metropolitan Region. Approximately 2590 ha of the complex are protected under Bush Forever, compared to the 64 ha being cleared for this proposal.

The clearing of vegetation will mean a loss of representation of upland habitat in the vicinity of South and Bibra lakes. The loss of upland vegetation will cause local (Lot 502 and South Lake) decline in abundance and distribution of some local fauna in proportion to the area cleared, through loss of habitat and subsequent increased susceptibility to predation. Some of the affected species are regionally significant and/or specially protected under legislation or Priority listing. The rehabilitation of degraded areas within the buffer area to be retained between the estate and South Lake will compensate for some of this loss. The buffer area makes up a significant proportion (25-30%) of an area identified as having the highest importance to fauna in Lot 502. The rehabilitation of the southern area of the South Lake reserve and creation of fauna habitat will also replace a proportion of that cleared for development and in an area of potentially high importance to fauna. The implementation of the described measures should reduce the potential local declines in species abundance and minimise the risk of some susceptible species being lost locally or sub-regionally (City of Cockburn and adjacent areas). The regional (Perth Metropolitan Region) abundance of species is not expected to be significantly affected by the proposal.

The loss of upland vegetation in Lot 502 will affect local visual amenity with a change in the vista to the west of South Lake from intact woodland to a mixture of trees and buildings established within the industrial estate. The impact of the estate on local visual amenity will be decreased by retaining vegetation within 150 m of South Lake and constructing a bund on which to establish trees. In the medium to long term, this will provide a greater visual buffer between South Lake and the estate.

The development of the estate reduces the size of an upland area of vegetation between the lake and industrial activity to the west. The proposed estate however poses no significant threat to the water quality or water levels of South Lake. Retaining vegetation and rehabilitating degraded areas will serve to sufficiently protect the lake from wind blown dust from the south west.

Formal agreement has been made with local Aboriginal representatives for the retention of vegetation within the South Lake buffer area. Two scar trees of cultural importance to local Aborigines will be relocated from areas to be cleared in accordance with the agreement with local representatives and Section 18 of the Aboriginal Heritage Act. The campsite and remaining scar trees will not be disturbed during the development and operation of the estate.

Development works on the site will introduce a temporary noise source to the local environment. This will however remain within guideline levels. The introduction of some traffic associated with estate construction will occur on local major roads. Dust management within the development area will prevent the dust generation being a problem to local residents.

There is likely to be a small increase in traffic on local major roads as a result of the occupancy of the industrial estate. However, Phoenix Road is anticipated to have a substantial decrease in traffic volume.



There are a number of potential environmental benefits that may not have occurred without the implementation of this proposal:

- Rehabilitation of 4 to 5 ha of completely degraded vegetation around the south-western side of South Lake, which will increase the conservation value of the lake.
- Establishment of a collaborative rehabilitation program with CALM for an area of up to 10 ha on the south side of South Lake. This would improve the condition of an area of potentially high importance to fauna, improve the condition of vegetation around the lake, and potentially increase the conservation value of the lake.
- Improvement in the condition of an area of potentially high importance to local fauna adjacent to South Lake. This is particularly so for fauna directly associated with the lake such as tortoise, bandicoots and frogs.
- Establishment of a formal buffer area around the western side of South Lake, which will increase the conservation value of the lake.
- Addition of approximately 6 ha of remnant and rehabilitated vegetation into Beeliar Regional Park.
- Remediation of localised site contamination within Lot 502.
- Cessation of wastewater disposal in Lot 502.
- Reduction in the volume of traffic on Phoenix Road through the establishment of link roads between North Lake Road and Sudlow Road and Spearwood Avenue through the estate.

### Key characteristics of proposal

Characteristic	Description
Location	Lot 502 North Lake Road, Phoenix Road, and Sudlow Road, Bibra Lake
<b>Industrial subdivision</b>	
Area	89 ha
Number of lots	180
Area of Public Open Space	4.5 ha
Associated infrastructure	Roads
	Native vegetation gardens along road verges and median strips
	Power
	Water
	Gas
	Communications
Vegetation disturbance*	Approximately 64 ha of mostly Jarrah Banksia woodland in degraded to very good condition as graded by Bennett Environmental Consultancy 2002.
<b>South Lake buffer</b>	
Regional Open Space	6.2 ha
Rehabilitation	Area approximately 4-5 ha to be rehabilitated
Bund	3 m high, to be built on boundary of buffer area before subdivision road

\* excludes all areas classified as highly degraded by Bennett Environmental Consulting.



## Summary of the environmental issues, potential impacts and management

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
<b>BIOPHYSICAL</b>					
Flora	<p>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.</p> <p>To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.</p>	<p>Site not protected under Bush Forever</p> <p>25% of Lot 502 is completely degraded vegetation or cleared.</p> <p>Remnant vegetation representative of Karrakatta Complex Central &amp; South. Complex represented in nearby reserves.</p> <p>No Declared or Priority Flora recorded</p> <p>No Dieback detected</p> <p>Extensive weed infestation</p>	<p>64 ha of vegetation cleared</p> <p>1.1% decrease in extent of Karrakatta Complex Central &amp; South in metropolitan region.</p> <p>Decrease in local representation of upland vegetation.</p> <p>Spread of Dieback</p> <p>Further weed infestation</p>	<p>Retain remnant vegetation in buffer strip around South Lake and POS in SW corner.</p> <p>Rehabilitation Plan for buffer.</p> <p>Use native flora in estate gardens.</p> <p>Dieback and Weed Management Plan</p> <p>Restrict access to buffer area</p> <p>Establish rehabilitation program for southern area of South Lake reserve.</p>	<p>No regional decrease in flora diversity.</p> <p>1.1% decrease in extent of Karrakatta Complex Central &amp; South in metropolitan region.</p> <p>Decrease in local representation of upland vegetation.</p> <p>Restoration of vegetation in South Lake buffer area.</p> <p>No spread of Dieback or increase in weed infestation.</p> <p>Improvement in condition of vegetation south of South Lake.</p>
Fauna	<p>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.</p> <p>To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.</p>	<p>Mostly upland habitat, representing 10-15% of such habitat in Beeliar Regional Park area.</p> <p>Possibly up to 147 vertebrate species (including 5 introduced) utilise Lot 502.</p> <p>Includes 2 species protected by WA Wildlife Act and 3 Priority species.</p> <p>Areas close to South Lake support higher numbers of species.</p>	<p>64 ha of intact habitat cleared.</p> <p>Moderate to high local reduction of some dependent species.</p> <p>Low to very low regional impact on species. No species likely to be reliant on Lot 502 for persistence in region.</p>	<p>Fauna Management Plan</p> <p>Retention of vegetation in buffer strip and along roads.</p> <p>Rehabilitation of habitat within buffer strip.</p> <p>Establishment of native gardens in estate.</p> <p>Control access to buffer area.</p> <p>Establish rehabilitation program for southern area of South Lake reserve.</p>	<p>Decrease in local abundance of some species.</p> <p>No significant impact on regional fauna diversity.</p> <p>Restoration of high value habitat near South Lake.</p>

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
South Lake (EPP wetland, WRC Management Category: Resource enhancement and Multiple Use)	<p>To maintain the integrity, ecological functions and environmental values of South Lake.</p> <p>To protect the environmental values of areas identified as having significant environmental attributes.</p> <p>To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.</p>	<p>South Lake is immediately east of Lot 502 and is an EPP wetland in a Bush Forever site.</p> <p>Part of Beeliar Regional Park.</p> <p>Supports range of flora and fauna.</p> <p>Fringing wetland vegetation mostly intact.</p> <p>Groundwater flow is away from lake.</p>	<p>Contaminated runoff from industrial estate.</p> <p>Potential impacts of miscellaneous activities associated with general industry.</p> <p>Removal of upland habitat required by lake fauna.</p>	<p>Drainage and Groundwater Management Plan</p> <p>All drainage diverted away from lake – stormwater management.</p> <p>Establishment of 150 m wide buffer strip between lake and estate.</p> <p>Rehabilitation of vegetation within buffer.</p> <p>Establish rehabilitation program for southern area of South Lake reserve.</p>	<p>No significant environmental impact of proposal on lake.</p> <p>Water quality and levels of South Lake not significantly affected by proposal.</p> <p>Lake fauna not significantly affected by removal of upland vegetation – buffer should enhance conservation value of the lake.</p> <p>Increase in conservation value of South Lake.</p>
<b>POLLUTION</b>					
Site Contamination	<p>To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.</p> <p>To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards</p> <p>To ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate criteria.</p>	<p>Low levels of soil contamination at sites of past and current landfill sites and effluent ponds.</p> <p>Oxygen deficient plume in groundwater down gradient of effluent ponds.</p> <p>Groundwater suitable for garden irrigation.</p>	<p>In-situ material may cause unacceptable soil and/or groundwater contamination.</p> <p>Site contamination from industrial activity in estate.</p>	<p>Site Contamination Plan</p> <p>Removal of material from past landfill site to offsite location.</p> <p>Decommissioning of effluent ponds and landfill site.</p> <p>Enterprises within estate to adhere to legislation, regulations, and license conditions.</p>	<p>No significant soil contamination remaining in Lot 502 in medium to long term.</p> <p>Self remediation of oxygen deficient plume over short period of time.</p> <p>Low risk of future site contamination.</p>
Dust and particulates	<p>To ensure that dust emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards</p>	<p>Closest nearby residents in St Paul's Estate and Yangebup.</p> <p>Privately owned amusement park nearby.</p>	<p>Dust from clearing of vegetation and earthwork.</p> <p>Removal of vegetation and ridgeline may increase dust deposition to South Lake.</p>	<p>Dust Management Plan</p> <p>Retention of vegetation in buffer strip.</p> <p>Revegetation of degraded areas in buffer strip and potentially in area south of lake.</p>	<p>Dust unlikely to affect amenity in sensitive areas.</p> <p>Decrease in potential for dust deposition to South Lake.</p>



ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
Noise	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.	Closest nearby residents in St Paul's Estate and Yangebup. Low background noise from traffic.	Noise from activities associated with development of estate. Increase in traffic noise associated with development and operation of estate.	Noise Management Plan Diversion of traffic from residential areas	Noise unlikely to affect amenity in sensitive areas. Decrease in traffic noise from Phoenix Road.
<b>SOCIAL SURROUNDINGS</b>					
Traffic and safety	To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.	Lot 502 has direct access to several major roads.  Current landuse presents little potential for risk to public safety.	Increase in truck movements associated with development.  Increase in traffic volumes from operation of estate.  Increase in risk to public safety from activities in industrial estate.	Traffic Management Plan  Appropriate fire and safety precautions taken during development.	Small increase in traffic along most major roads but mostly way from residential areas.  Decrease in traffic along Phoenix Road.  No significant increase in risk to public safety.
Aboriginal Heritage and Use	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	Campsite with associated scatters and six scar trees registered with Department of Indigenous Affairs.  Native vegetation and fauna has cultural importance to Aboriginal people.	Disturbance of Aboriginal sites and land of cultural importance.	Protection of campsite in buffer strip.  Protection of four scar trees in Public Open Space.  Relocation of two scar trees to Regional Open Space near campsite.  Contingency Plan for uncovering of archaeological material.  Retention of vegetation and rehabilitation in buffer strip.  Fauna relocation program	No disturbance of campsite and four scar trees.  Relocation of two scar trees to Regional Open Space near campsite, which already has s18 approval under Aboriginal Heritage Act.  Flora and fauna management measures to satisfaction of key Aboriginal representatives.

ISSUE	PRELIMINARY EPA OBJECTIVE	EXISTING ENVIRONMENT	POTENTIAL IMPACT	POTENTIAL MANAGEMENT	PREDICTED OUTCOMES
Visual Amenity	To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.	<p>Vegetated ridgeline west of South Lake of importance to local landscape values and visual amenity.</p> <p>Area contributes to landscape values of Beeliar Regional Park.</p>	<p>Clearing of native vegetation and disturbance of ridgeline.</p> <p>Establishment of buildings in estate will alter local visual amenity.</p> <p>Change in vista from South lake and surrounding residential areas and roads.</p>	<p>Landscape and Protection and Management Plan</p> <p>Retention of trees in buffer strip and along roadways.</p> <p>Revegetation of bund between estate and South Lake and buffer strip.</p> <p>Establishment of native trees and gardens in estate.</p> <p>Establish rehabilitation program for southern area of South Lake reserve.</p>	<p>Change in vista west of South Lake, but fringing vegetation between estate and lake will screen most buildings from view.</p> <p>Changes in view of lower significance into Lot 502 from North Lake Road, Phoenix Road and SE of St Paul's Estate.</p> <p>Improvement in landscape value of area immediately west and south of lake.</p>



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## **1. INTRODUCTION**

### **1.1 OVERVIEW OF PROPOSAL**

LandCorp proposes to subdivide 89 ha of land for industrial and mixed business purposes on Lot 502 North Lake, Phoenix and Sudlow Roads, Bibra Lake approximately 17 km south of Perth. LandCorp is seeking to develop the estate to assist in replacing the diminished short-term supply of industrial land.

The key characteristics of the proposal are as follows:

- Subdivision of 89 ha of Lot 502 to include 180 lots for general industrial use, roads and Regional and Public Open Space.
- Clearing of 64 ha of native vegetation and earthworks in stages for development.
- Retention of 6 ha of Lot 502 for a buffer strip, between South Lake and the estate, as Regional Open Space.
- Estate development including infrastructure such as road, power, and drainage.
- Rehabilitation of degraded areas of a 150 m wide buffer strip.
- Vesting of buffer strip with suitable management body as part of Beeliar Regional Park.
- Protection of sites of Aboriginal significance within Regional and Public Open Space.

The land is immediately west of South Lake (Bushplan Site No. 254), which is part of Beeliar Regional Park and subject to the provisions of the Environmental Protection (Swan Coastal Plain Lakes) Policy. Lot 502 contains extensive areas of native vegetation, some of which is affected by waste disposal and previous land uses such as grazing. The land is currently zoned Industrial under the Perth Metropolitan Scheme, General Industry under the current City of Cockburn District Zoning Scheme No. 2, and Industrial under the proposed City of Cockburn Town Planning Scheme No.3. Figure 1 shows the location of the proposal.

The tenants of the estate will be required to establish enterprises and carry out activities consistent with the general industrial zoning of the estate, which precludes the development of noxious industries. Enterprises would be similar to those established in the Canning Vale Industrial Estate.

Section 3 describes the proposal in detail and includes an explanation of the need for estate development and site selection.

### **1.2 PROPONENT**

The proponent is the Western Australian Land Authority trading as LandCorp, which is a statutory authority, whose mission is to foster major Government land and infrastructure projects to assist the achievement of economic and social prosperity for all Western Australians.

The key business outcomes for LandCorp are developing strategically located industrial and urban land to meet the needs of the State, and maximising the social and financial returns to the State from surplus Government land assets.

### **1.3 PREVIOUS ASSESSMENT BY EPA**

The Western Australian Planning Commission submitted the proposal to the Department of Environmental Protection (DEP) as a subdivision application in May 2000. The DEP subsequently



referred it to the Environmental Protection Authority (EPA) for consideration under Part IV of the *Environmental Protection Act 1986*. The EPA set the level of assessment at EPA-initiated Environmental Protection Statement (EPS) in accordance with the *Environmental Impact Assessment Administrative Procedures Amendment 1999*. The EPS and the EPA's report and recommendations in Bulletin 999 were released in November 2000 (EPA 2000a).

The EPA determined that the proposal could be implemented in an environmentally acceptable manner such that it would be unlikely that the EPA's objectives would be compromised, provided there was a satisfactory implementation by the proponent of its commitments. The EPA also stated in Bulletin 999 that it did not consider the proposal of magnitude warranting a full environmental impact assessment.

In August 2001, following submission of public appeals arising from the level of assessment set and the report and recommendations of the EPA, the Minister for the Environment decided to uphold appeals and determined that the proposal demanded a higher level of assessment. The Minister's determination was that the EPA had not adequately recognised native vegetation to be an environmental factor. The Minister further advised although the site had been examined through the Bushplan process and rejected, this could not be effectively substituted for a formal environmental assessment of the proposed development and a closer examination of the value of the bushland was warranted. It was also acknowledged the proponent had undertaken community consultation as part of the EPS process but more extensive community consultation was required. The Minister required that the proposal be more fully and publicly assessed. The proposal is now being assessed at the level of Public Environmental Review (PER) with a four-week public review period.

These aspects of the Ministerial determination and subsequent relevant guidelines supplied by the EPA have been addressed in the PER process by:

- implementing an intensive community consultation program involving an independent facilitator, responding to issues concerning stakeholders, and examining the feasibility of several development options;
- conducting further flora and fauna and cost benefit investigations; and
- examining in detail the significance of Lot 502 in terms of floral and faunal abundance and diversity both on a regional and local scale.

#### **1.4 PURPOSE AND STRUCTURE OF DOCUMENT**

The purpose of this document is to meet the requirements of the Public Environmental Review (PER) level of assessment as prescribed by Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002.

The environmental impact assessment methodology in this document is based on a risk assessment approach including:

- documentation and investigation of key features of the existing (and future if relevant) environment that are likely to be relevant to the proposal;
- assessment of adequacy of knowledge available on key environmental features;
- identification of the aspects of the proposal that may give rise to positive or negative impacts;
- description and likelihood of impacts and their consequences (in a local and regional context as required);
- formulation of mitigation measures/safeguards (including monitoring) to avoid, reduce or offset impacts; and



- contingency measures or corrective actions as required in the event that impacts are greater than predicted or there is a failure of management.

The extensive stakeholder consultation process is also documented in this PER. Responses to the issues raised during the consultation process will be addressed later in this PER.

## **1.5 APPROVALS AND LEGISLATIVE FRAMEWORK**

### **1.5.1 Environmental impact assessment and approval process**

This document was prepared in accordance with the environmental assessment procedures prescribed by EPA 2002 (Figure 2) and guidelines provided by EPA. The process involves the preparation of a PER that is issued for public review and following the analysis of submissions the EPA's provides its report and recommendations on its assessment of the proposal to the Minister for Environment and Heritage (the Minister). The review period will be four weeks. Following determination of any appeals lodged against the EPA's report and recommendation, a Ministerial Statement is issued if the Minister determines that the proposal can be implemented. The Ministerial Statement will list the conditions that are required for the proposal to be environmentally acceptable. Following the issue of the Ministerial Statement, other approvals for subdivision and development can then proceed as appropriate.

### **1.5.2 Subdivision and development**

The subdivision of Lot 502 and creation of new allotments and public roadways within the estate will require approval pursuant to the provisions of Parts III and IV of the Town Planning and Development Act, and planning policies for the region. The proponent has submitted a subdivision application to the Department of Planning and Infrastructure (DPI), which considers external agency advice as required. Planning approvals can be progressed in parallel with the environmental impact assessment process but cannot be finalised until the Ministerial Statement has been issued pursuant to Section 45 of the Environmental Protection Act.

The subdivision and estate development would be subject to:

- environmental protection and management conditions imposed by the Ministerial Statement;
- conditions imposed, through subdivision approval, by the DPI; and
- zoning and development control provisions established by the City of Cockburn's Town Planning Scheme No. 2 (to be soon replaced by TPS No.3).

### **1.5.3 Relevant legislation**

The current proposal has been developed in accordance with the requirements of the Environmental Protection Act 1986 and will take into consideration all applicable State legislation and regulations. Current State legislation applicable to the proposal includes the following:

- *Aboriginal Communities Act 1979;*
- *Aboriginal Heritage Act 1972;*
- *Bushfires Act 1954;*
- *Conservation and Land Management Act 1984;*
- *Endangered Species Protection Act 1992;*
- *Environmental Protection Act 1986 as amended;*

- *Environmental Protection (Noise) Regulations 1997;*
- *Explosive and Dangerous Goods Act 1961;*
- *Hazardous and Toxic Substances Regulation;*
- *Health Act 1911 - 1979 and Regulations;*
- *Heritage of Western Australia Act 1990;*
- *Land Administration Act 1997;*
- *Local Government Act 1960;*
- *Mining Act, 1978;*
- *National Trust of Australia (WA) Act 1964;*
- *Occupational Health, Safety and Health Act 1984;*
- *Parks and Reserves Act 1895;*
- *Plant diseases Act 1914;*
- *Soil and Land Conservation Act 1945;*
- *State Planning Commission Act;*
- *Town Planning and Development Act 1928;*
- *Rights in Water and Irrigation Act 1945 –1982;*
- *Water Authority Act 1984;*
- *Waterways Conservation Act 1976; and*
- *Wildlife Conservation Act 1950 - 1980.*

#### **1.5.4 Western Australia policies and strategies**

In addition to existing legislation, the following Government agency strategies and policies are of relevance to the environmental assessment and management of industrial estates and the development of urban bushland:

- 1987 State Conservation Strategy;
- EPA's Red Book recommendations for Conservation Reserves of Western Australia;
- Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (currently under review);
- Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy 1999;
- Wetland Conservation Policy for Western Australia 1997;
- Environmental Protection of Wetlands – Preliminary Position Statement (Position Statement No. 4). June 2001, Perth, Western Australia.
- Bush Forever (Government of Western Australia 2000);
- Draft Guidance Statement No. 26: Management of Surface Runoff from Industrial and Commercial Sites – Guidance for the Assessment of Environmental Factors. Environmental Protection Authority January 1999; and
- Draft Guidance Statement No.10: Level of assessment for Proposals affecting Bushland Areas within the System 6 and the Southern Swan Coastal Plain Region. Environmental Protection Authority January 2001.



### **1.5.5 Commonwealth legislation and policies**

Commonwealth policies and legislation applicable to the proposal include:

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (which operates concurrently with any existing State laws in so far as those laws would not be consistent with this Act);
- *Australian Heritage Commission Act 1975*;
- *Native Title Act 1993*; and
- *The Commonwealth Environment Protection and Biodiversity Conservation Act 2000*.

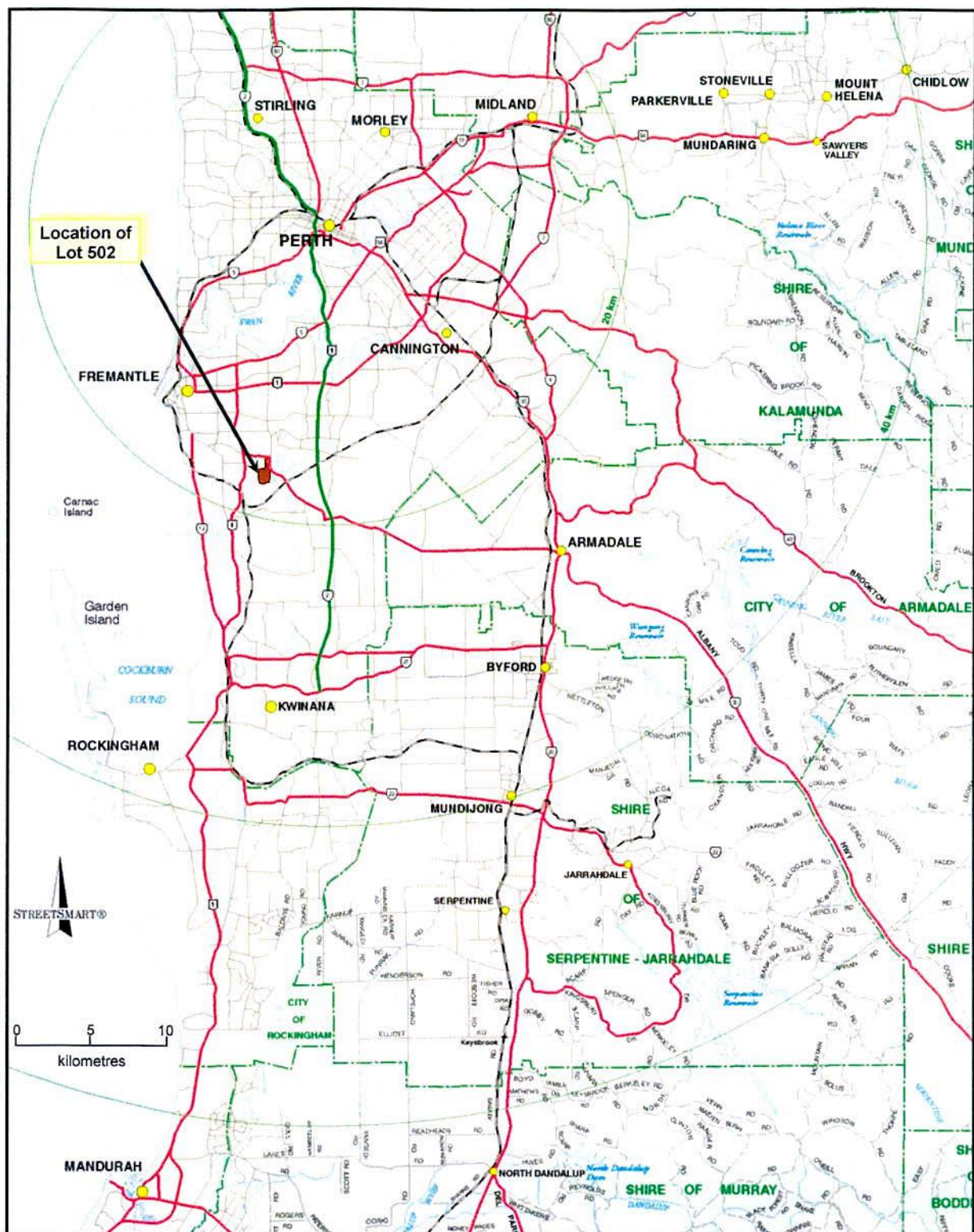
The following national strategies may also be relevant to the proposal:

- National Strategy for Ecologically Sustainable Development;
- Intergovernmental Agreement on the Environment;
- National Conservation Strategy for Australia; and
- National Strategy for Conservation of Australia's Biological Diversity.

### **1.5.6 International treaties, agreements and strategies**

International treaties, agreements and strategies relevant to the project include the:

- Convention on Biological Diversity (United Nations Environment Program, 1992); and
- Japan-Australia and China-Australia Migratory Birds Agreements (JAMBA/CAMBA).



**Figure 1 Location of Lot 502 North Lake, Phoenix and Sudlow Roads, Bibra Lake**



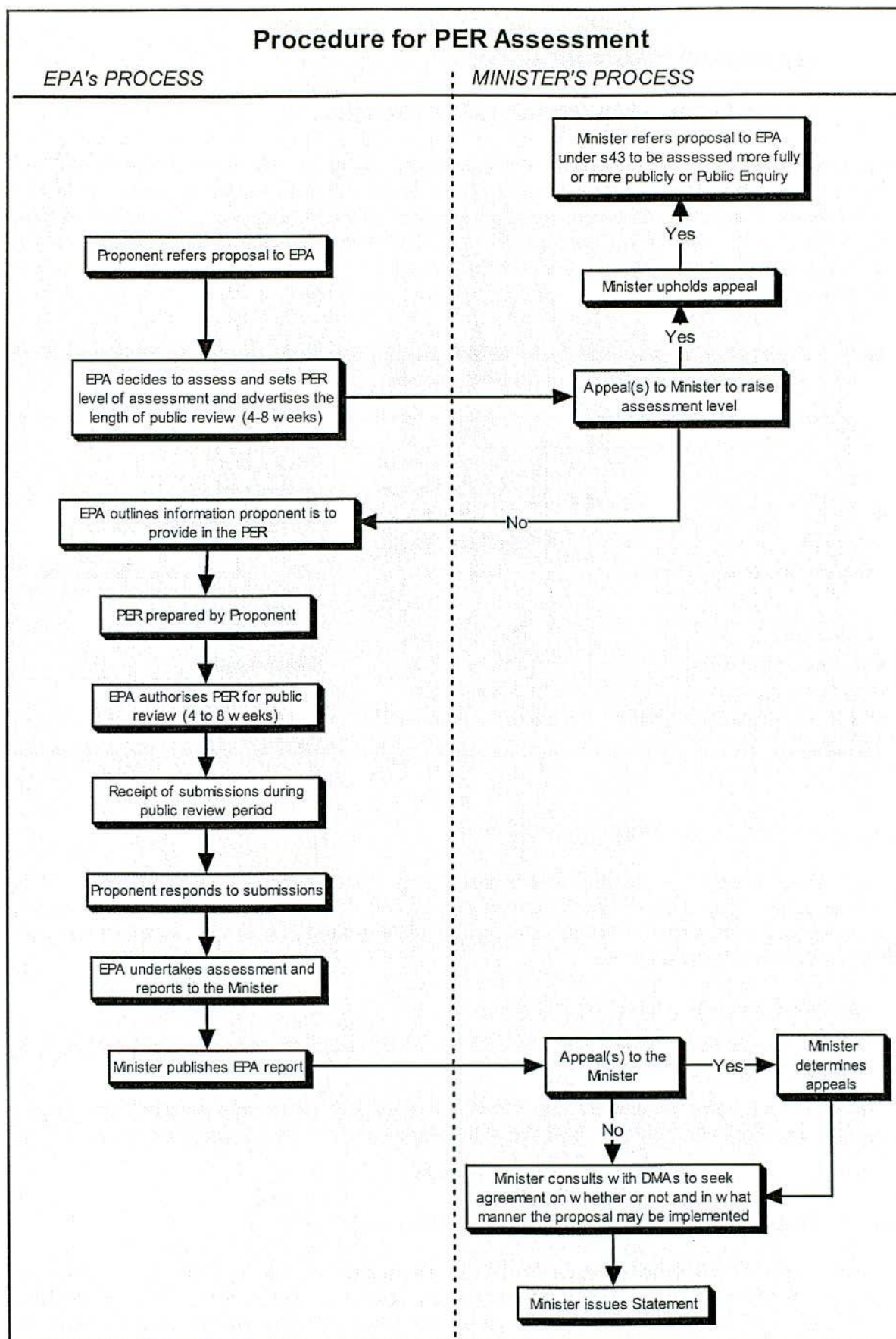


Figure 2 PER process

## 2. COMMUNITY CONSULTATION

### 2.1 CONSULTATION DURING PREVIOUS EPS PROCESS

The proponent briefed several agencies and community groups on the proposal during the land acquisition and EPS process to gain some feedback on key issues concerning individual groups. Table 1 lists the stakeholders that were consulted and how they were engaged. In addition to those listed, the Conservation Council of Western Australia, North Lake Resident Action Group, and Beeliar Conservation and Heritage Council were also approached for a briefing but a suitable session could not be arranged.

**Table 1 Summary of previous stakeholder consultation conducted in 1999 and 2000 during land acquisition and EPS process.**

Stakeholder	When	How
EPA	Throughout EPS process	On-going liaison
DEP	Throughout EPS process	On-going liaison
CALM	November 2000	Briefing and discussion
City of Cockburn	Throughout EPS process	On-going liaison
Representatives of Nyoongar community	July 1999	Briefings, site visits, discussion of issues and negotiation of actions to address concerns.
Perth Waldorf School	November 2000	Briefing / feedback
Yangebup Progress Association	November 2000	Briefing / feedback
Coolbellup Community Group	November 2000	Briefing / feedback
Wetlands Conservation Society / Cockburn Wetland Education Centre	September to November 2000	Briefing / feedback, discussion on appropriate buffers.

### 2.2 CONSULTATION PROGRAM FOR PER

The consultation program for the PER employed a variety of mechanisms to match the needs of each stakeholder group. The emphasis was to inform stakeholders of the proposal as early as possible and arrange meetings with or mail out information with a request for stakeholders to express their views and concerns regarding the proposal.

The consultation program involved the following:

- briefings and discussions by LandCorp with key Government agencies and the Cockburn City Council and officers;
- briefings and intensive one on one interaction with key community stakeholders, using a independent facilitator, Mr Ross Colliver, to address the concerns raised previously; and
- mail out to the residents of St Paul's Estate, north of Lot 502.

#### 2.2.1 Stakeholder identification for PER process

Two main groups of stakeholders were identified for consultation during the PER process. The first group was that of the relevant Government agency and regulatory bodies, which included the EPA, DEP, CALM and the City of Cockburn. The second group involved all key environmental and community groups known to have an interest in the proposed development, based on LandCorp's earlier consultation and appeals lodged against the EPS. Table 2 provides a list of stakeholders that



were consulted either directly by LandCorp and Welker Environmental Consultancy (WEC) or via Mr Ross Colliver acting as an independent facilitator in the consultation process.

**Table 2 Stakeholders and means of consultation**

Stakeholder	When	How
EPA	November 2001 to August 2002	Briefings and ongoing communication with WEC and LandCorp.
EPA staff	November 2001 to August 2002	Meetings and ongoing communication with WEC and LandCorp.
CALM	August 2002	Forwarded draft PER as requested to give advice and feedback regarding proposal.
City of Cockburn	December 2001	Briefing / feedback with WEC and LandCorp.
Conservation Council of WA / Forest Alliance	December 2001	One on one consultation via Facilitator.
Wetlands Conservation Society	December 2001	One on one consultation via Facilitator.
Cockburn Wetland Education Centre	December 2001	One on one consultation via Facilitator.
WA Wildflower Society	January 2002	One on one consultation via Facilitator (phone).
Beeliar Conservation and Heritage Council	December 2001	One on one consultation via Facilitator.
Yangebup Progress Association	December 2001	One on one consultation via Facilitator.
North Lake Resident Action Group	December 2001	One on one consultation via Facilitator.
Beeliar Resident Action Group	December 2001	One on one consultation via Facilitator.
Residents of St Paul Estate	January to February 2002	Consultation with Facilitator by phone and mail following delivery of flyer to residents summarising proposal and PER process.

The Perth Waldorf School (Friends of South Lake) and Coolbellup Community Association were also contacted several times from December 2001 to February 2002, but the facilitator was not able to arrange a meeting with representatives from these groups.

It is noted that several members of the Beeliar Regional Park Advisory Committee were consulted through engagement via other community and environmental groups listed in Table 2. The Committee will be directly consulted during finalisation of management plans and rehabilitation programs for areas adjacent to South Lake.

## 2.2.2 Community stakeholder consultation plan

The community consultation plan for the preparation of the PER was designed to ensure all those who expressed an interest in the proposal understood and participated in the new process under which the proposal was being assessed. The aim was to ensure that interested members of the community:

- understood what LandCorp was proposing;
- were informed of the environmental studies that were being conducted;
- had the opportunity to present their concerns about the environmental factors targeted by the PER, and other matters of concern to them;
- had the opportunity to compare their concerns with expert opinion assembled; and

- could present their ideas on options for improving the proposed development that would make it more acceptable to them.

The discussion sessions encouraged stakeholders to express their concerns and raise options for improving the proposed development in the presence of an independent facilitator rather than directly with the proponent. These views were reported to LandCorp, which then considered possible changes to the proposal and subdivision design in response to community views within the financial constraints on the project.

The community consultation sessions were “one-to-one” in nature, with the facilitator interacting with a single community group or a cluster of local conservation groups who work closely together. The sessions typically consisted of the following:

1. Briefing attendee/s on the purpose of the consultation.
2. Explaining the findings of the Appeals Convener and the decision of the Minister to require a PER.
3. Explaining the sequence of activities (including studies) associated with preparation and assessment of the PER, and their rights as members of the public in the period for public review.
4. Explaining the purpose of the consultation.
5. Describing the LandCorp proposal in broad terms, noting changes to the design of the site since the original proposal (e.g. only cut and fill earthworks for landforming during development rather than sand mining, hence much less removal of sand).
6. Asking for attendees’ concerns about the proposal and as they identify issues, use a relevant map to focus the comments. Maps were pre-prepared for discussion of:
  - local fauna and flora/vegetation;
  - local traffic, dust and noise;
  - local development issues;
  - regional fauna and flora/vegetation; and
  - regional development issues.
7. Responding to issues raised by noting expert opinions that were assembled for the PER by the proponent and seeking their opinion on the findings.
8. Describing management strategies already proposed, and asking for attendees’ opinion of each and if there were any other strategies that they felt would reduce negative impacts and improve outcomes.

Following each consultation session, the facilitator summarised the views expressed by the community group(s) on issues and strategies relating to the proposal. These summaries were sent to the community group for confirmation before being forwarded to the proponent.

In addition to the community group sessions, LandCorp conducted a mail-out to the residents of the south-eastern section of St Paul’s Estate, located immediately north of Phoenix Road and the Amcor Paper Recycling Mill. The leaflet that was distributed to the residents described the proposal and PER process. It also invited residents to contact the facilitator, Mr Ross Colliver. This contact provided the opportunity for residents to express their views on the proposal and discuss management measures or estate design options, which would alleviate any concerns regarding the development. A copy of the mail out is provided in Appendix 1.



LandCorp has used the summaries provided by the facilitator to assist in developing and assessing options for modifications to the proposal.

## **2.3 ATTITUDES OF COMMUNITY GROUPS**

There were three main bodies of opinion presented in the community consultation sessions for those that had concerns about the proposal:

1. No development - the view is that none of the area should be cleared;
2. Limited development – the view that the site should only be developed west of the ridgeline, as a “garden” estate; or
3. Development with best environmental practice in place with consideration of adjacent conservation areas.

### **2.3.1 No development (Group 1)**

This group of stakeholders were not prepared to negotiate an outcome and discuss anything other than the total conservation of Lot 502. Two respondents from St Paul’s Estate expressed a similar view.

The principle arguments from this group against any development were that:

- the area had too high a value to fauna and local landscape amenity to be cleared (addressed in Sections 7 and 8);
- there was already too much upland vegetation cleared in the region (representation of vegetation addressed in Section 6); and
- they were not convinced of the need for this proposal (addressed in Section 3.1).

### **2.3.2 Restricted development (Group 2)**

The issues presented by community groups regarding limited development of Lot 502 and the responses of the proponent to these issues are shown in Table 3. These stakeholders were prepared to discuss a proposal that demonstrated a response to their views.

These groups felt development should be limited to west of the ridgeline running north-south through Lot 502 because this would maintain visual landscape values around South Lake and prevent movement of windblown sand into South Lake and fringing vegetation. These issues are addressed in Sections 8 (visual amenity) and 11 (dust and particulates) respectively.

### **2.3.3 Development as planned with appropriate environmental measures (Group 3)**

Remaining stakeholders consulted felt the proposal would be satisfactory providing some measures were put in place to address their concerns. These issues and the related response of the proponent are shown in Table 3. Stakeholders who generally supported the proposal providing measures addressing their concerns are in place included some respondents from St Paul’s Estate. The emphasis of the feedback from these groups was that the benefit of the proposal to the community (i.e. employment, services) outweighed the apparent loss of flora and fauna.

## **2.4 SUMMARY OF ISSUES AND RESPONSES**

The main issues raised by stakeholders relating to the development of an industrial estate on Lot 502 were the current need for industrial land, regional significance of the vegetation, importance of the

area as habitat for fauna, the effect of the development on local landscape values, noise and dust generation during construction of the estate, and potential impact on aboriginal sites. These issues are specifically addressed in this PER and specific investigations were conducted to complete impact assessment on the factors of concern, including a:

- Report on the Economic Benefits from further Development of the Bibra Lake Industrial Area by Dr Paul McLeod of Economic Research Associates Pty Ltd (2002), which included an evaluation of the likely demand for the industrial estate in the near term and the role of the proposal to satisfy demand.
- Vegetation and flora study of Lot 502 by Bennett Environmental Consulting Pty Ltd (2002), which included an assessment of the regional representation and significance of vegetation communities and flora found in Lot 502.
- Report on the protection of vertebrate fauna of Lot 502 by MJ and AR Bamford Consulting Ecologists (2002), which examined the importance of Lot 502 as habitat for fauna in both a local and regional context and addressed potential management measures to reduce the impact on fauna.
- Viewshed analysis by Amcad 3-D (2002), generating images of the expected appearance of the industrial estate and vistas from South Lake, North Lake Road and St Paul's Estate to gauge the impact of the proposal on local visual amenity.
- Acoustic assessment for excavation and earthmoving works in Lot 502 by Herring Storer Acoustics (2000).
- Dust Management Plan for excavation and earthmoving works in Lot 502 by Bowman Bishaw Gorham (2000), which included an assessment of the potential for dust generation, susceptible residencies and provided details on appropriate management and monitoring.
- Aboriginal Site Identification Survey for Lot 502 by R.T. Parker and P. Greenfield (1999) on behalf of Australian Interaction Consultants, which included site visits with local aboriginal representatives, field surveys and archival research to ensure the position of sites was known and appropriate management measures can be applied.

The documentation listed above is available from LandCorp to members of the public for review. Interested persons should contact:

Mr John Silla  
Senior Projects Manager - Industrial Operations  
Level 3, Wesfarmers House, 40 The Esplanade  
PERTH, WA 6000

Phone: (08) 9482 7478  
Facsimile: (08) 9482 7484  
Email: john.silla@landcorp.com.au

The issues tabled during consultation sessions and the proponents responses to these issues are described in Table 3.

## 2.5 OUTCOME OF CONSULTATION

The proponent has considered the concerns and issues, as described in Table 3, of community groups and incorporated them into the design of the proposal as much as possible while also taking into account economic realities associated with the project.



**Table 3 Issues raised by stakeholders and proponent's response.**

Issue	Raised by	Response
Area valuable part of the wetlands system	Group 1	Area of highest importance to wetlands is that fringing South Lake, all vegetation with 150m of lake being retained. Addressed in Sections 6 and 7.
Protection of aboriginal sites (recorded and potential)	Aboriginal representatives, DEP, EPA	Recorded archaeological site to be protected within buffer area. Agreement with Aboriginal groups on treatment of scar trees within estate and contingency measures in case of uncovering new material during excavations. Addressed in Section 14.5.
Area provides valuable habitat for fauna	Group 1 and 2	Area of highest value to fauna is that closest to South Lake. Much of this area is being retained in 150m wide buffer around lake. Addressed in Section 7.
Maintenance of local landscape values	EPA, DEP, CALM, Groups 1, 2 and 3	Various measures will reduce impact on visual amenity. Addressed in Section 8.5.
Too much vegetation lost to urban development already	Group 1	Bush Forever secures large areas of bushland in metropolitan region. Lot 502 was not considered essential to maintain regional diversity. Addressed in Sections 4.2.4 and 6.1.3.
Opportunity to secure area of upland vegetation linked to the lake system.	Group 1	Nearby Bush Forever sites all contain upland vegetation linked to lakes. Extremely high cost to LandCorp in retaining all of vegetation in Lot 502.
No need for additional industrial land.	Group 1	Industrial areas needed in southern metropolitan area. Without Bibra Lake land there is potentially a supply issue (McLeod 2002). Addressed in Section 3.1.2.
Rehabilitation of buffer around South Lake	EPA, DEP, CALM, Aboriginal representatives, Group 2	Buffer area will be rehabilitated with suitable native vegetation. Addressed in Sections 6.5.1, 6.5.6, 7.5.1, 7.5.4, and 15.3.
Protection of South Lake from industry	EPA, DEP, CALM, Aboriginal representatives, Group 2	Provision of buffer and suitable drainage system will ensure industry does not impact on lake. Addressed in Sections 9.5.2, 9.5.3, and 10.5.2.
Development should be for non-noxious light industrial and commercial use only.	Group 2	Zoning prevents establishment of noxious industries.
Translocation of mammals and vegetation.	CALM, Aboriginal representatives, Group 2 and 3	LandCorp is examining potential to relocate some mammal species during development (see Section 7.5.1). Translocation of vegetation may be incorporated into rehabilitation plan (see Section 15.3.4)
Alteration of ridgeline - development should take place within the natural contours of the site.	Group 2	Current topography of site prevents establishment of usable industrial lots. Earthworks are required. Alteration of natural contours unavoidable
Setback of development from South Lake such that buildings are obscured from view from the southeast.	Group 2	Retention of vegetation in 150m buffer and revegetation of constructed bund between estate and lake will assist in obscuring view of buildings from east. Issue addressed in Section 8.5.2 and expected view from southeast shown in Figure 10b.
Potential for impact on nearby residences	Group 2 and 3	No significant impact anticipated from generation of dust, noise and traffic, following implementation of management measures described in Sections 11.5, 12.5, and 13.4 respectively, and effect on visual amenity (see Section 8.5).
Retention of native vegetation throughout the estate.	Group 2 and 3	Need for earthworks prevent much of the vegetation being retained. LandCorp will retain as much area as practicable. Addressed in Section 6.5.1.
Establishment of native gardens suited to local fauna within the estate.	Group 2 and 3	LandCorp will promote use of native species and placement of logs (for fauna habitat) in estate landscaping and utilise such species in vegetation of verges and median strips. Addressed in Sections 6.5.1, 7.5.1, and 15.
Necessity of entry from North Lake Road.	Group 2	Link to North Lake Road required for efficient and safe movement of traffic to and from the estate. Addressed in Section 13.4.1. Link between Sudlow Road and North Lake Road through the estate favoured by City of Cockburn.

Issue	Raised by	Response
Noise emissions in area	Group 3	Noise control measures will be implemented during estate development. Estate operation will be subject to noise regulations.
Noise and visual buffer between industrial estate and St Paul's Estate.	Group 3	Trees will be retained along Phoenix Road boundary of industrial estate as much as practicable. Acceptable significant noise emissions expected through application of noise management measures (see Section 12.5).

Group 1 – Community groups opposing any development

Group 2 – Community groups supporting limited development

Group 3 – Community groups supporting development as proposed with appropriate management in place.



### **3. PROPOSAL DESCRIPTION**

#### **3.1 JUSTIFICATION OF PROPOSAL AND SITE SELECTION**

##### **3.1.1 Planning context**

LandCorp is seeking to develop the estate to assist in replacing the diminished short-term supply of industrial land. The estate is being developed in light of:

- the services and employment it will provide locally;
- other nearby industrial zones already developed and close to being fully occupied (eg Canning Vale, existing Bibra Lake industrial area to the south west);
- unavailability of other land in the area to zone for further industrial zones, while Lot 502 has always been planned for industrial use as part of the Metropolitan Regional Scheme and Cockburn Town Planning Scheme No. 2;
- vacant industrial land in Cockburn estimated at less than 100 hectares, with less industrial land per capita than four similar-sized metropolitan local government areas (Bowen Bishaw and Gorham 2001);
- the long lead time on developing other industrial estates (Hope Valley/Wattleup industrial land will not be available for 5-10 years); and
- the large distances to other industrial zoned land, which means longer travel distances, freight costs, traffic, greenhouse emissions etc.

Lot 502 is already suitably zoned for general industry and hence the proposal does not require a rezoning approval.

##### **3.1.2 Need for proposal**

The level of demand for general industrial land in the Perth Metropolitan Region was determined based on the use of population forecasts and take up rates, utilising data from the DPI to adjust key ratios of employment to population and hectares per employee over time. Based on the population and employment growth model, an estimated additional 2801 hectares of general industrial land will be required between 2002 and 2026. Using historic take up rate data, about 1100 hectares will be needed in the Southern Suburbs area of Perth (McLeod 2002).

Based on the Chesterton International (2001) analysis, the competitive general industrial land in the South West totals 291 hectares if the Henderson Industrial area, which is reserved for marine based industry, is excluded and 400 hectares if it is included. This excludes the land in East Rockingham, Kwinana and Naval Base which is designated heavy industry.

Within the next ten years, around 467 hectares would be needed in the south west and east corridors of the metropolitan area (McLeod 2002). Using the Chesterton estimates and allowing for 100 hectares in the South East in addition to the Chesterton estimates, there is around 262 hectares of competitive land to match this demand excluding Henderson and Bibra Lake (Chesterton International 2001). The Chesterton estimate of competitively available land was 128.6 hectares for Bibra Lake including the land subject to environmental approval (Lot 502). Without the Bibra Lake land at Lot 502 there appears to be a potential supply issue and there is a market need for general industrial land in the southern metropolitan area (McLeod 2002).



### 3.1.3 Alternatives to the proposal

#### *Sites other than Lot 502*

There is little appropriately zoned undeveloped industrial land remaining in the southern part of the Perth Metropolitan Area. Future industrial zoning in the vicinity of Wattleup is still to be approved and there are only a few very small lots in the Southern River area, unsuitable for an estate development, which remain to be developed.

The Bibra Lake Industrial Estate is required to address the potential shortage of industrial land in the short to medium term. The Hope Valley/Wattleup industrial area is the solution for demand in the longer term.

#### *Alternative subdivision design/concept*

Four alternative subdivision designs were considered following feedback from community consultation. Economic and market feasibility studies were undertaken to assess the suitability of the designs and likely demand for lots as established by the designs. The following designs were seriously considered by LandCorp but not employed after it was assessed by LandCorp that it would incur unacceptable financial impacts:

1. Development excluded from area abutting South Lake, identified by M.J. and A.R. Bamford Consulting Ecologists as being of higher value for fauna compared to the remainder of Lot 502 (see Section 4.2.2).
2. Development restricted to the west of the ridgeline, which runs approximately north-south across the site (see Section 4.1.2).
3. Estate design including regular earthworks and industrial subdivision west of ridgeline, but only larger lots in the area east of the ridgeline. Building envelopes would restrict the amount of clearing allowable in each of the larger lots to a certain percentage of area.
4. Development of Lot 502 for residential rather than industrial purposes. This would have slightly decreased the level of earthworks required for the development. This alternative would however have required a change in zoning of the land both at a Metropolitan Region Scheme and local Town Planning Scheme level (and hence significantly delay the utilisation of the land). This proposal would also be direct conflict with a caveat by Amcor over Lot 502 restricting development to only general industrial use. Further restrictions for residential development imposed by the City of Cockburn requirements to keep residential areas at least 500m back from wetlands (Midge buffer).

Table 4 shows the relative cost compared with the potential environmental benefits for the proposal and each alternative considered.

### 3.1.4 Economic benefits of proposal

There are significant economic benefits associated with the development of the estate in the Bibra Lake area. The establishment of the estate is anticipated to generate 1115 employment positions directly with another 1086 jobs created indirectly elsewhere, with a total employment effect of 2201 (McLeod 2002).

The direct employment is estimated to generate nearly \$50 million in wages and salaries in the estate and a further \$53 million elsewhere, with a total of \$103 million in wages and salaries generated as a result of this proposal. Some existing firms will of course capture some of this flow in expenditure but this cannot be evaluated from the available data (McLeod 2002).



**Table 4 Comparison of alternatives for subdivision design**

Option	No. of lots	Impact on Net present value (NPV)	Environmental benefits
Current proposal (As described in Section 3.2)	180	- \$500,000	Rehabilitation of 150m wide buffer
Alternative 1 (No development in area of higher value to fauna as per Bamford 2002)	138	- \$5.8M	Larger area of upland habitat retained.
Alternative 2 (Exclusion of subdivision from area east of ridgeline)	121	- \$5.9M	Larger area of upland habitat retained Decreases impact on visual amenity
Alternative 3 (Larger lots and no earthworks east of ridgeline)	158 to 178	- \$6 to \$6.5M	Natural contours of landscape retained east of ridgeline. Some vegetation able to be retained within larger lots.
Alternative 4 (Residential subdivision) <sup>2</sup>	-	- \$1.5 to \$5.0M	Less earthworks required. Potential for more vegetation to be retained within lots.

<sup>1</sup> This shows the impact on the net present day value of the proposal over the life of the project (- indicates loss).

<sup>2</sup> Requires rezoning and extinguishment of caveat on land preventing use other than general industrial. NPV assumes no caveat or requirement to keep residencies 500m from lake.

### 3.2 PROJECT DETAILS

The proposal will involve developing 89 ha comprising an industrial subdivision, Regional and Public Open Space for conservation and recreation within the estate and remnant vegetation to provide a buffer area between the subdivision and South Lake. The key characteristics of the proposal are shown in Table 5.

**Table 5 Key characteristics of proposal**

Characteristic	Description
Location	Lot 502 North Lake Road, Phoenix Road, and Sudlow Road, Bibra Lake
<b>Industrial subdivision</b>	
Area	89 ha
Number of lots	180
Area of Public Open Space	4.5 ha
Associated infrastructure	Roads Native vegetation gardens along road verges and median strips Power Water Gas Communications
Vegetation disturbance*	Approximately 64 ha of mostly Jarrah Banksia woodland in degraded to very good condition as graded by Bennett Environmental Consulting (2002).
<b>South Lake buffer</b>	
Regional Open Space	6.2 ha
Rehabilitation	Area approximately 4-5 ha to be rehabilitated
Bund	3 m high, to be built on boundary of buffer area before subdivision road

\* excludes all areas classified as highly degraded by Bennett Environmental Consulting.

### **3.2.1 Subdivision plan**

The proposed subdivision consists of industrial lots and sets aside land for Public and Regional Open Space and road purposes. A stormwater drainage system will be installed, capturing all surface flow to prevent runoff from the estate to South Lake or its groundwater catchment area. The subdivision layout is shown in Figure 3.

### **3.2.2 Incorporation of flora protection measures into subdivision design and implementation**

Some important local ecological functions and values of the vegetation of Lot 502 will be retained or their loss mitigated through the following measures including:

- retaining and rehabilitating a 150 m wide 'buffer area' west of South Lake (see Section 15.3);
- establishing native gardens throughout the estate along road verges, lot frontages and newly established Public Open Space (see Section 15.3.1); and
- requiring enterprises in the estate to landscape their lots as far as practicable using native plant species and plants and soil material removed during stages of the estate development (see Section 15.3.1).

### **3.2.3 Earthworks**

The development of the industrial estate would be in stages, with areas sequentially cleared of vegetation and earthworks for cut and fill undertaken to create contours suitable for industrial lots. Taking into account fill requirements and compaction, the total amount of earth that will be required to be removed from site is estimated to be 1.6 million cubic metres. Figure 4 shows the topography of Lot 502 before and after development of the estate.

When required for rehabilitation purposes, the surface 5 to 10 cm of topsoil will be removed separately and placed directly in rehabilitation areas or native garden beds or stored in stockpiles for short periods (less than six months) until appropriate land becomes available.

Earthworks will also be required to build a bund along the western boundary of the South Lake buffer, the purpose of which is to provide further visual and noise screening of the estate from Beeliar Regional Park east of the estate.

### **3.2.4 Construction**

New public roads will be gradually established through the estate during the staged development, including a new link road between Sudlow Road and North Lake Road. Other infrastructure to be constructed includes power lines, stormwater drains, and utility services (eg. power supply cables, water mains, gas mains, sewerage).

### **3.2.5 Rehabilitation of South Lake buffer**

The degraded areas of the South Lake buffer area will be rehabilitated as part of the initial site works at the estate and Stage One of development. It is expected an area of approximately four to five hectares will be included in the rehabilitation program. The rehabilitation will be monitored throughout the staged development of the estate in consultation with CALM.



The objectives of the rehabilitation for the buffer are as follows:

- To re-establish native vegetation in the degraded areas contained within the 150 m buffer area between South Lake and the Bibra Lake Industrial Estate such that it is consistent with the original vegetation communities located around the lake.
- To rejuvenate the wetland habitat to the west of South Lake and re-establish suitable fauna habitat in the degraded areas within the 150 m buffer area between South Lake and the Bibra Lake Industrial Estate.

### **3.2.6 Establishment of native vegetation landscape within the estate**

To decrease the effects of removing local habitat for fauna from Lot 502, native gardens will be established in the estate, such that many fauna species will be able to utilise pockets of vegetation through the estate and use such areas as corridors for moving from one area to another.

The objective of the landscaping program, which will be part of the Landscape Protection and Management Plan and Rehabilitation Plan is:

- To establish native gardens in the estate using local species and utilising some rehabilitation techniques to maximise the potential of the existing seed stock and plant material being removed during the estate development.

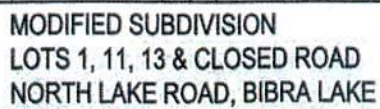
### **3.2.7 Expected activities in the estate**

Enterprises would be similar to those established in the Canning Vale Gardens Industrial Estate. Such enterprises include those providing the following services and products:

- food manufacturing, packaging and wholesalers;
- machine and vehicle servicing and sales;
- engineering and construction;
- wholesalers and distribution centres;
- electronic parts and manufacturers;
- plumbers, electricians etc; and
- metal and plastic products.

Figure 5 shows examples of the premises likely to be established in the proposed industrial estate













**Figure 5** Examples of likely premises in industrial estate (taken from Canning Vale Industrial Estate)



## 4. OVERVIEW OF EXISTING ENVIRONMENT

### 4.1 PHYSICAL

#### 4.1.1 Climate

Lot 502 Bibra Lake is located within the Perth Metropolitan Region in the southwest of Western Australia, which experiences a humid mesothermal (Mediterranean) climate, with distinct seasons, characterised by cool wet winters and warm to hot dry summers. Weather patterns are dominated by the west to east movement of high pressure systems across Western Australia, a coastal trough, and the movement of cold frontal systems across the southwest corner of the State, particularly in winter.

Perth receives more than 85% of its rain during May to October, with the remainder from thunderstorms and occasional cyclonic depressions in the warmer months (Churchward 1986). The area of the Swan Coastal Plain (SCP) on which Lot 502 is located experiences a long term annual average rainfall of 870 mm and pan evaporation of approximately 1500 mm. Monthly rainfall generally exceeds monthly evaporation during the winter months. Rainfall is experienced in Perth on average 110 days of the year, with approximately 50 of these occurring in winter (June to August). Table 6 shows the average monthly rainfall and number of rain days, and average daily evaporation for each month, at Jandakot Airport located nearby.

The summers of Perth are warm to hot with the average daily maximum in December through to March being 29 to 30°C. The winters are cool and the average minimum temperature from June through to August is between 7.3 and 7.5°C, with an average of 6.8 days below 2.2°C in July.

Extremes of wind and/or rain relate to tropical cyclones, summer thunderstorms and to winter frontal systems (Churchward 1986). Cyclones situated north of the tropic can still cause strong northerly winds to be experienced in the region from November through to May. When high temperatures are maintained over several days, heat-wave conditions can develop and the hazard of bushfire is great (Southern 1979). In the cooler months, frontal systems can cause extremes of wind, exacerbated by the close proximity to the coast.

**Table 6 Monthly climatic summary for Jandakot Airport**

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean daily max. temp. (°C) <sup>1</sup>	31.1	31.0	29.0	25.9	21.7	18.8	17.5	18.2	19.8	22.4	25.8	29.1	24.2
Mean daily min. temp (°C) <sup>1</sup>	16.8	16.9	15.5	13.1	9.8	7.5	6.5	7.3	8.4	9.4	12.4	14.8	11.5
Mean monthly rainfall (mm) <sup>2</sup>	16.4	18.5	16.7	40.3	114.0	168.9	188.7	130.2	86.9	51.1	28.4	10.5	870.6
Mean number of rain days <sup>2</sup>	2.5	2.5	3.8	6.7	12.9	16.6	17.8	15.5	13.1	9.1	6.2	3.3	109.9
Mean daily pan evap. (mm) <sup>3</sup>	8.5	7.5	6.4	4.2	2.4	1.7	1.8	2.5	2.8	4.1	6.0	7.2	4.6

<sup>1</sup> 1984 to 2001

<sup>2</sup> 1975 to 2001

<sup>3</sup> 1999 to 2001

#### 4.1.2 Geomorphology and topography

Lot 502 is located on the southern part of the Swan Coastal Plain (SCP), which represents Quaternary deposits overlying Tertiary, Mesozoic, and Palaeozoic sediments. The ocean to the west and the



Darling Scarp to the east border the SCP. The Darling Scarp represents the western limit of the Darling (or Great) Plateau, largely composed of Archean granite, and is the dominant geological feature of the southwest (Churchward 1986).

The SCP consists of a number of geomorphic units, with several alluvial systems extending outwards from the Darling Scarp as a piedmont to meet a series of dunes from the west (Churchward 1986). The youngest dunes, the Quindalup system, are calcareous sands. Inland are siliceous Spearwood dunes overlies a core of lithified calcareous sand. Eastward these give way to the Bassendean system, a complex of low dunes of leached sands and swamps. The division between the Spearwood and Bassendean Dune Systems is demarcated by a series of wetlands running north to south (Cockburn wetlands system), one of which, South Lake, abuts the eastern boundary of Lot 502. The estate is located on the eastern edge of the Spearwood Dune System.

Lot 502 is characterised by a high sandy undulating ridge in the north, west and south-west, sloping down to South Lake in the south-east. The highest part of this ridge (ridgeline) occurs in an almost north-south direction. The highest point of Lot 502 occurs along the southern boundary with an elevation of approximately 40 m AHD (Australian Height Datum) (Figure 6). The eastern boundary, adjacent to South Lake, is the lowest area of the property with an elevation of about 15 m AHD.

#### 4.1.3 Soils

The soils of the Spearwood dunes range from yellow-brown siliceous sands with limestone at shallow depths near the western margins, to bleached sands with yellow-brown B-horizons towards the east where Lot 502 is located. The yellow-brown sands of the Spearwood dune system differ from the bleached sand in the neighbouring Bassendean dune system, in that they adsorb phosphorus well. Market gardens in Perth have historically been preferentially located on these sands, as fertilisers are not leached readily. The Spearwood sands have a greater filtering capacity to protect groundwater sources from contaminants.

#### 4.1.4 Hydrology

The major hydrological influence on the SCP is the unconfined aquifer. The unconfined aquifer is in direct connection with the lakes and wetlands of the region, including South Lake immediately east of Lot 502. Lake water levels are directly dependent on groundwater elevation and they act both as sources and sinks of groundwater at different times of the year, through the processes of rainfall and open water evaporation (Townley and Turner 1990).

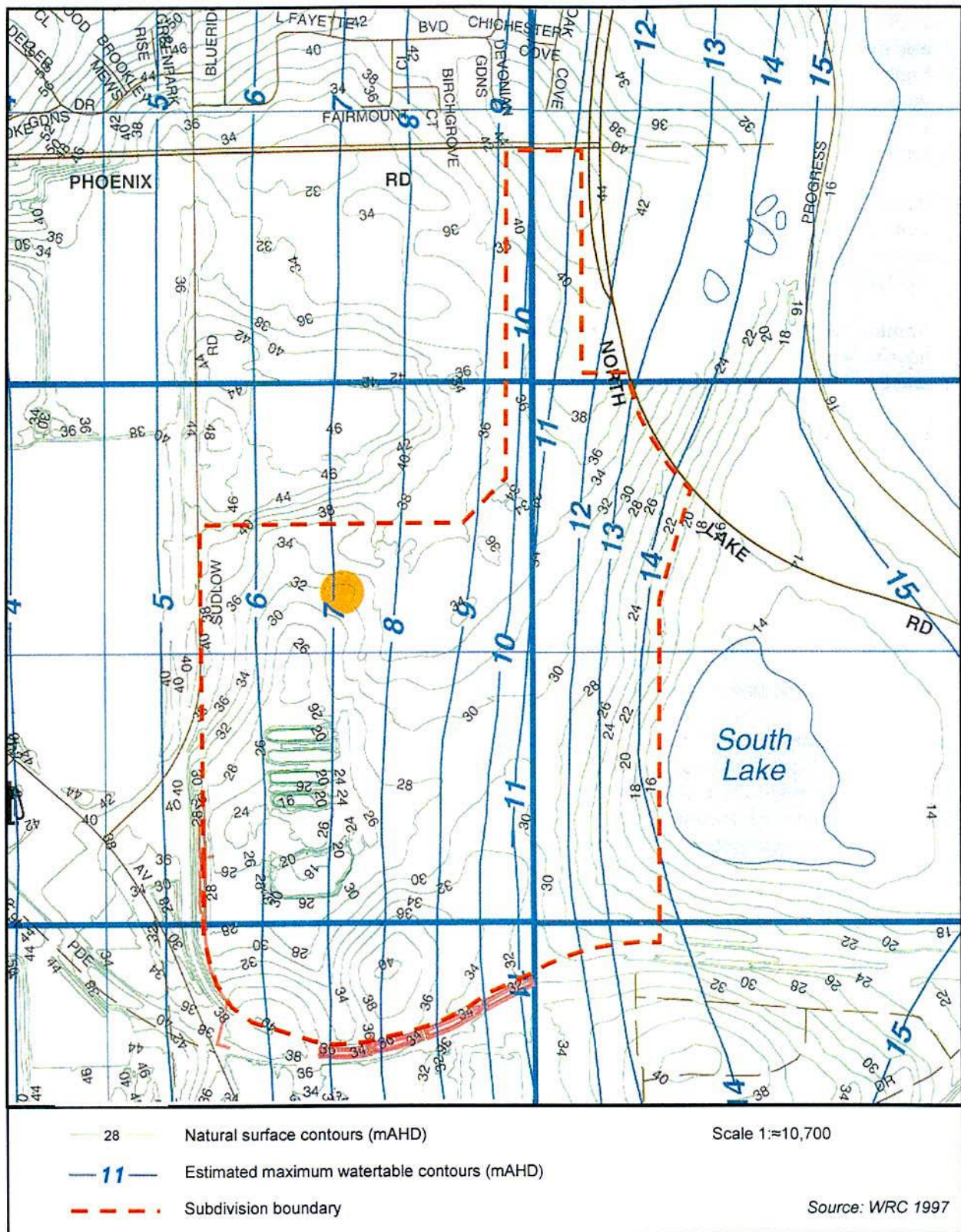
Lot 502 is located on the western edge of the Jandakot Mound, the primary influence on groundwater flow in the southern Metropolitan Region on the Swan Coastal Plain. Groundwater flows north-west and eventually westwards from the mound before intercepting the north-eastern Beelihar wetlands (including North, Bibra, Yangebup and South Lake).

The Beelihar Draft Management Plan describes the occurrence of some seasonal or occasional groundwater flow of lower importance in the vicinity of the eastern Beelihar lakes chain:

- A north to south flow can occur between wetlands when there is significant rainfall in one area of the chain and not in another. The groundwater will then move from one wetland to the other, as in a balancing process.
- There is some groundwater movement from a relatively small catchment area to the west of the eastern chain. Again the extent of water movement is determined by weather patterns and rainfall.

(CALM 2001)





**Figure 6 Topography and hydrology of lot 502 and adjacent South Lake**



In the case of Lot 502, groundwater travels from Bibra Lake and South Lake before moving directly east to west across Lot 502. There is a steep hydraulic gradient away from the lake under Lot 502 (see Figure 6). This indicates that the groundwater flow is extremely defined and moves directly perpendicular to the groundwater contours in the east to west direction (see Figure 6). The gradient is sufficiently steep that a reversal of this westerly flow would not be expected to occur under any foreseeable circumstances.

Recent groundwater monitoring has indicated that groundwater flow on the western side of Lot 502 is more to the north-west rather than directly west (Aquaterra 2002). Groundwater moving from Lot 502 would continue to move westwards, eventually discharging through the Quindalup sands into Cockburn Sound.

Rainfall received by Lot 502 primarily percolates through the siliceous sands into the unconfined aquifer, which is at variable depth below the land surface, with some escaping onto adjacent roadways and through surface flow into South Lake. The ridgeline running north-south through Lot 502 would effectively be a surface drainage divide, although only a small amount of surface runoff is expected to occur because of the high permeability of the soils and cover of vegetation.

South Lake, just east of Lot 502, is primarily a surface expression of the groundwater elevation where the land aquifer surface elevations coincide. In winter, the water level of the lake may be slightly higher than the groundwater elevation because of a lag period between surface runoff and rainfall input and recharge into the aquifer. Sediments and organic matter on the lake floor slowing the percolation of water into the aquifer typically cause this lag.

## **4.2 ECOLOGICAL OVERVIEW**

### **4.2.1 Vegetation and flora**

The natural vegetation of the SCP is diverse and varies greatly according to local soils, geology and hydrology. Tall mixed eucalypt woodlands of Tuart, Jarrah and Marri extend southward from Perth on the Spearwood dune system with Acacia and dryandra heath and shrublands on the calcareous Quindalup dune sands towards the sea (Churchward 1986). Low Banksia woodlands dominate the bleached Bassendean sands to the east, followed by Marri woodlands on the alluvial soils west of the Darling Scarp. Although the coastal plain has been substantially cleared, some large areas of uncleared lands remain, particularly on the more unproductive soils and in wet areas.

A detailed description of vegetation and flora at Lot 502 is provided under Vegetation and Flora Section 6.1.

### **4.2.2 Fauna**

Lot 502 essentially represents an upland habitat consisting mainly of Jarrah-Banksia woodland, which is adjacent to a wetland (South Lake) in the neighbouring open space. The woodland in itself is relatively uniform and its role as fauna habitat changes according to distance from South Lake. There are also some cleared areas used for paper waste storage and disposal from the adjacent Amcor recycling facility. Much of this waste is constantly wet from the continued spray disposal of the material and forms a moist modified habitat differing to the surrounding woodland. These areas are frequented by some species of waterbird such as Ibis.

A detailed description of fauna is provided under Fauna section 7.1.



### 4.2.3 South Lake and Beeliar Regional Park

Lot 502 is located on an upland area adjacent to South Lake, a sumpland of the Bibra suite of wetlands on the SCP (Hill *et al.* 1996). It forms part of a north-south linear belt of wetlands extending from Murdoch to Wellard, approximately five to seven kilometres east from the coast. These wetlands are typically mesoscale to macroscale lakes and sumplands, which are contact depressions with the groundwater, impounded against the Spearwood Dune ridge (Hill *et al.* 1996).

The majority of the wetland area has been evaluated by the WRC as having a management category of Resource Enhancement (RE) with some degraded areas on its perimeter within the Multiple Use (MU) management category.

South Lake is protected under the Swan Coastal Plain Lakes Environmental Protection Policy (EPA 1993b). The lake and surrounding reserve (Bush Forever site 254) are part of the Beeliar Regional Park, a collection of wetlands and upland reserves extending from Blue Gum Lake in Mount Pleasant to The Spectacles. The park comprises 19 lakes and many other associated wetlands in two main chains located parallel to the coast, one of these chains being part of the Bibra suite of wetlands. The park includes vegetated uplands consisting of mature woodland and forest areas, vegetated wetland areas, extensive areas of open water and areas of well maintained grassed parkland.

### 4.2.4 Regional significance of bushland on Lot 502

The assessment of regional significance of Lot 502 includes consideration of its importance in the context of selection criteria used by Bush Forever:

#### ***Representation of Ecological Communities, Diversity and Rarity***

Vegetation of Lot 502 is representative of the Karrakatta Complex C & S. An objective of the Bush Forever policy is to protect 10% or more of this complex. However, Bush Forever did not consider Lot 502 to be of sufficient regional importance for economic and social factors, such as its zoning and importance for industrial development in the region, were to be overlooked.

Vegetation communities found within Lot 502 are not in themselves rare, threatened or restricted in distribution and are well represented in reserves. The condition of the vegetation is not unusual for remnant vegetation on the Swan Coastal Plain. The majority of Lot 502 is representative of one vegetation community and is relatively uniform moving west from approximately 150 to 200 m away from South Lake. It does not contain as diverse a mosaic of vegetation communities as many Bush Forever sites in the region (Table 7).

No Rare, Priority or regionally significant flora have been recorded in Lot 502 during three flora searches, two of which were conducted in Spring. The species present are common to similar woodlands locally and regionally.

This issue is further addressed in Section 6.1.3.

#### ***Maintaining Ecological Processes or Natural Systems***

The woodland is potentially used by numerous fauna, many of which are likely to be traversing the area from other parts of the Beeliar Regional Park. The site is possibly utilised for foraging by the Carnaby's Black-Cockatoo (a threatened species that is nationally listed) and possibly of some significance to seven other vertebrate species considered to be of intra-state or national conservation significance. Notably, Carnaby's Black-Cockatoo potentially uses all upland woodland containing Banksia species in the Perth Metropolitan Region, and in fact the Swan Coastal Plain. The lot is not



considered to be of high significance to the other seven species of national conservation significance because of the likelihood of them being infrequent visitors to the site, the presence of sufficient surrounding suitable habitat and their ability to remain locally following removal of native vegetation. The woodland is potentially used by nine other vertebrate species of regional conservation significance (MJ and AR Bamford 2002, referred to as Bamford 2002).

The areas of vegetation close to the lake in Lot 502 may be utilised by lake fauna such as tortoises and frogs, and also serve as a buffer area around the lake, protecting the lake from potential aspects associated with surrounding land uses such as surface water drainage contamination and sand drift.

The lot is included as part of Greenways 72 and 90 (as per Alan Tingay and Associates 1998) and is part of a regionally significant bushland/wetland linkage.

This issue is further addressed in Section 6.1.3, 7.1.6 and 7.1.7.

**Table 7 Vegetation Units at Lot 502 and nearby Bush Forever Sites (BFS). (Government of Western Australia 2000; Bennett Environmental Consulting 2001).**

Site	Vegetation Complex	No. of Veg. Units	Descriptions of units
BFS 254 – South Lake	Bassendean Complex C & S (interface with Karrakatta) Karrakatta Complex C & S Herdsman Complex	6	<i>Eucalyptus marginata</i> , <i>Corymbia calophylla</i> Open Forest; <i>Banksia attenuata</i> , <i>B. menziesii</i> Low Open Forest; <i>Eucalyptus rudis</i> Low Closed Forest; <i>Eucalyptus rudis</i> and <i>Melaleuca preissiana</i> Open Forest; <i>Acacia saligna</i> Low Woodland; Mixed Closed Sedgeland.
BFS 244 – North Lake & Bibra Lake	Bassendean Complex C & S (interface with Karrakatta) Karrakatta Complex C & S Herdsman Complex	5	<i>Eucalyptus marginata</i> Open Forest; <i>Banksia attenuata</i> , <i>B. menziesii</i> , <i>Allocasuarina fraseriana</i> Low forest; <i>Eucalyptus rudis</i> , <i>Melaleuca preissiana</i> , <i>M. raphiophylla</i> , <i>B. ilicifolia</i> Forest to Woodland; <i>Melaleuca teretifolia</i> Tall Shrubland; <i>Baumea articulata</i> , <i>Typha orientalis</i> Sedgelands
BFS 256 – Yangebup & Little Rush Lakes	Bassendean Complex C & S (interface with Karrakatta) Karrakatta Complex C & S Herdsman Complex	9	<i>Eucalyptus gomphocephala</i> , <i>E. marginata</i> , <i>Corymbia calophylla</i> Woodland; <i>Eucalyptus marginata</i> Woodland; <i>Banksia attenuata</i> , <i>B. menziesii</i> Low Woodland; <i>Eucalyptus rudis</i> Open Forest; <i>Melaleuca raphiophylla</i> and <i>Eucalyptus rudis</i> Woodland; <i>Melaleuca preissiana</i> , <i>Banksia ilicifolia</i> Low Woodland; <i>Melaleuca teretifolia</i> Low Woodland; <i>Acacia saligna</i> Tall Shrubland; Sedgelands to Closed sedgeland.
BFS 391 – Thomsons Lake Nature Reserve	Bassendean Complex C & S Karrakatta Complex C & S Herdsman Complex	7	<i>Eucalyptus marginata</i> Low Open Forest; <i>Banksia attenuata</i> , <i>B. menziesii</i> Low Open Forest; mixed low heath; <i>Eucalyptus rudis</i> , <i>Melaleuca preissiana</i> , <i>M. raphiophylla</i> Open Forest; <i>Eucalyptus tottiana</i> , <i>Melaleuca preissiana</i> Low Open Forest; <i>Acacia</i> sp. Closed to Open Tall Scrub; <i>Melaleuca teretifolia</i> Low Open Forest; <i>Baumea articulata</i> , <i>Typha</i> sp. Closed Sedgeland.
Lot 502	Karrakatta Complex C & S  Bassendean Complex C & S (interface with Karrakatta)	3	<i>Eucalyptus marginata</i> , <i>Banksia attenuata</i> Closed Forest to Woodland, <i>Eucalyptus rudis</i> , <i>Banksia grandis</i> Open Woodland, <i>Hakea prostrata</i> , <i>Jacksonia furcellata</i> , <i>Kunzea glabrescens</i> Tall Open Scrub to Tall Shrubland.

### **General criteria for Protection of Wetland, Streamline and estuarine Fringing Vegetation and Coastal Vegetation**

South Lake is adjacent to the site and is an EPP wetland and entered in the Interim List of the register of the National Estate. The eastern side of Lot 502 includes an area of *Eucalyptus rudis* *Banksia grandis* woodland that fringes the western side of South Lake. This area extends 50 to 130 m into



Lot 502 and would form the outer edge of the lakes wetland and associated phreatophytic vegetation. The area further into Lot 502 is upland vegetation weakly associated with the wetland as habitat that may be potentially occasionally utilised by fauna of the lake such as bandicoots and tortoise.

#### **4.2.5 Local significance**

The vegetation of Lot 502 has some local significance because of the following factors:

- It contains a local representation of flora and vegetation communities.
- The vegetation abutting South Lake may be utilised by fauna associated with the lake, such as tortoises and frogs, and also serves as a buffer area around the lake, protecting the lake from potential aspects associated with surrounding land uses such as surface water drainage contamination and sand drift.
- The northeast and east area of Lot 502 has some linkage with vegetation around Bibra Lake and South Lake, which helps maintain local fauna populations.
- Lot 502 contains an area of upland woodland that is of aesthetic value to local residents.

Locally, there are already a number of conservation areas present to maintain representation of local vegetation and containing significant fauna populations (as shown in Table 7).

### **4.3 SOCIAL ENVIRONMENT**

#### **4.3.1 Planning**

Lot 502 is zoned Industrial under the Perth Metropolitan Region Scheme (MRS) and for General Industry under City of Cockburn's Town Planning Scheme No. 2. The area is zoned for industry under the proposed City of Cockburn's Town Planning Scheme No. 3.

#### **4.3.2 Land use**

Amcor Fibre Packaging previously owned Lot 502. Amcor has operated a paper mill and box plant adjacent to the subject site for approximately 30 years. Although the mill and box plant are not included in the subject land under this proposal, the site currently comprises a liquid waste spray irrigation area, four liquid waste/effluent disposal ponds and an unlined pit for solid waste disposal. These areas are currently being utilised for waste disposal, however, over time and with development these uses will discontinue and the irrigation and effluent ponds will be developed for industrial use and the landfill area converted into Public Open Space.

The remainder of the site is bushland and not currently utilised for any approved activities. However, the margins of South Lake are largely cleared and appear to have been used for the agistment of horses in the past. There is some evidence of the recreational use by four-wheel drive vehicles and motorbikes on the site.

#### **4.3.3 Surrounding land uses**

There are a number of varying land uses in the vicinity of Lot 502 including general industrial, residential, conservation, parks and recreation, and a privately owned amusement park. Specifically, Lot 502 is adjacent to:

- The Amcor Fibre Packaging facility and property, zoned general industry under MRS to the north and north-west;

- St Pauls residential estate, zoned Urban under MRS to the north, across Phoenix Road from the Amcor facility;
- Henderson Commercial Area, zoned Industrial under MRS to the west;
- General industrial area, zoned Industrial under MRS to the southwest and south, and includes Cocos Park;
- Regional Open Space containing South Lake, zoned Parks and Recreation under MRS to the east; and
- Adventure World Amusement Park, zoned private recreation under MRS.

Lot 502 is separated from the surrounding land uses by major roads, except in the case of the Amcor facility and South Lake reserve, which directly abut Lot 502, and Cocos Park to the south, which is separated by a disused railway easement. The major roads abutting Lot 502 are North Lake Road along the north-eastern boundary, Phoenix Road along the northern boundary, and Sudlow Road and Spearwood Avenue along the eastern boundary.

The residential area of St Paul's Estate is located approximately 50 m from the northern 'pan-handle' section of Lot 502. The residential suburb of Yangebup is located approximately 600 m from the south eastern corner of the site.

#### **4.3.4 South Lake and Beeliar Regional Park**

Lot 502 is immediately west of South Lake and its surrounding open space, zoned as Parks and Recreation under the Perth MRS, which is part of Beeliar Regional Park. The park itself contains many values and is used for a variety of activities and functions including:

- Significant landscape and amenity value to the region with its varying landscapes. Significant views, deemed important to the Park's identity, of the major wetland areas can be appreciated from many vantage points around the Park. The relationship of adjoining land uses to the Park's landscape often has a significant impact on the overall amenity of the Park (CALM 2000).
- Cultural significance to both Aboriginal and non-Aboriginal people. There are numerous Aboriginal sites within or immediately adjacent to the Park, which have been identified by the Aboriginal Affairs Department.
- Both passive and active recreation opportunities. It contains a number of small recreation nodes offering a diversity of settings, uses and facilities, such as BBQ areas, parks, walk trails etc.
- Significant research and scientific values and the collection of technical data on wetland habitats, water quality and water quantity from the area make it an extremely valuable resource in gaining technical and managerial expertise that can be applied to other wetlands.

#### **4.4 ABORIGINAL HERITAGE**

The area pertaining to the Beeliar chain of wetlands was historically used as camping areas and important sources of food and other materials (Polglaze 1986). The chain is also said to have been part of a major trade route between Aboriginal people in the Swan and Murray River areas (Polglaze 1986). There is no doubt that in light of the historical use of the areas around Perth's wetland chains, they are significant to Nyoongar people. There are known mythological associations with the lakes and some occurrence of archaeological sites.

A detailed description of Aboriginal heritage, specific to Lot 502, is provided under the Aboriginal Heritage Section 14.



#### **4.5 NON-ABORIGINAL HERITAGE**

The first European settlement of the Cockburn district was Thomas Peel's failed town of Clarence, abandoned after two or three years, on the western side of market Garden Swamps in 1830 (Drake and Kennealy 1995). The infertile nature of the soils in this area, with only small pockets of 'good soil', limited the agricultural use of the land initially. Market gardening began to surround the wetlands in the late 1800s and extensive areas were cleared for horticulture, particularly when irrigation became available (Drake and Kennealy 1995).

There are no sites on Lot 502 listed with the Australian Heritage Commission, Heritage Council of Western Australia, or the National Trust of Australia.

## **5. ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT**

### **5.1 INTRODUCTION**

Interactions between the proposal and the existing environment will result in changes to the environment that may affect environmental factors. The EPA guidelines require the following key environmental issues to be addressed:

1. Clearing of remnant vegetation.
2. Protection of South Lake.
3. Protection of landscape values.
4. Protection of fauna.
5. Site contamination.
6. Drainage management.

Other factors, including dust management, noise, traffic and safety issues, and protection of Aboriginal Heritage have also been addressed in the PER.

### **5.2 ENVIRONMENTAL IMPACT ASSESSMENT APPROACH**

#### **5.2.1 Consideration of environmental risk**

This review uses the framework and principles of Australian Standard 4360:1999 "Risk Management" as a guideline in identifying, assessing and managing environmental risk.

#### **5.2.2 Assessment of environmental factors**

Each identified environmental factor is addressed under its own heading, and the assessment addresses the following topics.

##### ***Description of factor***

A brief summary of the environmental factor is provided to assist in the understanding of environmental impacts. In-depth description of each environmental factor has already been provided in Section 2 and referenced to environmental documentation.

##### ***Objectives***

These are the criteria or desirable outcomes (usually specified by the EPA) for each environmental factor that is to be achieved if the proposal is to be considered environmentally acceptable. The primary objectives considered in this assessment are typically those prescribed by the EPA in its preliminary guidelines (June 2002). Other objectives (proponent management objectives) may also be described that are relevant to the proponent's Environmental Policy.

##### ***Assessment context***

The relevant legislation, policies, regulations and regulatory guidance are briefly described to indicate the context in which the impacts of the proposal can be assessed and the level of management required to address these impacts.



### ***Potential causes of impact***

The first stage in impact assessment is to identify potential sources of impacts (environmental hazards) that may be associated with an aspect or activity of the proposal. For instance, activities or aspects that may cause impacts include land clearing, traffic and rehabilitation.

### ***Consequences and mitigation***

This section describes the likelihood of impacts (adverse or beneficial) occurring as well as describing the environmental consequences and impacts.

The process of risk identification and management is ongoing and has resulted in modifications to the proposal to avoid or reduce the likelihood of impacts. Potential environmental impacts associated with this proposal are managed by:

- aversion or avoidance of adverse impacts by eliminating the causes or potential causes (hazards) of impact;
- reduction in the likelihood of the impact through application of environmental management procedures or redesign of the proposal;
- reduction in the consequences or extent of impact (if it occurs) through application of environmental management procedures including rehabilitation, contingency planning and incident response; or
- offsetting impacts through enhancing environmental protection or conservation values of areas unaffected by the proposal.

The likelihood of impacts occurring depends on the characteristics (frequency and timing) of the potential source of impact and the characteristics of the surrounding environment at the time of the impact. Using known information on the environment, the extent and consequences of impacts following the application of management procedures, modifications or environmental offsets to the proposal is described.

### ***Environmental outcome***

This section is a summary description of residual impact including consideration of the likelihood of the outcome being achieved. The significance of the outcome and its consistency with EPA objective(s) is addressed. The environmental outcome may be described in temporal and spatial terms according to the environmental factor being addressed.

## 6. FLORA

### 6.1 DESCRIPTION

Lot 502 contains approximately 67 ha of native vegetation in very good to degraded condition and approximately 22 ha of cleared and completely degraded land containing almost no native species. The native vegetation of Lot 502 is mostly representative of the Karrakatta Vegetation Complex<sup>1</sup> - Central and South (C&S) as mapped by Heddle *et al.* (1980). The Karrakatta Vegetation Complex C & S is predominantly open forest of *Eucalyptus gomphocephala* (Tuart) – *E. marginata* (Jarrah) – *Corymbia calophylla* (Marri) and woodland of *E. marginata* and *Banksia* species. There is a very small area (approximately 2 ha) in the northeast part of the property that was mapped by Heddle *et al.* 1980 as belonging to the Bassendean Complex – Central and South, which ranges from woodland of *E. marginata* – *Casuarina fraseriana* – *Banksia* spp. to low woodland of *Melaleuca* species, and sedgelands on the moister sites (Heddle *et al.* 1980). For the purpose of this assessment, the site has been assumed to be generally representative of the Karrakatta Complex C & S.

Several vegetation and flora studies have been specifically conducted in Lot 502 to further describe the vegetation communities present and their condition, as well as the presence of significant flora, namely:

- Winter survey for Declared Rare and Priority Flora search (Consulting Botanist, Dr Arthur Weston, June 1999);
- Spring survey for Declared Rare and Priority Flora search (Consulting Botanist, Dr Arthur Weston September 2000); and
- Spring vegetation and flora survey (Consulting Botanists, Bennett Environmental Consulting 2001).

#### 6.1.1 Vegetation communities

Three vegetation communities occur in Lot 502 using the vegetation structural classes listed in Bush Forever (Bennett Environmental Consulting 2001). Vegetation communities were described so vegetation could be directly compared to structural units described in Bush Forever (Government of WA 2000) as follows (Figure 7):

- **EmBa:** Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* over an Open Heath dominated by *Xanthorrhoea preissii* or *Hibbertia hypericoides*.
- **HpJsKg:** Tall Open Scrub to Tall Shrubland of *Hakea prostrata*, *Jacksonia furcellata* and *Kunzea glabrescens* over a Low Open Shrubland over a Grassland dominated by *Briza maxima* (exotic species).
- **ErBg:** Open Woodland of *Eucalyptus rudis* and *Banksia grandis* over an Open Shrubland of *Hakea prostrata* over a Herbland of weeds.

A few, tall Tuart (*E. gomphocephala*) trees were located in the southwest corner of Lot 502, indicating that a Tuart dominated vegetation community possibly existed previously just southwest of the property. There are also several severely degraded areas in Lot 502, with little to no native species

<sup>1</sup> Vegetation complexes represent a mapping unit defined by changes in geology, soil, topography and hydrology, which represent a specific collection of vegetation communities. Therefore, boundaries between vegetation complexes over a small area are not usually distinct, but rather represent a demarcation where changes in vegetation composition and structure are expected because of changes in the physical environment.



present, and have not been described as native vegetation communities. Figure 7 shows an approximation of the boundaries of these vegetation communities.

The majority of Lot 502 is EmBa (94% of 89 ha area, inclusive of completely degraded areas), with areas of HpJsKg and ErBg communities very small in comparison (about 6% and 1% respectively). The EmBa and HpJsKg vegetation is representative of Floristic Community Type 28 as described by Gibson *et al* (1996). The Gibson *et al*. study was a large floristic survey of the southern Swan Coastal Plain, which described the vegetation of this region as 43 floristic community types, defined by the absence and presence of indicator species.

The small area of ErBg in the southeast is a remnant of a previously much larger area, which continued down to the western shore of South Lake. The remnant was dominant along the southeastern side of Lot 502, but the understorey was completely replaced by weeds with large open areas of *Carpobrotus edulis* and *Ehrharta calycina*. This area represents part of a transition zone between Floristic Community Type 28 and Floristic Community Type 11 as defined by Gibson *et al*. (1996).

The dominant species in each of these communities at each structural class (i.e. trees, shrubs 1-2 m tall, shrubs less than 1 m tall and herbs) are shown in Appendix 2 as well as a complete list of flora species recorded in each of these communities during the spring 2001 survey.

The vegetation communities are typical of the eastern edge of the Spearwood dune system with the Jarrah (*E. marginata*)-Banksia woodland characteristic of Karrakatta Complex C&S. The high occurrence of Banksia species and low occurrence of Tuart (*E. gomphocephala*) and only occasional occurrence of Marri (*C. calophylla*) is indicative of a transition into the Bassendean Complex C&S characteristic of the Bassendean dune system nearby. The metropolitan region now contains 18% (6,275 ha) of its original cover of the Karrakatta Complex C&S (34,532 ha) and 24% (10,919 ha) of its original area of Bassendean Complex C&S (46,220 ha) (Government of WA 2000). These two complexes originally covered the largest and second largest areas within the current metropolitan boundary, compared to all other complexes mapped by Heddle *et al*. (1980).

### 6.1.2 Condition of vegetation

Much of the woodland of Lot 502 consists of regrowth, with a few large trees present. The condition of vegetation in Lot 502 was recorded using the Keighery (1994) condition scale as used in Bush Forever (see Table 8), which has been mapped as shown in Figure 7. Approximately 22 ha (25%) of Lot 502 was categorised as completely degraded (Condition 6) with the remainder (67 ha) categorised approximately evenly through the degraded to very good condition categories (Conditions 5 to 3).

None of the vegetation surveyed recorded a Rating of 1 – Pristine or 2 – Excellent, as all areas included several to dense weeds in the understorey. Generally the condition of the vegetation was rated lower along roads and firebreaks.

The deposition of wet paper throughout cleared areas of Lot 502 has increased the number of weeds and caused the deaths of trees within the radius of the sprinklers. Large areas have become completely degraded due to the paper pulp and “rivers” of the material have penetrated some distance into the bushland (Bennett Environmental Consulting 2001).

An area adjacent to South Lake in the southeast of the site is largely degraded, possibly associated with past uses for grazing and the use of four-wheel drive vehicles and motorbikes on the site. This vegetation was originally representative of an ErBg vegetation community.

Figure 7 shows the approximate condition of the vegetation across Lot 502.



**Table 8 Vegetation condition categories (Keighery 1994)**

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual taxa and weeds are non-aggressive taxa.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native taxa.

### 6.1.3 Significance of vegetation communities

#### ***Bush Forever considerations***

The importance of the native vegetation of Lot 502 has already been assessed as part of Bush Forever (Bushplan) site selection process. The site was both considered during the initial Bushplan assessment of sites and following the City of Cockburn's referral of a 30 ha area of Lot 502 for consideration. However, Lot 502 was not included in the proposed parks and reserve system established by the Bush Forever Policy (Government of WA 2000).

Bush Forever states that no land was automatically excluded from consideration, but where lands were significantly constrained by existing zoning or development approvals, alternative choices were made where possible. A number of criteria for protection under the policy were employed and the site selection process was also refined to take into account wider social and economic values of land such as land use and the wider financial considerations of Government.

Lot 502 either did not meet the criteria for the selection of regionally significant bushland under Bush Forever and/or was not considered for inclusion in the parks and reserve system because of social and economic considerations.

However the local and regional significance of Lot 502 was examined here, as requested by EPA, using similar criteria to Bush Forever. There have been no changes to the presence and condition of vegetation communities or use by fauna of Lot 502 since the Bush Forever examination.

#### ***Karrakatta Complex C & S complex***

Although an objective of Bush Forever was to protect a target of at least 10% of the original extent of each of the Heddle *et al.* (1980) vegetation complexes in the metropolitan area within parks and reserves, to date only 8% of the Karrakatta Complex C & S has been allocated into such areas. Other areas outside the metropolitan area could be protected to compensate for not reaching the Bush Forever target if deemed necessary. Bush Forever states that:

*'The Karrakatta Central South complex retains more than 10 per cent bushland at present, but is substantially constrained by existing development proposals and Urban/Industrial Zones to the extent that the target is unlikely to be achieved. It is notable that this complex extends north from the Perth Metropolitan Region and there are better opportunities for conservation in these areas.'*

(page 81, Volume 2 Bush Forever. Government of Western Australia 2000)

The Karrakatta Complex C & S, which originally covered 12% of the SCP, second only to the Bassendean Complex C & S, which covered 16% of the SCP. Although the Karrakatta Complex C & S may be poorly represented in the reserve system as a percentage of its original area on the SCP,



under Bush Forever, only six of the 26 vegetation complexes found in the metropolitan region are afforded more protection in terms of area protected.

The Karrakatta Complex C & S is represented in all the Bush Forever sites that make up the eastern chain of the Beeliar Regional Park wetlands (see Table 9). The complex is also protected in other high profile and relatively large parks and reserves in Perth. These include Kings Park, containing 321 ha of Karrakatta Complex C & S; Whitfords Avenue Bushland and Pinaroo Valley Memorial Park in Craigie/Padbury, containing about 190 ha of Karrakatta Complex C & S, and Koondoola Regional Bushland, which contains 124 ha of bushland, all Karrakatta Complex C & S.

It is recognised that vegetation complexes, as defined by Heddle *et al.* 1980, are not representative of a specific vegetation association or community, but rather a description of the mosaic of associations and/or plant communities that occur within its boundaries as defined by changes in geomorphology, geology, climate and hydrology. Vegetation associations and communities can be common to more than a single vegetation complex as found by Gibson *et al.* 1996, who found floristic community types were not necessarily restricted to a specific vegetation complex.

Bush Forever provides for the inclusion of 18% of the original extent of the Cottesloe Complex C & S into parks and reserves, which contains many vegetation communities found in Bush Forever sites located in the Karrakatta complex C & S. Therefore, although a vegetation complex as a mapping unit may be poorly represented in reserves, some communities associated with that complex may be well protected because they are found in association with other complexes and hence further represented in other reserves.

### **Vegetation associations/communities**

At a plant community level, the vegetation of Lot 502 would appear well represented in the metropolitan region. Gibson *et al.* (1996) considered both floristic community types found in Lot 502 to be well reserved and at a low risk to threatening processes that could increase its need for conservation (Table 9). Floristic Community Type 28 (*Banksia attenuata* – *Eucalyptus* woodlands) is common to the majority of remnant bushland in the area, found in nearby Bush Forever Sites as listed in Table 9.

None of the vegetation communities in Lot 502 is a Threatened Ecological Community (TEC) as listed by the Department of Conservation and Land Management (English 2001).

**Table 9 Reservation and Conservation Status of Floristic Community Types found on Lot 502.**

Floristic Community Type	Reservation Status	Conservation Status	Representation in Bush Forever site within 5 km of Lot 502
11 *	Well reserved	Low risk	Bush Forever sites 59, 244, 254, 256, 391
28	Well reserved	Low risk	Bush Forever sites 244, 254, 256, 391

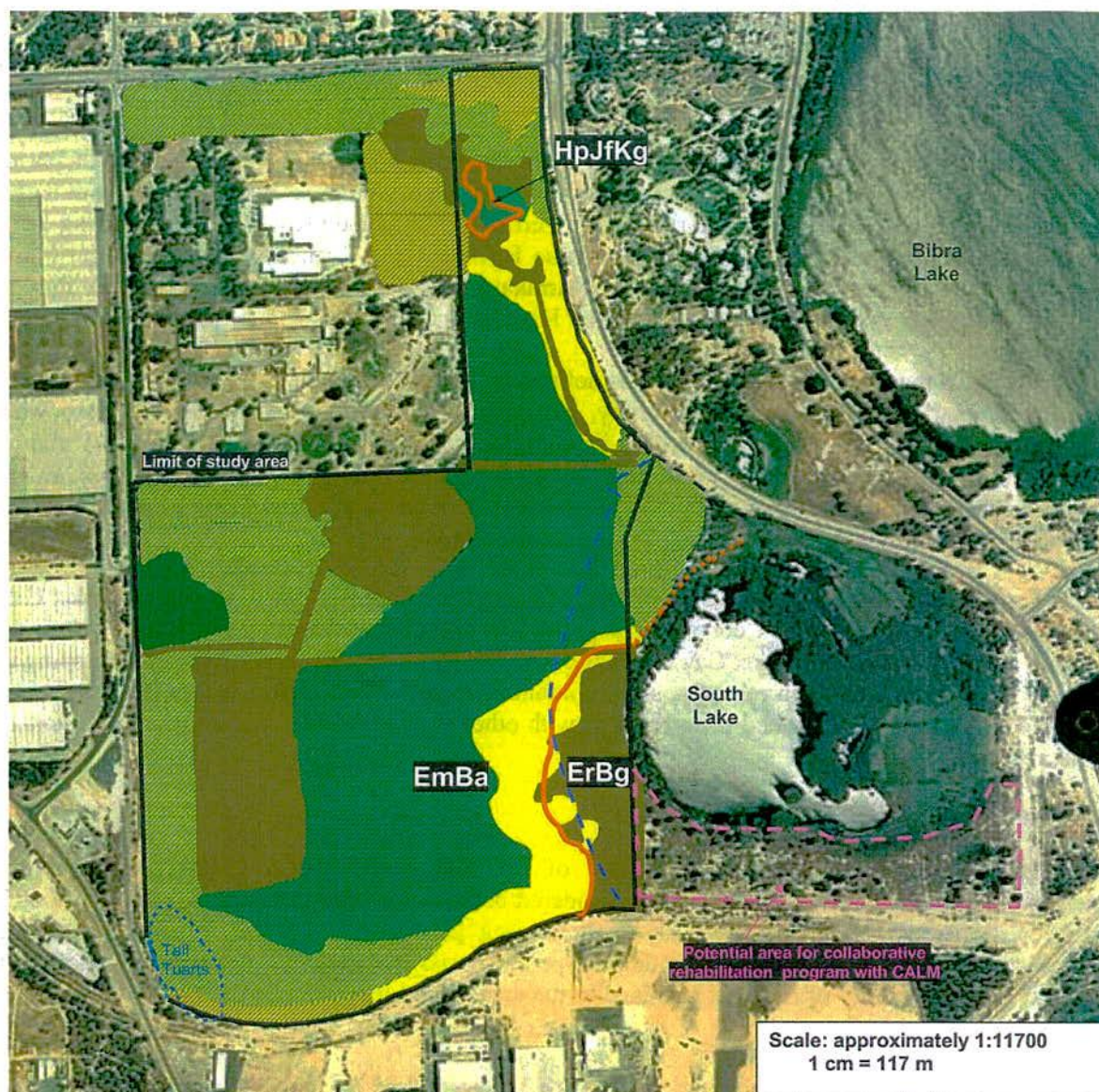
\*Site contains only a small transition area into Floristic Community Type 11. Not good representation of this community type.

### **6.1.4 Flora**

A total of 172 vascular plant taxa from 136 genera and 49 families were recorded during the Bennett Environmental Consulting survey of Lot 502. This included 67 weed taxa, representing 39% of the total number of taxa recorded. The dominant plant families were Papilionaceae, Asteraceae, Poaceae, Proteaceae, Myrtaceae, Anthericaceae, and Euphorbiaceae. These seven plant families represent 46% of the total number of taxa recorded.

Appendix 2 contains a complete list of the flora recorded during the Spring 2001 survey.





#### KEY:

	Sub-division area boundary
	Boundary of vegetation community
	Proposed set back from South Lake (at least 150m)
	Other significant areas

#### Vegetation communities of Lot 502

Key	Floristic Community Type	Vegetation Community
<b>EmBa</b>	28	Closed Forest to Woodland of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia attenuata</i> with occasional to dense <i>Corymbia calophylla</i> over an Open Heath dominated by <i>Xanthorrhoea preissii</i> or <i>Hibbertia hypericoides</i>
<b>HpJfKg</b>	28	Tall Open Scrub to Tall Shrubland of <i>Hakea prostrata</i> , <i>Jacksonia furcellata</i> and <i>Kunzea glabrescens</i> over a Low Open Shrubland over a Grassland dominated by <i>Briza maxima</i>
<b>ErBg</b>	Interzone 11-28	Open Woodland of <i>Eucalyptus rudis</i> and <i>Banksia grandis</i> over an Open Shrubland of <i>Hakea prostrata</i> over a Herbland of weeds

(adapted from Gibson *et al.* 1994)

Photo: DOLA 1998



#### Vegetation condition categories

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual taxa and weeds are non-aggressive taxa.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
3-4	Very Good to Good	
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
4-5	Good to Degraded	
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
5-6	Degraded to Completely Degraded	
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native taxa.

(as assessed by Bennett Environmental Consultancy 2001)

Figure 7 Vegetation communities and their condition in Lot 502 (adapted from Bennett Environmental Consulting 2001)



## Conservation flora

No Declared Rare or Priority Flora was recorded during the three flora surveys conducted between 1999 and 2001. Two of the surveys were conducted during spring periods that should maximise the number of species observed including the presence of annuals.

Weston (2000) refers to locating a small sedge species that “could be *Schoneus latitans*”, however *S. clandestinus* is expected to be the correct classification. This same sedge was common throughout the Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* but was not in flower. Checking with FloraBase (Western Australian Herbarium, 2001b) *Schoenus latitans* has been collected from near Geraldton whereas *S. clandestinus* has been collected from Eneabba southwards to south of Perth including several collections from the metropolitan area. Both species flower in March so a collection at that time of year would determine the correct classification.

During the most recent flora study, it was also noted that:

- The Declared Rare Flora, *Caladenia huegelii* was not recorded in Lot 502. Similar but more common *Caladenia* species including *Caladenia flava*, *C. latifolia* and *Caladenia longicauda* subsp. *calcigenia* have been recorded at Lot 502, but are not considered threatened.
- The Declared Rare Flora, *Diuris micrantha*, was not recorded but the similar non-listed species *D. corymbosa* was recorded at the site.
- *Phlebocarya ciliata* was recorded in the Closed Forest to Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* with occasional to dense *Corymbia calophylla* but not the Priority Three Flora, *Phlebocarya pilosissima* subsp. *pilosissima*.

### 6.1.5 Weeds

A total of 67 weeds were recorded during the survey representing 39% of the total plant taxa recorded. Most have been determined as environmental weeds by the Department of Conservation and Land Management (1999) and the Western Australian Herbarium (2001a) and their rating is based on the following criteria:

- **Invasiveness** – ability to invade natural bushland in good to excellent condition or ability to invade waterways.
- **Distribution** – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world.
- **Environmental impacts** – Ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community.

The ratings are as follows:

- **High** indicates this weed is prioritised for control and/or research ie prioritising funding to it.
- **Moderate** indicates control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).
- **Mild** indicates monitoring of the weed and control where appropriate.
- **Low** indicates that the taxa would require a low level of monitoring.

Twelve of the weed taxa are recorded as High, indicating that the species are significant environmental weeds (Table 10). Many of the weeds were strongly associated with the degraded areas. Agriculture WA also lists *Moraea flaccida*, rated High by CALM, as a Declared Plant. “Declared Plants” are

those species which have been categorised as potential or current agricultural pests. *Moraea flaccida* is classified as Category P1 – Plants which cannot be introduced or spread. Most Declared Plants are in this category.

The percentage of dominance and often the weed taxa varied across the Amcor site and the suite of weeds dominant at different areas within the bushland have been mapped by Bennett Environmental Consulting (2001).

**Table 10 Weed species recorded in Lot 502 prioritised (High) for control by CALM.**

Scientific Name	Common Name	Found in degraded area	Found in vegetation community		
			EmBa	HpJfKg	ErBg
<i>Brassica tournefortii</i>	Wild turnip	*	*		
<i>Bromus diandrus</i>	Great brome	*	*		*
<i>Ehrharta calycina</i>	Perennial veldt grass	*	*	*	*
<i>Eragrostis curvula</i>	African love grass	*	*		
<i>Euphorbia terracina</i>	Geraldton carnation weed		*		
<i>Freesia hybrid</i>	Freesia	*	*		
<i>Lagurus ovatus</i>	Hares tail grass	*	*	*	*
<i>Leptospermum laevigatum</i>	Victorian tea tree			*	
<i>Lupinus cosentinii</i>	Blue lupin		*		
<i>Moraea flaccida</i>	One-leaf cape tulip		*		*
<i>Pelargonium capitatum</i>	Rose pelargonium	*	*	*	*
<i>Romulea rosea</i>	Guildford grass	*	*		
<i>Zantedeschia aethiopica</i>	Arum lily		*	*	

Weeds are considered a major problem in the adjacent Beeliar Regional Park (CALM 2001).

### 6.1.6 Dieback

A soil-borne fungus of the genus *Phytophthora* causes the plant disease known in Western Australia as “dieback” or “Jarrah dieback”. The most destructive and widespread species is *Phytophthora cinnamomi* Rands, which has caused irreversible decline of susceptible species from Eneabba in the north to Cape Arid on the south coast (Shearer & Tippet, 1989). *Armillaria luteobubalina* is a native fungus belonging to the basidiomycetes group of wood rotting fungi. It causes a similar “dieback” of vegetation to *P. cinnamomi*, but is typically restricted to the coastal dunes and Spearwood Dune system, affecting approximately 40% of coastal species.

A survey was conducted by Fungus Doctors (M.J Reynolds for Fieldview Nominees Pty Ltd) in February 2002 to determine the distribution of disease caused by the plant pathogen *P.cinnamomi* within native vegetation and demarcate any active disease fronts (Figure 8). Assessment was also made of the presence of *Armillaria luteobubalina* infestations.





Figure 8 Results of mapping of *Phytophthora* infection in Lot 502



There were no *P. cinnamomi* or *A. luteobubalina* infestations detected within the survey area and the majority of the area was classified as uninfested with the exception being areas classified as uninterpretable (see below).

Three areas were classified as uninterpretable due to susceptible species being absent or in too low distribution to determine the presence or absence of *P. cinnamomi*. The distribution of the areas is recorded on the "*Phytophthora cinnamomi* Occurrence Map" shown in Figure 8.

Dieback has not been reported in the South Lake section of Beeliar Regional Park, adjoining Lot 502.

#### **6.1.7 Fire**

The most recently noted significant fire event to occur on Lot 502 occurred approximately 10 years ago along the southern boundary adjacent to the abandoned railway easement (Amcor Fibre Packaging Mill staff, pers. comm. 2002). Several small fires have occurred in the South Lake area over the 2001-2002 period (CALM, pers. comm. 2002).

### **6.2 PRELIMINARY EPA OBJECTIVES**

The following EPA objective applies to the protection of flora:

- 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.

The following overriding EPA objective addressing biodiversity is also relevant to this factor:

- To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

#### **LandCorp objectives**

LandCorp has also applied the following specific objectives for addressing this factor:

- To protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*.
- Minimise the potential spread of dieback and weeds.

### **6.3 ASSESSMENT FRAMEWORK OR POLICY CONTEXT**

The State and Commonwealth Governments have endorsed the National Strategy for Conservation of Australia Biodiversity and the National Strategy for Ecologically Sustainable Development that protects biodiversity. The principals adopted by this strategy are:

1. Biological diversity is best preserved in-situ.
2. Although all levels of Government have clear responsibility, the cooperation of conservation groups, resource users, indigenous peoples, and the community in general is critical to the conservation of biological diversity.
3. It is vital to anticipate, prevent and attack at source the causes of significant reduction or loss of biological diversity.
4. Processes for and decisions about the allocation of Australia's resources should be efficient, equitable and transparent.



5. Lack of full knowledge should not be an excuse for postponing action to conserve biological diversity.
6. The conservation of Australia's biological diversity is affected by international activities and requires actions extending beyond Australia's national jurisdiction.
7. Australians operating beyond our national jurisdiction should respect the principles of conservation and sustainable use of biological diversity and act in accordance with any relevant national or international laws.
8. Central to the conservation of Australia's biological diversity is the establishment of a comprehensive and adequate system of ecologically viable protected areas integrated into sympathetic management of all areas, including agricultural and other resource production systems.
9. The close, traditional association of Australia's indigenous peoples with components of biological diversity should be recognised, as should the desirability of sharing equitably benefits arising from the innovative use of traditional knowledge of biological diversity.

### 6.3.1 EPA Position Statement No 2

The EPA regards biological diversity as being a key environmental factor in the State. The EPA will focus on the principles (see above) and the related objectives and actions of the National Strategy for Conservation of Australia's Biological Diversity.

The EPA, in assessing a clearing proposal outside the Agricultural Region will include the following basic elements in its consideration of biological diversity:

1. A comparison of development scenarios or options to evaluate protection of biodiversity at the species and ecosystem levels and demonstrate that all reasonable steps have been taken to avoid disturbing vegetation.
2. No known species of plant or animal is caused to become extinct as a consequence of the development and the risks to threatened species are considered to be acceptable.
3. No association or community of indigenous plants or animals ceases to exist as a result of the project.
4. There would be an expectation that a proposal would demonstrate that the vegetation removal would not compromise any vegetation type by taking it below the threshold level of 30% of the pre-clearing extent of the vegetation type.
5. Where a proposal would result in a reduction below the 30% level, the EPA would expect alternative mechanisms to be put forward to address the protection of biodiversity.
6. There is comprehensive, adequate and secure representation of scarce or endangered habitats within the project area and/or in areas which are biologically comparable to the project area, protected in secure reserves;
7. If the project is large (in the order of 10 ha to 100 ha or greater, depending on where in the State) the project area itself should include a comprehensive and adequate network of conservation areas and linking corridors whose integrity and biodiversity are secure and protected.
8. The on-site and off-site impacts of the project are identified and the proponent demonstrates that these impacts can be managed.

Biodiversity has two key aspects:

- its functional value at the ecosystem level; and

- its intrinsic value at the individual species, species assemblages and genetic levels.

### 6.3.2 Bush Forever

In the Perth Metropolitan Region, the presence of a vegetation complex, as mapped by Heddle *et al.* 1980, of which less than 10% remains in the region, is also of high significance. There is a general presumption against clearing such bushland under the Bush Forever policy (Government of Western Australia 2000).

The Bush Forever policy also set a target of protecting 10% of the original extent each of the Heddle *et al.* vegetation complexes in the metropolitan area within reserves and/or Bush Forever sites. In some cases this was accepted as not being possible and the protection of similar vegetation outside of the metropolitan region would compensate.

### 6.3.3 Significance of vegetation communities

The significance of vegetation lost or disturbed by the proposal was determined by considering the following:

- any special ecological functions (including fauna habitat) of the vegetation;
- regional and local abundance of the vegetation communities;
- representation in existing or proposed conservation reserves and State Forest;
- condition of the vegetation;
- presence of Priority or Declared Rare Flora species;
- presence of threatening processes (for example, weeds, dieback); and
- presence of Threatened Ecological Communities (TECs) as listed by the Department of Conservation and Land Management and under the EPBC Act.

### 6.3.4 Flora

The preservation and conservation of flora is covered primarily by the following three Western Australian and one Commonwealth statutes:

- *Wildlife Conservation Act 1950*;
- *Conservation and Land Management Act 1984*;
- *Environmental Protection Act 1986*; and
- *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth).

The definition of Declared Rare and Priority Flora (CALM 1999) is shown in Appendix 2.

The assessment of the significance of impacts (following the application of management measures) on Declared Rare and Priority Flora was to be on the basis of the following:

- change in the distribution and abundance of Declared Rare and Priority Flora species and species genotypes; and
- compliance with the Wildlife Conservation Act 1950.



### 6.3.5 Weeds and dieback

Weeds in agricultural and native bushland areas are managed under the State Weed Plan. Dieback is currently not covered by legislation.

### 6.3.6 CALM advice

CALM describes five issues it considers to be the principle threats to the six upland vegetation communities found in Beeliar Regional Park:

- importation of soil into the Park;
- unplanned fire;
- weeds;
- threat of *Phytophthora* dieback and other diseases; and
- urban interface issues and uncontrolled access by vehicles, pedestrians and horses.

The relevance of the proposal to contributing to these threats and the proponent's commitments to address them are described below.

## 6.4 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal have the potential to affect the local and regional vegetation and flora values of Lot 502:

- **Clearing and earthworks** will decrease the area of native vegetation and reduce the abundance of native flora in Lot 502.
- **Earthworks and movement of soils** could spread *Phytophthora cinnamomi* infected soils to areas adjacent to Dieback free areas to be retained in Lot 502 or located in the neighbouring reserve.
- **Establishment of exotic gardens in the estate** could cause further weed infestation of adjacent native woodland areas.
- **Industrial activity** may increase the risk of fire events occurring in the adjacent native bushland areas.
- **Increased human activity** associated with the estate may impact on adjacent native bushland areas if there is uncontrolled vehicle and pedestrian access.
- **Rehabilitation of South Lake buffer** will restore vegetation in degraded areas adjacent to South Lake.

## 6.5 CONSEQUENCES AND MANAGEMENT MEASURES

### 6.5.1 Clearing of native vegetation

The development of the Bibra Lake Industrial Estate will involve the gradual clearing of approximately 64 ha of native bushland. The local and regional effects of this clearing in the context of community and flora diversity and conservation are described below:

- Removal of 63 ha of *E. marginata* B. *attenuata* Closed Forest to Woodland and 0.9 ha of Shrubland of *Hakea prostrata*, *Jacksonia furcellata* and *Kunzea glabrescens*. Figure 7 shows the vegetation communities in Lot 502 and the boundaries of the estate in which the clearing is required. These communities are well represented regionally and are not communities that are

considered rare, threatened or restricted in distribution. The removal of this vegetation will not decrease the diversity of vegetation communities locally or regionally.

- A decrease of less than 0.2% of the original extent of the Karrakatta Complex C & S in the Perth Metropolitan Region, as mapped by Heddlé *et al.* 1980. Approximately 18% of its original extent in the region remains, but it is not restricted to Perth and may be substantially represented south of Perth in association with the Spearwood Dune System. Bush Forever policy does not preclude the development of land representative of vegetation complexes for which more than 10% remains in the metropolitan region. The project area contains about 1.1% of Karrakatta Complex C & S that remains and about 2.7% of that proposed for reservation.
- No impact to Declared Rare or Priority Flora populations, flora with restricted regional distributions or those at geographical limits of their distribution.
- Negligible effect on regional floral diversity as communities and individual species are not regionally restricted.
- A possible small decrease in local (South Lake and surrounds) floral diversity as a result of clearing a substantial proportion of upland vegetation from the immediate area.

Little of the vegetation inside the estate will be able to be retained in Public Open Space because of the need to develop the site such that it is suitable for industrial lots. It will be difficult to retain pockets of vegetation because of the engineering difficulties in maintaining pockets of the original surface amongst a new levelled landscape.

To reduce the potential impact on vegetation communities and flora, the following mitigation measures would be implemented:

- Establish a buffer area extending 150 m from South Lake in which no development will occur and all vegetation is retained. The buffer area located within Lot 502 will potentially serve to extend the Beeliar Regional Park further west of South Lake, increase the representation of upland vegetation, and conservation of the wetland-upland continuum.
- Rehabilitate degraded areas within South Lake buffer consistent with the original vegetation communities present. This will restore and improve the condition of the *Eucalyptus rudis* *Banksia grandis* woodland surrounding South Lake and the fringing upland *E. marginata* *B. attenuata* woodland in the buffer area.
- Retain the area containing tall Tuarts (*E. gomphocephala*) near Spearwood Avenue entrance as Public Open Space.
- Establish native gardens throughout the estate on road verges and cleared Public Open Space.
- Encourage businesses throughout the estate to use native, preferably local, species as far as practicable in gardens established around their buildings.
- Use topsoil and plant material stripped during development of the site for rehabilitation of South Lake buffer and for landscaping in the development. These soils will provide a local source of seed, organic material, microorganisms and will increase the rate of return of local species in the estate.
- Establish collaborative rehabilitation program with CALM for area south of South Lake. The aim of this program would be to restore woodland habitat in the area south of South Lake, which would replace a proportion of habitat lost during clearing for development of Lot 502.

### 6.5.2 Dieback

The absence of secondary symptoms of infestation within the highly susceptible *Banksia* woodland indicates that the probability of the pathogens being present is extremely low. This is of considerable



importance to hygiene management as the susceptible vegetation is at no risk of autonomous disease spread due to the absence of existing infestations. The main consideration in developing management plans for the site is the prevention of inward movement of the pathogens from outside the survey area

There are some degraded areas in the estate that were uninterpretable in the Dieback assessment and these areas would be treated with some caution (Figure 8). *Phytophthora* could have an impact on revegetation programs in the buffer area if the pathogen is present in the soils and the species planted are vulnerable to the disease.

Any activities with a potential risk of moving infective soil or vegetative material to uninfected Banksia woodland would be analysed to determine the level of risk. Activities requiring importation of soils such as road construction and planting of nursery stock are considered high potential risk of inoculum vectoring and hygiene procedures would be established for any planned activities.

Unauthorised vehicle access to the uninfected Jarrah-Banksia woodland presents a potential risk of inoculum movement, particularly dumping of organic waste. Access is currently being gained through breaches in the southern boundary fence via Spearwood Avenue.

To further reduce the risk of spreading Dieback to the fringing woodland during development, particularly that surrounding South Lake, a Dieback and Weed Management Plan will be prepared and implemented in consultation with CALM and include the following mitigation measures:

- controlling access to highly susceptible areas, including the low lying area around South Lake;
- cleaning machinery, vehicles and footwear during estate construction before entering the estate development area (Lot 502) and when leaving a potentially infected area (mapped as uninterpretable areas on Figure 8);
- scheduling activities for dry soil conditions, if dust management measures are sufficient to control dust generation;
- preventing the import of materials for fill into the estate or for road construction that may be potentially infected with *Phytophthora cinnamomi*;
- controlling access into bushland areas following establishment of the estate, which may involve fencing, track rationalisation, upgrading tracks and walkways, and/or restricting off-road vehicle access; and
- ensuring planting of nursery stock in rehabilitation and native gardens does not introduce infected soils into the area by utilizing contractors / nurseries with dieback hygiene procedures in place.

Unauthorised vehicle access to the uninfected Banksia woodland presents a potential risk of inoculum movement, particularly dumping of organic waste.

### 6.5.3 Weeds

There is substantial weed infestation throughout Lot 502 and the adjacent South Lake reserve.

A weed control program would be prepared as part of the Dieback and Weed Management Plan including the following mitigation measures:

- restricting access to areas of bushland not being developed;
- utilising soil from areas of lowest weed infestation for rehabilitation and landscaping in the estate (as mapped in Bennett Environmental Consulting 2001);
- utilising native species in gardens of the estate to prevent introduction of further exotic species;



- separating roads to industrial lots from bushland; and
- designing new landform contours and drainage such that little surface runoff is to bushland.

#### **6.5.4 Fire**

The increased activity of machinery and vehicles as a result of development and operation of the industrial estate has some potential to increase the likelihood of fire events on Lot 502, which could spread to surrounding bushland. This can alter the ecology of such bushland and should be carefully managed.

Fire management will be in accordance with the Bushfires Act 1954 and appropriate requirements of the City of Cockburn. A range of statutory fire prevention and control requirements will be imposed upon the contractors during estate development and the industrial operators within the park. Compliance with these requirements should lessen any increase in fire risk from the park.

Fire suppression in Beeliar Regional Park is the joint responsibility of the Fire and Emergency Service Authority (FESA) and the relevant local Government bush fire brigade (CALM 2001). A Fire Response Plan has been developed by the Department of Conservation and Land Management in conjunction with FESA and the relevant local governments to help ensure effective response to unplanned fire by the responsible agencies.

To reduce the risk of fire in bushland adjacent to the estate, the following measures will also be implemented:

- controlling access of light petrol run vehicles to bushland, in particular areas with grass cover, during development;
- building roads between industrial lots from bushland to act as firebreaks;
- maintaining firebreaks on back of lots, in absence of road; and
- identification of operators in the estate using inflammable liquids and requirement for risk management procedures from tenant in consultation with local emergency services.

#### **6.5.5 Uncontrolled and increased access**

Unauthorised vehicle access to the woodland presents a potential risk from introduction of Dieback inoculum, weed infestation and fire, and from the direct impact of vehicles and pedestrian activity flattening and degrading vegetation. Uncontrolled access also increases the number of informal tracks through the bushland, which are more susceptible to erosion, subsequently further affecting vegetation.

Uncontrolled vehicle access is currently being gained through breaches in the southern boundary fence via Spearwood Avenue. Fences around the majority of the estate have prevented the site from being frequently used by walkers.

The development of the estate will increase human activity in the local area, which could potentially affect the undeveloped bushland areas and the South Lake reserve through the associated increase in recreational use. The following mitigation measures will be implemented to reduce the potential impact from increased human activity in the area on native vegetation:

- establishing low wire fences, such that they do not restrict faunal movements or fire access, along the road which separates the estate from the buffer area;
- repairing the fence along the southern and eastern boundaries of the property; and



- providing some Public Open Space within the estate to ease pressure on adjacent bushland for recreational activities by occupants of the estate.

### 6.5.6 Rehabilitation of buffer

LandCorp is committed to prepare and implement a rehabilitation program for the degraded areas contained within the South Lake buffer area in Lot 502. The area to be included in the rehabilitation program is expected to be between four and five hectares. The details of this program are further described in Section 15.3.

The rehabilitation of the buffer area is likely to have the following effects on vegetation and flora values:

- improve the conditions and local representation of *Eucalyptus rudis* *Banksia grandis* woodland and associated species (no such woodland will be cleared during the development);
- compensate for some impact from the removal of upland vegetation during estate development by restoring some upland vegetation on the more elevated fringes of the buffer area;
- complete the wetland-upland vegetation continuum on the western side of South Lake; and
- decrease the infestation of weeds on the western side of South Lake, through the clearing and covering of infested land and replacement of weed species with native species in the degraded areas.

### 6.5.7 Collaborative rehabilitation program for South Lake

LandCorp is committed to undertake a rehabilitation program to restore woodland along the south side of South Lake. It is proposed the program will be developed in conjunction with CALM. Preliminary discussions have already been held to identify the issues.

The aim of such a program will be to restore native vegetation in the southern area of the South Lake reserve (Regional Open Space in Beeliar Regional Park). It is currently a degraded area containing some mostly widely spaced remnant native trees (*E. rudis*, *Melaleuca raphiophylla* in the lower areas, *E. marginata* and *C. calophylla* in more elevated areas) with an undergrowth mostly of weed species. It is considered the rehabilitation of this area would improve linkages to bushland to the south and increase the quality of vegetation around a larger perimeter of the lake. Figure 7 shows the possible boundary of the area LandCorp is investigating, which is approximately 10 ha.

LandCorp has identified it could possibly provide ground support for the program during the development of the estate (ie topsoil supply, earthmoving, translocated soil and plant material. The details of this support if appropriate would be described in the Rehabilitation Plan.

A major component of the rehabilitation program would be to remove and control weed infestations.

The potential benefits of such a program to flora include:

- an improvement in condition of vegetation immediately surrounding South Lake;
- an improvement in condition of upland habitat to south of South Lake;
- enhancing wetland upland continuum in area south of South Lake; and
- decrease in weeds in area south of Lake which will improve conditions for establishment of native species that are typically out-competed by weed species.

## 6.6 PROPONENT COMMITMENTS FOR VEGETATION AND FLORA

The proponent has made the following commitment to the protection of flora:

- Provide a 150 m buffer strip between development on Lot 502 and South Lake as shown in Figure 7, to be fenced off from estate before commencement of earthworks.
- Prepare and implement a rehabilitation plan for degraded areas in the buffer area in consultation with CALM and the Wetlands Education Centre.
- Prepare and implement a dieback and weed management plan in consultation with CALM.
- Prepare and implement a Landscape Protection and Management Plan to include natural landscaping program as part for the establishment of native gardens within the estate in consultation with CALM.
- Retain the area containing tall Tuarts (*E. gomphocephala*) near Spearwood Avenue entrance as Public Open Space.
- Establish collaborative rehabilitation program with CALM for southern area of South Lake reserve.

## 6.7 OUTCOME

The establishment of the Bibra Lake Industrial Estate and the implementation of the described management measures will result in the following outcome in relation to vegetation and flora.

- No significant decrease in vegetation and community flora diversity in a regional context.
- A small decrease (0.2%) in the original extent of the Karrakatta Complex C & S in the Perth Metropolitan Region.
- Decrease in the local representation of upland vegetation communities by approximately 50-60% and a small local decrease in local representation of associated flora.
- Improvement in condition and increased protection of *E. rudis* *B. grandis* woodland surrounding South Lake and potential increase in the local representation of similar vegetation.
- Improvement in condition of vegetation around South Lake.
- Control of weeds to west and south of South Lake.



## 7. TERRESTRIAL FAUNA

### 7.1 DESCRIPTION

M.J. and A.R. Bamford Consulting Ecologists conducted a fauna study of Lot 502 as part of the EPS process in 2000 (M.J. and A.R. Bamford Consulting Ecologists 2000). In addition to this original study, M.J. and A.R. Bamford Consulting completed a second report to provide additional information on fauna, particularly with respect to fauna protection (Bamford 2002). This study has utilised several recent studies to assess the possible significance of Lot 502, including How (1998), How and Dell (1993, 1994 and 2000), and Storr, Smith and Johnstone (1983, 1986, 1988, 1990 and 1999).

Bamford (2002) determined that there were possibly 147 vertebrate species, eleven of which are introduced species, utilising Lot 502 consisting of eight species of frogs, 38 species of reptiles, 80 species of birds, and 16 species of mammals (11 native and five introduced). These species, listed in Appendix 3, include vertebrate species known to occur in remnant bushland on the Swan Coastal Plain of the Perth region. The lists indicate those species observed or expected to use the site regularly if there appears to be suitable habitat for them and they are known to occur in the region. Species for which there appears to be no suitable habitat, or that are believed to be extinct in the Perth region, have been excluded.

Terrestrial invertebrates were not sampled as part of the environmental studies of Lot 502 for the PER. Benthic macro-invertebrates were also not sampled as there are no wetlands within Lot 502.

#### 7.1.1 Frogs

Three frog species were recorded in Lot 502 and on the basis of patterns of distribution and the habitats present, all eight species of frogs known from the Swan Coastal Plain south of the Swan River are expected to occur on site (Bamford 2002). This reflects the juxtaposition of the site to South Lake.

The most important areas for frogs are likely to be those closest to South Lake, although the Turtle Frog (*Myobatrachus gouldii*), Moaning Frog (*Heleioporus eyrie*), and Pobblebonk (*Limnodynastes dorsalis*) are likely to be found throughout the woodland habitat. The Turtle Frog is an entirely terrestrial species that may occur on Lot 502 throughout its life cycle. The Moaning Frog and Pobblebonk have aquatic larvae but terrestrial adults that live up to several kilometres away from wetlands. Guenther's Toadlet (*Pseudophryne guentheri*) also have aquatic larvae and have been recorded up to 1 km away from wetlands (Bamford, unpublished data, 2002). The cleared area adjacent to the lake is unlikely to be of value to the frogs, but such cleared areas do not present a barrier to their movement (Bamford 2002).

No frog species expected to occur in Lot 502 are listed rare or threatened under Commonwealth or State legislation or listed as Priority species by CALM.

#### 7.1.2 Reptiles

Lot 502 lacks some habitats, such as heathland and Banksia woodland, suitable for many reptile species common to the SCP with the result that not all species known to persist in the region (see How and Dell 1994) are likely to be present. Despite this, the site is likely to be used by 38 species, of which five were observed during the site inspection (Bamford 2002).

One reptile species, the Long-necked Tortoise (*Chelodina oblonga*), is aquatic and would visit Lot 502 only to lay eggs, while the South-West Cool Skink (*Acriscincus (Bassiana) trilineatus*), Mourning Skink (*Egernia luctuosa*) and Tiger Snake (*Notechis scutatus*) are closely associated with riparian habitats around wetlands and might encroach a little into the property from the lake. All remaining



species would inhabit the upland woodlands of Lot 502. It was not possible to identify particular areas within the bushland that are more important for reptiles than others, as apart from degradation around the margins of the site, the woodland is relatively uniform.

No reptiles expected to occur in Lot 502 are listed rare or threatened under Commonwealth or State legislation or listed as Priority species by CALM (2001). However, the Perth Lined Lerista (*Lerista lineata*) is listed as 'Rare or Insufficiently Known', and the Black-striped Snake (*Neelaps (Vermicella) calonotus*) as 'Endangered', by Cogger *et al.* (1993). Neither is listed for special protection under legislation or listed as Priority species by CALM.

### 7.1.3 Birds

Eighty species of bird are expected to be making regular use of the habitat in Lot 502 and 34 species were observed during the site inspection. Some bird species known from the general region of the site have been included in the fauna lists shown in Appendix 3 but are not expected to utilise the site as there appears to be no suitable habitat for them. Waterbirds such as the Australian Pelican *Pelecanus conspicillatus* and Silver Gulls *Larus novaehollandiae*, observed flying over the bushland during the site inspection, are not expected to use the site itself. However, some waterbirds may nest in trees within the site (some ducks and the White-faced Heron *Egretta novaehollandiae*) and waterbirds may visit the effluent ponds. Several other bird species might be attracted to the site because of these disturbed areas, but most of those listed are likely to depend upon the woodland habitat.

The highest densities of birds were observed in the narrow area of degraded bushland between the Amcor Plant and North Lake Road (Bamford 2002). This appeared to be because of the presence of several Tuart trees in this area, especially attractive to Weebills (*Smicrornis brevirostris*), and flowering Firewood Banksias and Marri, attractive to several honeyeater species and the Silvereye (*Zosterops lateralis*). There were also scattered low bushes in this area being used by Splendid Fairy-wrens. The Weebills and Splendid Fairy-wrens (*Mahurus splendens*) were found elsewhere on the site, but may always be abundant in this northern section, but the honeyeaters probably move around as the availability of flowers varies seasonally.

A total density of 4.2 birds/ha was calculated for the site following a bird census in 2000, although only ten of the 34 species recorded for the site were also recorded during this census. Densities in the northern area were much higher than this but were due largely to honeyeaters and Silvereyes.

Lot 502 is likely to be used by the following species, which are afforded some protection through legislation and/or international agreements:

- Square-tailed Kite (*Lophoictinia isura*), Priority 4 species listed with CALM and wide ranging species with reduced populations on the SCP (Government of WA 2000).
- Peregrine Falcon (*Falco peregrinus*), Specially Protected Fauna (Schedule 4 – Need of special protection reasons other than mentioned under Schedules 1,2 and 3) listed under the Wildlife Protection Act 1950.
- Carnaby's Black-Cockatoo (*Calyptrorhynchus latirostris*), Specially Protected Fauna (Schedule 1 - Rare or likely to become extinct) listed under Wildlife Protection Act 1950 and listed as Endangered under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999. It is a wide ranging species with reduced populations on the SCP (Government of WA 2000). It may favour Lot 502 because of the high density of Banksias.
- Common Sandpiper (*Tringa hypoleucos*) listed under JAMBA/CAMBA, is an internationally protected migratory species.



The site is not expected to be particularly significant to the Square-tailed Kite or the Peregrine Falcon and they are likely to be infrequent visitors. Lot 502 is however likely to be one of many sites used by migratory Common Sandpipers. Carnaby's Black-Cockatoo was not observed during site visits but is expected to use Lot 502 to forage on the seeds of Banksia, as this species utilises similar patches of vegetation and pine plantations across the metropolitan region to maintain its presence on the SCP (Bamford 2002).

Six of the bird species that may potentially utilise habitat in Lot 502 are listed in Bush Forever as being habitat specialists with reduced distributions on the Swan Coastal Plain (see Table 2 Appendix 3). Fourteen bird species potentially utilising habitat in Lot 502 are listed as being wide ranging species with reduced populations on the Swan Coastal Plain such that they are locally extinct in some areas (see Table 2 Appendix 3).

#### 7.1.4 Mammals

The extent of mammal fauna on the site is likely to be poor with only ten native and five introduced species (Table 3), compared with as many as 16 mammal species that may be locally extinct (listed in Bamford 2002). The high level of extinction has been attributed to changes in fire regime, habitat loss and fragmentation, and predation by foxes and cats (Burbidge and McKenzie 1989, Paton 1991). Of the mammalian species that are listed, it is likely that:

- species such as the Echidna may still be present but probably cannot persist even in the existing area of habitat at the site; and
- the Brush Wallaby, if actually still present, may not survive even if all vegetation on Lot 502 is retained. The record of this species at the site is based on a weathered skeleton of a mature specimen and it is possible that this was the last specimen present and the species no longer occurs in the area. Bamford (2000) found a population density of Brush Wallabies in Whiteman Park of 0.16 animals/ha, so the project area would be able to support fewer than 10 animals; not a viable population even in the medium term.

Of the remaining native mammals, the characteristic diggings of the Quenda were found at the northern end of the bushland and in the central area, while tracks of the Brush-tailed Possum were seen in the central area and one was observed in a tree just over the boundary fence near South Lake.

Like the Brush Wallaby, the Grey Kangaroo has probably recently disappeared from the site, as skeletal remains have been found in woodland just to the north (M. Bamford pers. obs. 2002). The Kangaroo has therefore been excluded from the expected species list, although it is possible that vagrants may still occur in the area.

Two conservation category fauna may frequent the area. The woodland of Lot 502 may represent additional habitat utilised by a population of the Quenda *Isodon obesulus fusciventer* (Priority 4 listed by CALM) centred on Bibra and South Lakes (Bamford 2002). This species typically roams close to wetlands, using upland areas to forage for food and traversing to other wetland areas. The Rakali (Water Rat) *Hydromys chrysogaster* (Priority 4 listed by CALM) is likely to occur in the wetlands of the area but is not expected to utilise the drier woodlands of Lot 502.

#### 7.1.5 Invertebrates

Information on the distribution and habitat preferences of these species is limited and therefore it is difficult to predict their presence or abundance in the development area.

Six invertebrate species, three of which are native bees, found in the Perth Metropolitan Region are listed under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 1999 as



“fauna that is rare or likely to become extinct”. Four other invertebrate species have been listed as “Priority” species. While some of these species are aquatic or associated with cave environments, several may be present in the woodland areas, including the Graceful Sunmoth *Symenon grantiosa* (Castniidae) (Schedule 1), four species of native bees, *Leioproctus bilobatus* (Priority 2) *Leioproctus douglasiellus* (Schedule 1) *Neopasiphae simplicior* (Schedule 1) and *Hylaeus globuliferous* (Priority 3) and the cricket *Austrosaga spinifer* (Priority 3).

### 7.1.6 Habitat

Lot 502 consists mostly of upland vegetation habitat in the form of Jarrah-Banksia woodland/forest in varied condition over the site. There are also some degraded areas of Flooded Gum (*E. rudis*) woodland close to South Lake, and cleared areas being used for effluent ponds, paper waste storage, and waste disposal. A small stand of Tuart trees is located in the southwest of the site and the northern ‘pan-handle’ of Lot 502 also contains several Tuarts that could serve certain bird species as habitat.

The most important parts of the project area for fauna are the somewhat degraded areas of woodland in the east and north-east of the site as assessed by Bamford (2002). This can be attributed to the fact that these areas are close to South and Bibra Lakes and serve as wildlife corridors and the vegetation, although degraded, is structurally complex. Birds were observed to favour this area. The woodland fringing the cleared area near South Lake is of high value for fauna because it is close to the lake, has more structurally complex vegetation than some other areas of woodland and because such transitional regions are favoured by some species.

Areas of the project area that are of low value for fauna are those that have been highly disturbed, including within cleared areas near South Lake and waste disposal areas associated with the Amcor Plant.

Figure 9 shows an approximate evaluation of the extent of varying fauna habitats across Lot 502 and their relative importance to fauna.

### **Regional representation of habitat**

In terms of regional representation of fauna habitat, upland woodland, dominated by Eucalypts and Banksias growing on sandy soil is considered as a broad habitat type. Bush Forever Site 244 (North Lake) has an area of 128 ha of bushland compared with the 67 ha in the project area (omitting completely degraded areas), with the project area representing 50-60% of upland woodland in the South Lake to North Lake sector of the City of Cockburn.

In contrast, Bush Forever Sites 391 and 392 have areas of 367 ha and 272 ha respectively and, although not all of this total area is woodland comparable as fauna habitat to the woodland in the project area, this suggests that the total area of woodland within Beeliar Regional Park is in the order of 600 ha. The project area contains approximately 10-15% of woodland fauna habitat in the City of Cockburn and adjacent areas.

To assess the significance of woodland in the project area within the Perth region, the extent of the Karrakatta Complex C & S across the Perth region was considered broadly indicative of the presence of similar habitat. Across the Perth Metropolitan Region, 6,275 ha of this complex remain of an original area of 34,532 (Government of Western Australia, 2000). An area of 2,081 ha of this woodland is either reserved or proposed for reservation. The project area contains about 1.1% of Karrakatta Complex C & S that remains and about 2.7% of that proposed for reservation.



### 7.1.7 Wildlife linkage

The area containing South Lake and Lot 502 was identified as being part of Greenways 75 and 90 and part of a regionally significant bushland/wetland linkage (Government of Western Australia 2000).

The study area is adjacent to Beeliar Regional Park that lies to the east and there is some native vegetation around low density housing to the north, but the site is not closely associated with native vegetation to the west or south. To the north-east, the site is weakly linked to Bibra Lake via remnant vegetation in a recreational complex (Adventure World). Within the adjacent sector of Beeliar Regional Park, there is little similar upland woodland, so this woodland area is effectively isolated from similar woodland (Bamford 2002).

## 7.2 PRELIMINARY EPA OBJECTIVES

The following EPA objective applies to the protection of 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.

The following overriding EPA objective addressing biodiversity is also relevant to this factor:

- To avoid adverse impacts on biological diversity, comprising the different plants and animals and the ecosystems they form, at the levels of genetic diversity, species diversity and ecosystem diversity.

## 7.3 ASSESSMENT FRAMEWORK OR POLICY CONTEXT

The conservation status of fauna species is assessed under Federal and State Acts including:

- Commonwealth EPBC Act; and the
- WA Wildlife Conservation Act.

These use levels of significance recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN) and reviewed by Mace and Stuart (1994), although the WA Act also has a category of "Other Specially Protected Fauna" that has no equivalent IUCN level.

In addition, Environment Australia has supported the publication of reports on the conservation status of reptiles (Cogger *et al.* 1993) and birds (Garnett and Crowley 2000), while the Threatened Species and Communities Section of Environment Australia has produced a list of Threatened Australian Fauna (Environment Australia 2000), although this list is effectively a precursor to a list produced under the EPBC Act. These publications also use the IUCN categories, although those used by Cogger *et al.* (1993) differ in some respects as this report pre-dates Mace and Stuart's review.

In Western Australia, CALM has produced a supplementary list of Priority Fauna, being species that are not considered Threatened under the IUCN categories but which the Department feels there is cause for concern. Levels of Priority are described below:

- **Priority 1** – taxa with few, poorly known populations on threatened lands.
- **Priority 2** – taxa with few, poorly known populations on conservation lands.
- **Priority 3** – taxa with several, poorly known populations, some on conservation lands.
- **Priority 4** – taxa in need of monitoring.

Map of the project area, indicating main features and fauna habitats. The project area is indicated by a double solid line, roads by broken lines and boundaries between main habitat types by dotted lines.

Key.

1. Amcor Packaging Plant. 2. Bibra Lake. 3. South Lake. 4. Little Rush Lake.

- A. High value fauna habitat along eastern margin of project area.
- B. Riparian vegetation along edges of wetlands within Beeliar Regional Park.
- C. Degraded upland woodland in urban and recreational areas.
- D. Cleared and severely degraded habitat, including existing suburbs and industry.
- E. Main upland woodland of project area.

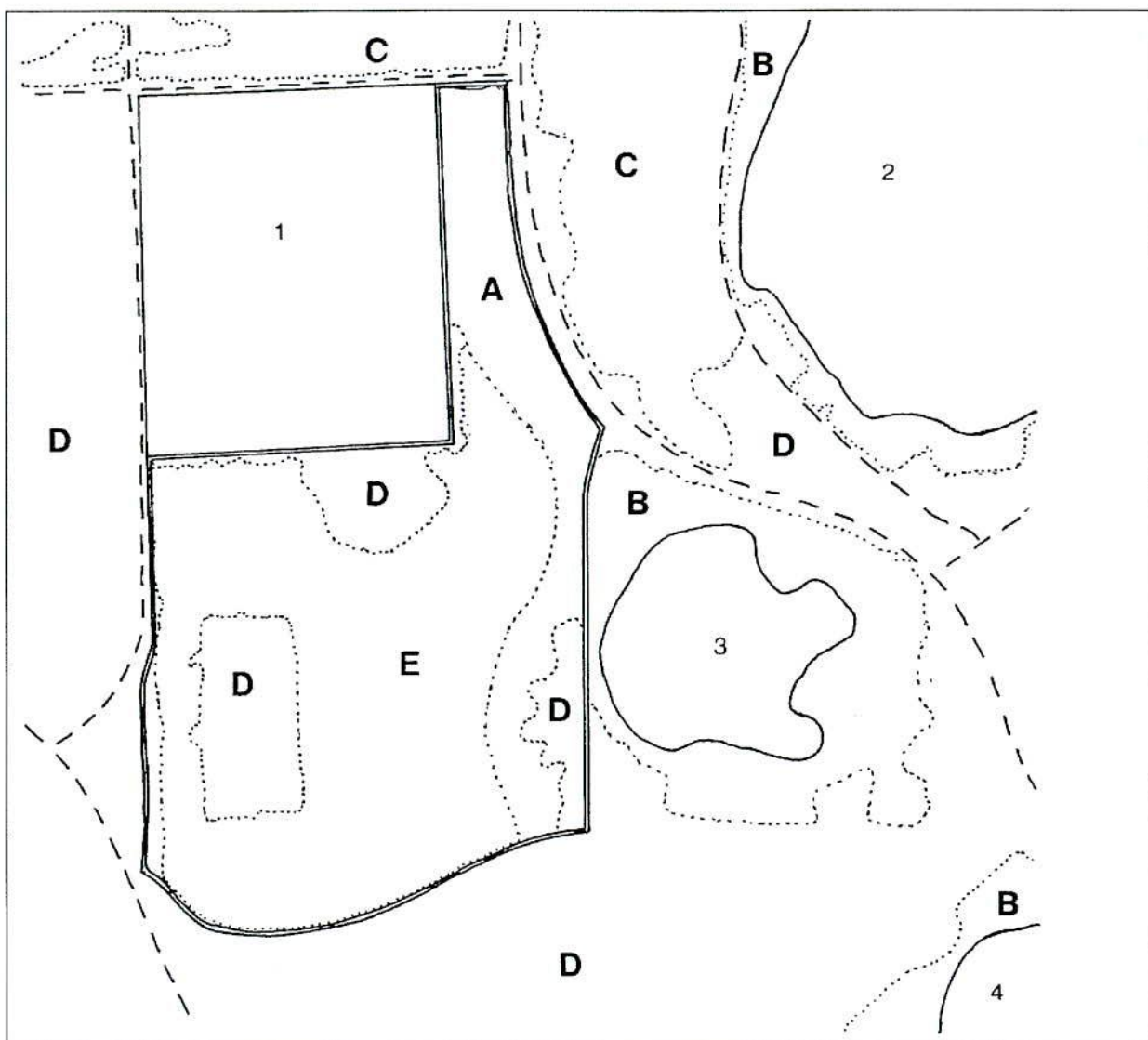


Figure 9 Fauna habitats in Lot 502



In addition to the assessment of fauna under CALM's Priority list and the IUCN categories, some fauna are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA) and the Japan Australia Migratory Bird Agreement (JAMBA). Species listed under these agreements are mostly migrants that spend part of the year in each country, although some of the species are non-migrants but occur in both countries.

Fauna species included under Commonwealth conservation acts and/or agreements are of national significance, while those listed as Priority Species, can be considered of regional significance, and possibly of national significance. Those for the Perth region are summarised in Bush Forever (Government of Western Australia 2000). Species that are not listed under any of the above categories can be considered of regional significance if they are at the limit of their distribution or are common but within a very restricted range.

MJ and AR Bamford Consulting Ecologists conducted this assessment and it is largely a personal judgement based on familiarity with the species concerned and available information on patterns of distribution.

## 7.4 POTENTIAL SOURCE OF IMPACTS

The following aspects of the proposal have the potential to affect the local and regional vegetation and flora values of Lot 502:

- **Clearing and earthworks** will decrease the area of upland habitat and may locally or regionally cause significant reductions in fauna populations.
- **Drainage and/or groundwater flow from the estate into South Lake** may alter the water regime of the lake and/or affect water quality and affect reliant fauna.
- **Increased human activity** associated with the estate may impact on fauna in adjacent native bushland areas if there is uncontrolled vehicle and pedestrian access.
- **Rehabilitation of South Lake buffer** will restore vegetation in degraded areas adjacent to South Lake, which will increase the value of these areas to fauna associated with the lake.

## 7.5 CONSEQUENCES AND MANAGEMENT MEASURES

### 7.5.1 Clearing of habitat

The majority of the native fauna in Perth is dependent on remnants of the bushland that once covered the Swan Coastal Plain and adjacent Darling Scarp and Plateau (Government of WA 2000).

The development of Lot 502 will result in the clearing of approximately 64 ha of upland (Jarrah-Banksia woodland) habitat. The majority of this area is not located in an area of highest importance to fauna as identified by Bamford (2002). The clearing of fauna habitat is described in order of significance below:

- area of woodland of highest importance to fauna in Lot 502, because of its role in linkage to other remnant bushland, proximity to South Lake, and complexity of vegetation (shown as A on Figure 9);
- area of remaining woodland of lower regional significance to fauna (shown as E on Figure 9); and
- degraded areas of low importance to fauna (shown as D on Figure 9).

Construction impacts will be direct in terms of habitat loss but the sequential nature of the development should give time for fauna to move into neighbouring remnant areas. The sequential



nature of the development will allow for some recolonisation of species that can occupy habitats in the created, light industrial landscape. It is noted that displaced individuals of many species can only survive if there is space within neighbouring populations for them. This capacity to cater for displaced individuals could be increased by restoring habitat in degraded areas.

The clearing of habitat will however inevitably cause a local reduction in the numbers of some fauna species, in proportion to the area cleared, as a substantial proportion of the expected fauna is dependent on the woodland environment. Within Lot 502 and the adjoining South lake reserve, the development of the estate is likely to cause a local decline (Lot 502 and South Lake environs) in abundance of:

- four of the eight species of frog that may possibly occur (no Declared Rare, Priority or regionally significant species);
- 27 of the 38 reptile species that may possibly occur (includes one rare, one threatened species, and eight other species of some regional significance);
- birds possibly utilising Lot 502 (may include two Declared Rare species, one Priority listed species, one species listed under JAMBA/CAMBA, and one species of some regional significance); and
- ten of the eleven mammal species that may possibly occur, although only the Brush-tailed Possum is likely to be significantly reduced (includes two Priority listed species, although one, the Rakali, is not likely to rely on habitat within the site). It is likely that in the case of most of the expected mammal species, with the exception of the Rakali, Quenda and Brush-tailed Possum, if the species does actually occur on site, population sizes are already at unsustainably low levels and the species is likely to become locally extinct regardless of development (Bamford 2002).

These species are individually listed in Table 4 Appendix 3.

The impact of population declines of species within the site upon the populations of these species locally (including the South Lake area of Beeliar Regional Park) and sub-regionally (City of Cockburn and adjacent municipalities) is difficult to assess (Bamford 2002).

### **Local impact**

The loss of upland vegetation will cause local (Lot 502 and South Lake) decline in abundance and distribution of some local fauna in proportion to the area cleared, through loss of habitat and subsequent increased susceptibility to predation (Bamford 2002). It is possible that the proposal will result in a moderate to high reduction in the numbers of Carnaby's Black Cockatoo, listed under the WA Wildlife Conservation Act and the EPBC Act, visiting the site. The reduction in habitat will also potentially result in a moderate to low reduction of the numbers of Quenda, CALM Priority 4 listed species, in the immediate area of Lot 502 and South Lake. There is a small possibility that the site is utilised by the Peregrine Falcon, listed under the WA Wildlife Conservation Act, and the Square-tailed Kite, a Priority 4 CALM listed species, and if so there will be a reduction in the area which it can utilise at Lot 502 and South Lake.

### **Sub-regional and regional impact**

The impact of the proposal on all species in a sub-regional context (City of Cockburn and adjacent municipalities) is of moderate to low significance and no species are expected to be reliant on Lot 502 for their persistence in the region (Perth Metropolitan Region). The removal of upland habitat from the area may theoretically increase the risk of disappearance of some species that occur in low population densities from the City of Cockburn and adjacent area. Species most likely to be so



affected include large predatory reptiles, such as goanna species, sedentary birds, such as fairy-wrens and thornbills, and the Brush-tailed Possum.

No species are expected to be reliant on Lot 502 for their persistence in the Perth Metropolitan Region because of the existence of large areas of similar habitat and the relative size of the area proposed to be cleared.

Appendix 3 shows a summary of the conservation status of significant species possibly utilising or inhabiting the site as well as an indication of the level of local and regional impact to the species. The impact of the project on these species is further described in Bamford (2002), as well as the sub-regional impact to species not of high conservation significance.

Because the site does not lie between conservation areas, its loss will not fragment fauna communities, but will have some impact on adjacent mobile fauna that use it as a seasonal food source.

### **Mitigation**

The following measures will be implemented to minimise the immediate impacts of the proposal on local fauna and decrease the medium to long-term effects on local and regional fauna values:

- Rehabilitate buffer area, which will improve habitat for species that use vegetation close to the lake, and include placement of old logs, tree debris in rehabilitation program for specific fauna habitat requirements. The buffer includes some upland vegetation, which will decrease the impact of clearing habitat to the west.
- Relocate some species if practicable (in particular, the Quenda, in consultation with CALM).
- Design and timing of staged development over 10 years to allow migration of some ground dwelling species to retained bushland and rehabilitated buffer.
- Promote use of native species in landscaping within the estate to increase the area of permanent habitat. This will have particular value for birds and possums.
- Encourage replanting by businesses of native vegetation to support native fauna.
- Protect tall tuarts at Spearwood Avenue entrance, which have specific habitat value.
- Establish collaborative rehabilitation program with CALM to restore woodland habitat in southern area of South Lake reserve.

Appendix 4 contains an opinion from Dr MJ Bamford on the potential benefits of rehabilitation around South Lake to fauna and the ability of such programs to offset the disturbance of habitat in Lot 502.

A population of South-West Long-necked Tortoise, which may utilise some areas of Lot 502 should not be significantly affected by the proposal as they reside in South Lake and only move up into the bushland to nest. The retention of the 150 m buffer should leave sufficient area for their breeding habits around the lake. The bunding layout, which is described in Section 8.5.2, is designed to control and allow tortoise movements from the lake, such that their populations will not be affected by the loss of woodland up-gradient of this and the presence of roads.

To minimise the immediate effects of the subdivision process, a Quenda relocation program will be implemented in consultation and cooperation with CALM as part of the Fauna Management Plan. Previous discussions between LandCorp and CALM have indicated a relocation program could possibly be feasible. Practicable relocation of other mammals, such as possums will also be investigated as part of the Fauna Management Plan.



The resident species of Lot 502 are more likely to be affected if they disappear from the site, as they will only be able to colonise rehabilitated areas and gardens if they are able to persist in the nearby Beeliar Regional Park. In contrast, species that are regular visitors to the site can be expected to discover suitable habitat when it develops.

### ***South Lake buffer***

The retention and rehabilitation of the buffer area will compensate for some of the clearing of habitat on Lot 502 and mitigate the extent of local declines in species abundance as:

- Most of the bird species predicted to decline may persist in the rehabilitated buffer around South Lake, particularly because this buffer will be adjacent to Beeliar Regional Park. The juxtaposition of the buffer and the park means that the area of woodland to be rehabilitated around South Lake should be more effective at retaining bird species than if it were in isolation. Some species may however still be susceptible to local extinction as a result of their reduced population size, although this risk will be further reduced by the rehabilitation of the southern area of the South Lake reserve and establishment of native gardens in the estate.
- The retention or translocation of scattered old trees within the development, even if dead, will provide roosting sites for bats and possums and some species of birds, but it is not known to what extent they will be able to successfully forage in the absence of native woodland.
- The rehabilitated buffer would have the potential to provide some replacement habitat for the Quenda and Brush-tailed Possum, although their requirements are different. The Quenda favours low, dense vegetation that can be established within a timeframe of a few years using direct seeding techniques. In contrast, the Brush-tailed Possum requires large, hollow-bearing trees for shelter as well as native trees and shrubs for foraging. The translocation of large, hollow-bearing trees from areas to be cleared would benefit the Possum.

Appendix 4 contains an opinion from Dr MJ Bamford on the potential benefits of rehabilitation around South Lake to fauna and the ability of such programs to offset the disturbance of habitat in Lot 502.

### ***Native gardens***

The establishment of native gardens in the estate will be of considerable conservation value and decrease the medium to long-term impact on local and regional fauna values. Such gardens will allow the populations of wildlife to be larger and therefore less likely to suffer from local extinction than could be supported by the buffer zone alone, and would allow wildlife to move through the industrial area, providing linkage to bushland along road verges and in suburban areas to the north. The sequential development would mean that by the time the last of the original bushland was being cleared, the gardens within the oldest parts of the industrial estate would probably be sufficiently developed to support many species (Bamford 2002). Many species of reptiles and frogs are known to survive in urban gardens and hence should be able to exist in native gardens within the estate, particularly if they are linked with the remnant vegetation around South Lake.

### ***Collaborative rehabilitation program for South Lake***

A principle objective of the potential collaborative rehabilitation program with CALM would be to recreate habitat characteristics that will encourage its use by a diverse range of fauna. The area would be vegetated such that it contains local *Banksia* and other flowering species to maximise the areas utilisation by birds (such as Carnaby's Cockatoo) and provide shelter and habitat for reptiles and mammals.



The potential benefits of this program to fauna would be similar to those for rehabilitating the buffer strip, as the collaborative rehabilitation program would effectively extend this buffer around the southern side of South Lake. These potential benefits include:

- compensating for a proportion of the loss of habitat associated with estate development and providing replacement habitat for birds and mammal species such as the Quenda and Brush tailed Possum;
- restoring habitat in an area of potentially high importance to fauna compared to the majority of upland area in Lot 502 because of its proximity to South Lake and the proposed emphasis on establishing characteristics specific to local fauna needs (e.g. Banksia species);
- improving habitat immediately south of South Lake benefiting fauna associated with the lake such as Rakali, Quenda and the Long-Necked Tortoise; and
- restoring a buffer area on the southern side of South Lake that would increase the protection of fauna associated with the lake.

Appendix 4 contains an opinion from Dr MJ Bamford on the potential benefits of rehabilitation around South Lake to fauna and the ability of such programs to offset the disturbance of habitat in Lot 502.

### **7.5.2 Drainage and groundwater flow from the estate**

Some fauna, particularly frogs, are dependent upon natural seasonal fluctuations in the water level of wetlands where they breed eg Moaning Frog. Successful breeding by this species requires a predictable rise in water level in early winter.

Current lake water levels are principally controlled by groundwater elevation and directly received rainfall, with runoff only received from immediately surrounding areas, because of the high infiltration rate through the local sands. As the stormwater drainage system and road design will be such that no runoff will be directed into the lake, the proposal is not expected to alter the water levels of the lake and hence will not affect fauna dependent on the current water regime. Those frog species that make least use of the upland habitats should be unaffected by the development.

There is no potential for water quality to be affected by contaminated stormwater from Lot 502 as drainage will be directed away from South Lake.

There is little potential for contaminated groundwater to reach South Lake as a result of the development and operation of the estate. This aspect is addressed in Section 9.5.4.

There is no anticipated impact on fauna from changes to water quality.

### **7.5.3 Increased human activity**

The development of the estate will increase human activity in the local area, which could potentially affect fauna in the undeveloped bushland areas and the South Lake reserve through the associated increase in recreational use. The potential impact on native fauna from increased human activity in the area will be reduced by implementing management measures described in Section 6.5.5.

### **7.5.4 Rehabilitation of South Lake buffer**

The beneficial effects to fauna from rehabilitating the buffer area around South Lake are described in Section 7.5.1.

## **7.6 PROPONENT COMMITMENTS TO PROTECT FAUNA**

The proponent has made the following commitments, in addition to those already made previously for vegetation, for the protection of fauna:

- Prepare and implement a Fauna Management Plan to include:
  - a Quenda relocation program and possibly relocation programs for other mammals if deemed feasible through discussion between LandCorp and CALM.
  - fauna habitat restoration techniques, such as log placement and niche creation, within the South Lake buffer rehabilitation program and estate landscaping program, in consultation with CALM and the Wetlands Education Centre.

## **7.7 OUTCOME**

The loss of upland vegetation will cause some local decline in abundance and distribution of local fauna in proportion to the area cleared, through loss of habitat and subsequent increased susceptibility to predation. Some of these species are regionally significant and/or specially protected under legislation or Priority listing, but are not expected to be reliant on Lot 502 for their persistence in the region.

This loss will be offset to some degree by the already considerable habitat remaining in the Bibra Lake area and Beeliar Regional Park, the restoration of the buffer area, the establishment of native gardens in the estate. The establishment of a collaborative program with CALM to rehabilitate the area south of South Lake would further replace habitat lost during development. This would allow affected species to remain or return in proportion to the area of natural habitat present and improve bushland linkages to the south of the lake.



## 8. VISUAL AMENITY

### 8.1 SETTING

Lot 502 lies within the Swan Coastal Plain landscape character type (CALM 1989). South Lake and the eastern side of Lot 502 represent an area that could be considered of high scenic quality under CALM's visual landscape grading (CALM 1989), as they are vegetated representations of:

- dunal formations (Spearwood Dunes in this case) of distinctive height, which provide an obvious contrast to the landform patterns common in the SCP; and
- wetlands in relatively natural state.

There are many other areas of high scenic quality within Beeliar Regional Park. Most of these occur in areas with a management zoning of Conservation and Protection and include natural areas with water as a major element. Other areas of high scenic quality include well-maintained parkland areas.

The area to be cleared within Lot 502 is mostly of moderate to high landscape value as categorised using CALM's Land Management's Visual Landscape Management System (1989). The woodland east of the ridge through Lot 502 is likely to be considered of higher landscape value to that west of the ridge because it represents an area of distinctive height and contrast from the adjacent low lying lake areas in the east. Lot 502 also contains areas of low visual quality, which include large cleared areas and highly disturbed areas (with dumped rubbish and weed infestation).

Lot 502 is located immediately up-gradient of the western side of South Lake and is perceived as an important landscape "backdrop" to the lake and Beeliar Regional Park, particularly when viewed from the east and south-east. The vegetated ridge landform that runs almost north to south through Lot 502 provides a visual barrier from general industrial activity to the west, giving viewers the impression of continuous woodland from the lake, not affected by the urban environment. The impression is most intact when viewed from the south-east looking north-west across the lake towards Lot 502 (see Figure 10a). Degraded and cleared areas leading up to the woodland on the ridge detract from the view from the western shore. Residential areas to the east of South Lake are visible at all view points and hence South Lake is not within an area devoid of visual connection to urban environments and does not represent an entirely natural landscape.

### 8.2 PRELIMINARY EPA OBJECTIVE

- To ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.

#### *LandCorp objective*

- To protect the landscape amenity of the Beeliar Regional Park and provide a visual buffer to South Lake.

### 8.3 ASSESSMENT FRAMEWORK OR POLICY

The impact of the proposal on landscape values can be assessed in the context of the relevant strategies for maintaining and enhancing the natural and cultural landscape qualities of Beeliar Regional Park as listed in the park's draft management plan (CALM 2001).

- Classify landscape features in the Park according to the Department of Conservation and Land Management's Visual Management System in order to assess the form and location of all facilities and services within the Park.

- Identify and protect important landscapes within the Park.
- Ensure that new infrastructure and developments within or adjacent to the Park are designed to minimise impacts on visual quality and include a landscape plan demonstrating integration with the surrounding area. Liaise with infrastructure providers before works are carried out in the Park.
- Identify sites of low visual quality (e.g. drainage outlets, degraded and weed infested areas) and undertake appropriate remedial action.
- Consider view corridors when undertaking rehabilitation works within the Park.

## 8.4 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal have the potential to affect the landscape values in the vicinity of South Lake:

- **Clearing and earthworks** will affect an area of high landscape quality adjacent to Beeliar Regional Park and may detract from the landscape qualities of the Park.
- **Development of the estate** may affect the landscape values of the area by adding a commercial/industrial landscape.
- **Rehabilitation of South Lake buffer** will increase the area of high visual quality immediately surrounding the lake.

## 8.5 CONSEQUENCES AND MANAGEMENT MEASURES

### 8.5.1 Clearing of vegetation and landforming

The development of the industrial estate would be in stages, with areas sequentially cleared of vegetation and earthworks for cut and fill undertaken to create contours suitable for industrial lots. Taking into account fill requirements and compaction, the total amount of earth that will be required to be removed from site is estimated to be 1.6 million cubic metres. Figure 4 shows the topography of Lot 502 before and after development of the estate.

The clearing and landforming for site preparation will result in the gradual removal from Lot 502 of:

- woodland of high landscape quality (non-degraded woodland east of ridge);
- woodland of moderate to high landscape quality (non-degraded woodland west of ridge; and
- degraded and cleared areas of low landscape quality.

The proposal does not involve the removal of such areas from within the Beeliar Regional Park.

The visual impact resulting from the removal of vegetation and land forming on views experienced from within Beeliar Regional Park, particularly from South Lake will be minimised by:

- retaining remnant vegetation up to 150 m west of South Lake, which incorporates the area of closest proximity to Beeliar Regional Park and of greatest incline towards the ridge (this area is highly exposed visually to the park);
- rehabilitating degraded areas within the buffer area to increase the density of vegetation and increase the landscape quality within this area; and
- retaining remnant vegetation along the north-eastern boundary of Lot 502, adjacent to North Lake and Phoenix Roads, to maintain the appearance of bushland along the road.



### 8.5.2 Visual impact of the estate

The development of buildings and infrastructure within the estate has the potential to detract from the landscape values of Beeliar Regional Park by the introduction of a commercial/industrial environment into a "backdrop" of South Lake, which is currently devoid of manmade structures. The Beeliar Regional Park Draft Management Plan provides guidance directing that structures should be sympathetic in design, materials and colour to complement surrounding landscape elements and be carefully sited away from major natural focal points, out of viewer sight-lines and where vegetation or landform screening can be used.

LandCorp will protect the landscape amenity of the Beeliar Regional Park by implementing a Landscape Protection and Management Plan, to include the following measures:

- Retaining remnant vegetation up to 150 m west of South Lake and rehabilitating degraded areas within this buffer area to provide natural screening between the estate and South Lake.
- Rehabilitating degraded areas to improve landscape quality within Beeliar Regional Park.
- Retaining vegetation along North Lake and Phoenix Roads, such that the North Lake Road entrance into the estate is characterised by a native bushland facade either side of the road and the change in view from St Paul's Estate to Lot 502 is minimised.
- Landscaping degraded sections along the western boundary of the buffer area, to form a bund which slopes up to approximately 3 m higher than the existing elevation, along the eastern portion of the site (as shown in Figure 11). The bund will be formed from earth removed during cut and spoil earthworks for estate development. The planting of trees along this bund as part of the rehabilitation program will eventually increase the density and height of screening measures between South Lake and the estate and further prevent buildings being visible from the Park. The bund is to be located and designed such that no significant remnant vegetation is disturbed. LandCorp will prepare the final design of the bund in consultation with CALM.
- Managing the development such that building heights are low on the east side of the ridge and able to be screened by the heights of remnant trees on the eastern and northern boundary of the estate.
- Managing building construction materials and colours of buildings close to subdivision boundaries to complement surrounding landscape, in consultation with CALM.
- Establishing native gardens within the estate

A viewshed analysis has been conducted for the appearance of the estate from several vista points around Lot 502 and South Lake. The analysis was conducted digitally by creating a Digital Terrain Model (DTM) with the cadastre of the subdivision overlain and simulated buildings positioned over the estate at high points and places of interface to existing developments or areas to be retained. Views from certain locations in the model were then combined with photos taken from the equivalent location at South Lake at Lot 502 to produce an image depicting the anticipated view of the estate from that point.

The view shed analysis was conducted for the views looking towards Lot 502 from the:

- South-eastern side of South Lake (Figure 10);
- North Lake Road entrance to the estate (Figure 12);
- North Lake Road/Phoenix Road intersection (Figure 13); and
- St Paul's Estate looking towards Lot 502 across Phoenix Road (Figure 14).



The buildings superimposed onto the landscape in these images are full height and full size general industrial and showroom type buildings. The main entry road to the estate from North Lake Road (Figure 12) will be treated as a landscaped entry statement.

The visual impact of the estate is not likely to be severe compared with existing landscape values in the vicinity of South Lake. The most significant view of concern to stakeholders is that looking east across South Lake to the ridge. Figure 10 shows that the buildings within the estate will only just be visible above the tree line with the provision of the buffer area between the lake and the estate. This change in view seems of low significance in light of the existing reverse view. Looking east across South Lake from Lot 502 the Bibra Lake residential area is clearly visible.

The retention of vegetation along North Lake and Phoenix Road will minimise the affect of the estate on views from the roads and St Paul's Estate (Figures 12, 13 and 14), except at the estate entry, where the new vista will be substantially different with a landscaped entry statement. Native vegetation will be retained either side of the entry and the landscaping will utilise native gardens, such that the new entrance will not appear inconsistent with the surrounding environment.

Some buildings may be visible from Treaty Oak Cove in St Paul's Estate, which is in proximity to the northern 'pan-handle' boundary of Lot 502 (see Figure 14). The retention of trees along Phoenix Road will minimise the impact on visual amenity. Buildings should not be visible from other parts of St Paul's Estate.

The views of Lot 502 from North Lake and Phoenix Road, shown in Figures 13 and 14, are considered of lower significance to visitors to Beeliar Regional Park, compared to the view across South Lake, as they are views from outside the park and also in an obviously urban environment (traffic lights, dual lane road, residential area and amusement park in view at these points).

### **8.5.3 Rehabilitation of the buffer**

The Rehabilitation of South Lake buffer will restore vegetation in degraded areas adjacent to South Lake, currently considered of low visual quality, thereby increasing the area of high visual quality immediately surrounding the lake. The beneficial effects of rehabilitating the buffer including those resulting from the establishment of trees on the constructed bund, are covered in the previous sections 8.5.1 and 8.5.2.

### **8.5.4 Collaborative rehabilitation program for South Lake**

As described in Section 6.5.7, a collaborative rehabilitation program with CALM is proposed to restore woodland habitat along the south side of South Lake. This would potentially improve the appearance of the South Lake environment and enhance the perceived natural state of the bushland for visitors to Beeliar Regional Park in the area south of the lake.

The highly disturbed and degraded areas immediately south of South Lake are of low landscape value as categorised using CALM's Land Management's Visual Landscape Management System (1989). The revegetation of these areas and improvement of the woodland would increase their landscape value and improve the visual amenity around South Lake.

## **8.6 PROPONENT COMMITMENT TO PROTECT VISUAL AMENITY**

The proponent has made the following commitments, in addition to those already made previously in this document, for the protection of landscape values:

- Prepare and implement a Landscape Protection and Management Plan to ensure that the landscape value of Beeliar Regional Park and South Lake are protected, which would include a:



- Mapping of existing vegetation to be retained;
- Screening establishment plan (linked with rehabilitation plan);
- Bund design and revegetation of buffer area; and
- Building heights and colours for the estate will minimise visual impacts on Beeliar Regional Park.

## **8.7 OUTCOME**

The impact of the estate on landscape quality and local visual amenity will be low in light of the existing surrounding urban environment and as a result of the described mitigation measures, including bund construction and revegetation, rehabilitation of degraded areas west and south of South Lake, retention of vegetation in buffer and along North Lake Road, and management of building heights in the estate.

The proposal will improve visual amenity immediately west and south of South Lake and secure a green belt entry statement to the Beeliar Regional Park along North Lake Road.



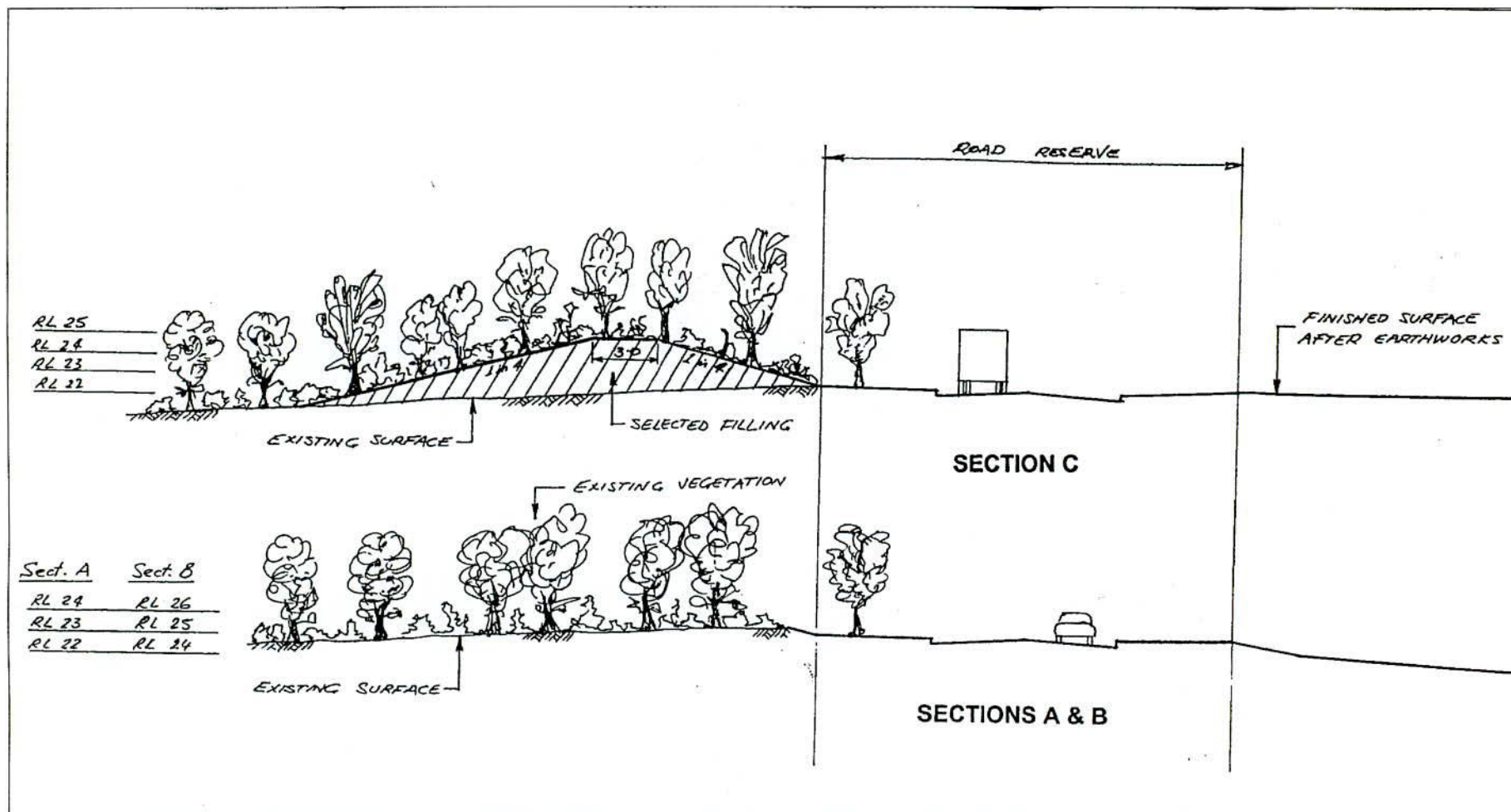
(a)



(b)

**Figure 10 Viewshed analysis from south-eastern side of lake. (a) Current view; and (b) View following development of estate. (AMCAD 3-D 2002)**





Locations of cross sections shown in Figure 3.

Figure 11 Cross section of bund along western boundary of South Lake



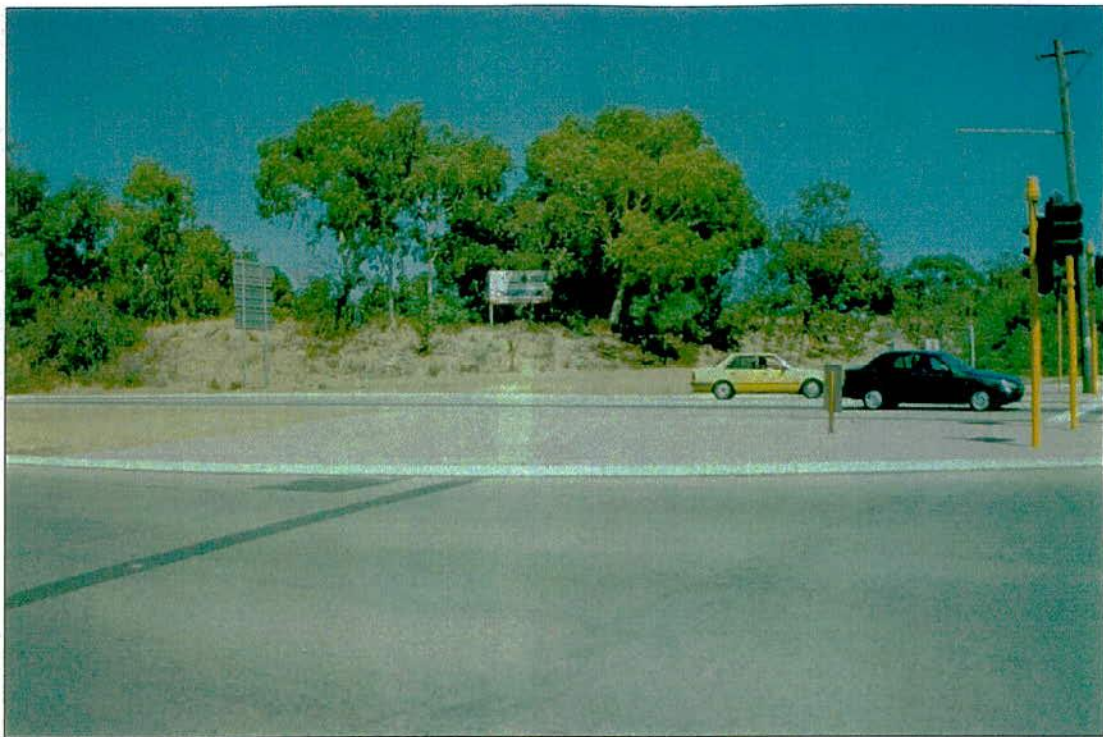
(a)



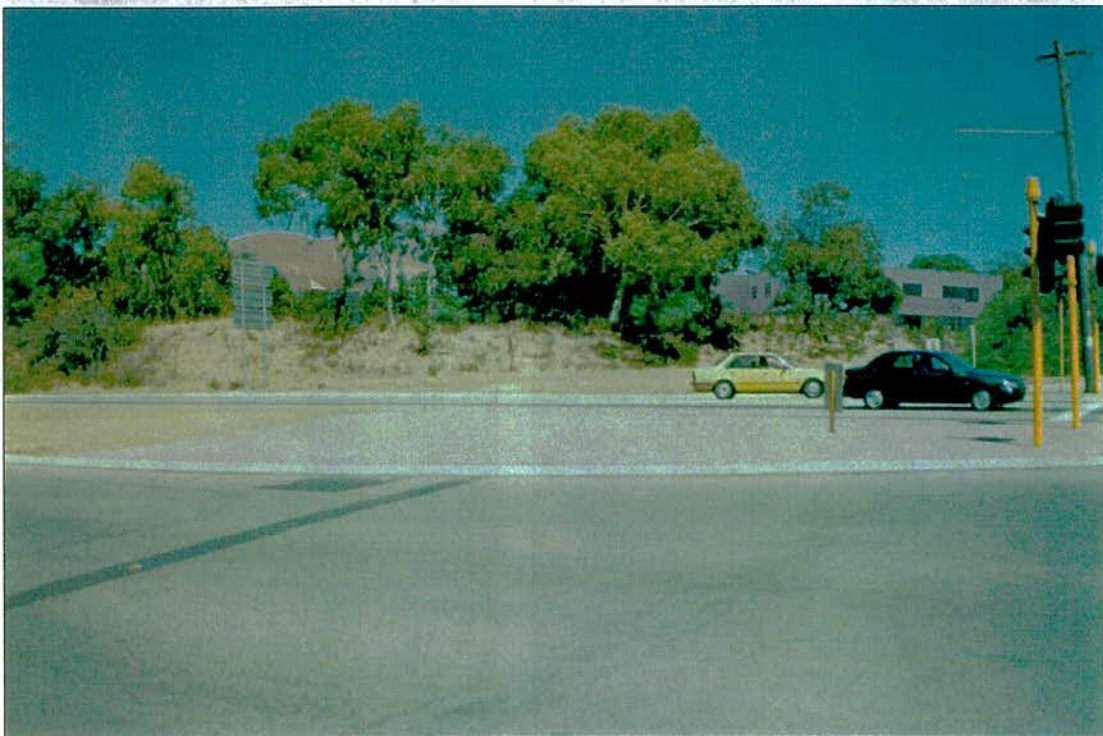
(b)

**Figure 12 Viewshed analysis from North Lake Road entrance to estate. (a) Current view; and (b) View following development of estate. (AMCAD 3-D 2002)**





(a)



(b)

**Figure 13 Viewshed analysis from North Lake Road/Phoenix Road intersection.  
(a) Current view; and (b) View following development of estate.  
(AMCAD 3-D 2002)**





Current view south from Treaty Oak Cove



Predicted view south from Treaty Oak Cove



Current view south from MirabeauMews



Predicted view south from MirabeauMews



Current view south from Fairmont Close



Predicted view south from Fairmont Close

**Figure 14 Viewshed analysis from three streets in St Paul's Estate showing current and predicted views following estate development. (AMCAD 2002)**



## 9. SOUTH LAKE

### 9.1 DESCRIPTION

Lot 502 is located on the area upland of South Lake, a sumpland of the Bibra suite of wetlands on the SCP (Hill *et al.* 1996). It forms part of a north-south linear belt of wetlands extending from Murdoch to Wellard, approximately five to seven kilometres east from the coast. South Lake has been entered in the Interim List of the register of the National Estate and is subject to protection under the Commonwealth EPBC Act. The majority of its area has been evaluated by the WRC as having a management category of Resource Enhancement (RE) with some degraded areas on its perimeter within the Multiple Use (MU) management category.

The lake and surrounding reserve (Bush Forever site 254) are part of the Beeliar Regional Park, a collection of wetland and upland reserves extending from Blue Gum Lake in Mount Pleasant to The Spectacles. The park comprises 19 lakes and many other associated wetlands in two main chains located parallel to the coast, one of these chains being part of the Bibra suite of wetlands. The park includes vegetated uplands consisting of mature woodland and forest areas, vegetated wetland areas, extensive areas of open water and areas of well maintained grassed parkland.

The site lies on the Jandakot Groundwater Mound. The regional groundwater flow direction is westerly (flow away from South Lake). Very little surface runoff from surrounding areas is expected to reach the lake as the soil type (sands) is such that water infiltration is rapid following rainfall. Water levels in South Lake are controlled principally by groundwater elevation and directly received rainfall.

There is an extremely narrow reserve on the west side of the lake. A reasonable vegetated buffer exists on the north-western side of the lake but the original vegetation to the south-west of the lake has been historically cleared resulting in a substantially degraded buffer in this area.

Work undertaken by Bamford (2000) found that the site does support a range of fauna and provides a habitat continuum from the wetland to upland vegetation communities. Several frog species, and the South West Long-necked Tortoise *Chelodina oblonga*, seasonally rely on bushland areas around the wetland for their breeding requirements.

### 9.2 PRELIMINARY EPA OBJECTIVES

- To maintain the integrity, ecological functions and environmental values of South Lake.
- To protect the environmental values of areas identified as having significant environmental attributes.
- To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

LandCorp has also applied the following objectives to address this factor:

- To achieve protection of South Lake from the impacts of development.
- To ensure water quality in South Lake is not impacted by drainage from the industrial area and associated road systems.

### 9.3 ASSESSMENT FRAMEWORK OR POLICY FRAMEWORK

Several policies provide specifically for the protection of significant wetlands on the Swan Coastal Plain and the south-west region of the state:



- Environmental Protection of Wetlands Preliminary Position Statement (Position Statement No. 4) (EPA 2001); which supports the
- Wetlands Conservation Policy for Western Australia 1997 (EPA 1997a); and
- Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (currently under review) (EPA 1992).

The EPA has also reported on strategies for the protection and management of wetlands in this region in several bulletins:

- Strategy for the protection of lakes and wetlands of the Swan Coastal Plain EPA Bulletin 685 (EPA 1993a).
- A Guide to Wetland Management in the Perth and Near Perth Swan Coastal Plain Area, EPA Bulletin 686 (EPA 1993b).

South Lake is protected under the Swan Coastal Plain Lakes Environmental Protection Policy (EPP). The WRC management categories assigned to the area of South Lake are Resource Enhancement (RE) and Multiple Use (MU).

South Lake is also within a Bush Forever Site 254, the bushland of which is listed as part of a System 6 Area (Part M93).

### **Buffers**

EPA Bulletin 686 states that the size of buffer zones should be determined according to the physical and ecological properties of the individual wetland and the purpose for which it is being managed (EPA 1993b). Property or reserve boundaries used in the above computation should be at least 50 m from the wetland edge<sup>2</sup>. The bulletin indicates that the higher the proportion of a wetland's perimeter surrounded with a 50 m or wider strip of native vegetation, the higher its natural attributes value.

The Draft Guidelines for Environment and Planning (EPA 1997b) state that as a general guide, the minimum recommended distance between intensive landuses and wetlands should be 50 m from, or 1 m AHD higher than, the furthest extent of the wetland vegetation (minimum dryland buffer) whichever is the larger (EPA 1997b). More recently, the *Guidance for the Assessment of Environmental Factors EPA Draft Guidance No. 26: Management of Surface Runoff from Industrial And Commercial Sites* (EPA 1999) provides similar recommendations for buffers between wetlands and other landuses. It also assumes that there is no vector for contaminated surface water runoff to reach the wetland, which is also a requirement of the guidelines and is the case with this proposal.

The WRC's position on buffer requirements for wetlands has been outlined in their *Wetlands Position Statement* (6<sup>th</sup> June 2001) and *Water Notes January 2000, Advisory Notes for Land Managers on Rivers and Wetland Restoration*. Proposed activities are required to be compatible with the management requirements of any wetlands that the land use may impact. Again, the buffer width<sup>3</sup> recommended for a particular wetland is dependent upon the conservation significance of the wetland and the purpose of the buffer. As a general guideline to protect wetland's environmental values, the

<sup>2</sup> The provision of 50 m does not appear to have a solid scientific basis and its justification is not detailed in the Draft Guidelines for Environment and Planning (EPA 1997b), but is a popular 'safe' width of vegetation for the protection of a wetland.

<sup>3</sup> The term buffer in the WRC Wetlands Position Statement June 2001 refers to a distance required between a wetland and another land use. The statement does not refer to a requirement for vegetation within this buffer distance.



WRC recommends that a minimum distance of 50 m is established from the boundary of wetland dependent vegetation to an adjacent land use. The 50 m requirement is based on the protection of the wetland from weed invasion from residential areas.

The 50 m requirement is generally sufficient for determining requirements for adjacent residential land, but for land uses such as horticulture and industry, a setback of at least 200 m is recommended to protect the wetland from pollution sources. A buffer of 200 m or greater may also be recommended in situations where a wetland has significant conservation value or has characteristics such as high midge populations which would require greater distances to decrease its impact on the public. Midge buffers are typically greater between wetlands and residential areas compared to wetlands and industrial areas.

The DPI is currently reviewing setbacks and buffers around wetlands.

### **Drainage**

The *Guidance for the Assessment of Environmental Factors EPA Draft Guidance No. 26: Management of Surface Runoff from Industrial And Commercial Sites* (EPA 1999) recommends the preparation of a stormwater management plan as part of industrial development proposals. This plan may form part of an overall site drainage management plan. The guidance contains a list of possible components of a stormwater management plan.

## **9.4 POTENTIAL SOURCES OF IMPACTS**

The following aspects of the proposal have the potential to impact on the ecological functions of South Lake:

- **Clearing of woodland for the estate** may remove areas of importance to resident fauna of the lake
- **General activities associated with the development operation of the estate** may impact on the lake and associated wetland if not managed and sufficient buffering is not provided.
- **Runoff from the estate** may affect water level and quality of South Lake, affecting species reliant on current conditions.
- **Contaminated groundwater flow** may affect water quality of South Lake;
- **Rehabilitation of buffer** will improve condition of vegetation area immediately west of South Lake, which may benefit resident fauna of the lake that seasonally use such areas.

Groundwater contamination and subsequent degradation of water quality in South Lake is not considered to be a significant risk in regard to this proposal as groundwater flow from the estate area is in a west to north-westerly direction and if contaminants were to reach the groundwater from the estate, they would be unlikely to reach South Lake. There is some concern for the potential of an easterly flow resulting from the drawdown influence of the lakes themselves in dry periods, and hence this aspect has been addressed in the following section.

Site contamination that arose from activities of the previous owner of the site is addressed in Section 10.

## **9.5 CONSEQUENCES AND MANAGEMENT MEASURES**

### **9.5.1 Clearing of vegetation up-gradient of South Lake**

The impact of clearing upland vegetation in association with South Lake is addressed in Section 6.5.1.



The impact of clearing woodland in Lot 502 on resident fauna of South Lake is addressed in Section 7.5.1, along with all other fauna.

Given the relatively small area of the area to be cleared in comparison to the capture zone of South Lake and the slow rate of clearing, any watertable rise following clearing of the site is expected to be minimal. As the site is down gradient of South Lake, any rise that does occur will not have any significant effect on South Lake water levels.

### **9.5.2 Protection of the lake from development and general operation of the estate (buffering)**

Potential impacts of the proposal on vegetation in addition to direct effects of clearing, such as dieback, weeds, fire risk, and access, which equally apply to the wetland vegetation surrounding South Lake, are addressed in Sections 6.5.2, 6.5.3, 6.5.4, and 6.5.5 respectively.

The lake is to be afforded general protection from activities within the estate by the provision of a 150 m wide buffer zone between South Lake and the estate. The estate was designed to be set back 150 m from the high water mark of the lake after consultation with the Department of Environmental Protection, Wetlands Conservation Society, and Aboriginal groups, and several other key stakeholders.

The provision of the buffer zone exceeds the requirements of EPA guidance (EPA 1993, EPA 1997), which states that as a general guide a 50 m buffer is sufficient between industrial areas providing there is no vector for surface water contamination as is the case for this proposal in which all surface drainage from the estate is being directed away from the lake. A buffer distance of 200 m is recommended by WRC to prevent contaminants reaching wetlands through groundwater, but as groundwater flow is in a westerly direction away from South Lake (see Section 9.5.4) the recommended distances do not appear as relevant.

The buffer zone will be protected during construction by marking off boundaries, controlling clearing adjacent to the buffer, minimising movement through the buffer, dieback and weed control, and protection from erosion, contamination, sand drift and dust. The bund to be constructed in the southern part of the buffer, as described in Section 8.5.2, will be designed and stabilised such that the potential for erosion is minimised. The effect of the bund on surface drainage will be addressed as part of a Drainage and Groundwater Management Plan.

The buffer strip will be permanently separated from the estate through the provision of fencing along the eastern boundary of the estate. This will increase the protection of the area and be of particular importance during rehabilitation efforts.

The provision of this buffer and addition of this area to Regional Open Space to Beeliar Regional Park will increase the size of the conservation reserve around South Lake. EPA Bulletin 686 (EPA 1993b) indicates that the larger the size of the reserve around a wetland the higher its conservation value. The addition of the 6.2 ha buffer area to the South Lake reserve will increase its size from approximately 35ha to 41ha, an increase by 17%. According to Bulletin 686, this will improve its conservation value.

### **9.5.3 Drainage**

South Lake is unlikely to be impacted on by runoff from the industrial estate. Sinclair Knight Mertz (SKM) has prepared a report on stormwater management and the hydrology of the site, and the report concludes all drainage can be diverted away from the lake. (SKM 2000).

The lake water quality will not be affected by the development of the estate as although the lake receives some small amount of surface flow runoff from the surrounding landscape, particularly



because of the steep gradient to the west, the lake is primarily fed by groundwater flow and hence its water quality depends highly on the quality of the aquifer not surface water flow. As surface water flow from the estate will either be diverted by the drainage design or percolate through the soil into the groundwater, which is flowing away from the lake, the waters of South Lake are extremely unlikely to be affected by drainage from the proposal.

The final drainage design will be described in a stormwater management plan as part of the Drainage and Groundwater Management Plan to be prepared by the proponent.

#### **9.5.4 Groundwater flow**

There is little potential for the water quality of South Lake to be affected by contaminated groundwater flow from the proposed industrial estate. Groundwater travels from Bibra Lake and South Lake before moving directly east to west across Lot 502. There is a steep hydraulic gradient away from the lake under Lot 502 (see Figure 6). The gradient is sufficiently steep that a reversal of this westerly flow would not be expected to occur under any foreseeable circumstances. This would prevent any groundwater contamination in Lot 502 from reaching the lake.

The drainage design will be such that accidental spills on roads and bitumised surfaces by enterprises in the estate will be directed away from the lake through the stormwater drainage system, as to be outlined in the DMP. This will act to prevent these spills from percolating into the watertable.

The DGMP will include a program for monitoring groundwater flow and quality through the estate with particular emphasis on the behaviour and quality of groundwater in proximity to South Lake.

Enterprises established in the estate will be required to comply with regulations for responsible chemical handling and storage.

The management of existing groundwater contamination and likelihood of transport towards the lake is addressed in Section 10.5.1.

#### **9.5.5 Rehabilitation of buffer**

Degraded areas of the buffer are to be rehabilitated as part of this proposal. The beneficial effects of this rehabilitation to vegetation and fauna associated with the lake are addressed in Sections 6.5.6 and 7.5.4.

The rehabilitation of the buffer area is likely to increase the conservation value of South Lake as it will increase the representation of native vegetation around the lake. EPA Bulletin 686 (EPA 1993b) indicates that the higher the proportion of a wetland's perimeter surrounded with a 50 m or wider strip of native vegetation, the higher its natural attributes value and subsequently the wetland is of higher conservation value.

#### **9.5.6 Rehabilitation of area south of lake**

Similar to the outcome of rehabilitating the buffer area (Section 9.5.5), the potential establishment of a rehabilitation program to restore vegetation in area of up to 10 ha on the southern side of South Lake would act to increase the conservation value of South Lake by increasing the representation of native vegetation around the lake.

## **9.6 PROPONENT COMMITMENTS FOR SOUTH LAKE**

The proponent has made the following commitment, in addition to those already made previously for vegetation and fauna, for the protection of South Lake:

- Protect buffer strip area by providing adequate fencing between the estate and buffer.
- Prepare and implement a Drainage and Groundwater Management Plan (DGMP) in consultation with DEP and WRC, to include:
  - Stormwater management plan for estate as described on page 4 of EPA (1999); and a
  - Groundwater monitoring program.

Also refer to commitments for flora and fauna.

## **9.7 OUTCOME**

The proposal will not disturb South Lake, but in fact improve the vegetation surrounding it through rehabilitation of the 150 m buffer area. The addition of the buffer strip to Beeliar Regional Park and the rehabilitation of degraded areas within the buffer will increase conservation value of South Lake. The collaborative rehabilitation program for the area south of South Lake would also increase the lake's conservation value, if established, by increasing the condition and protection of vegetation immediately around the wetland.

The water levels and environmental quality of South Lake will not be affected by the long-term operation of the proposed industrial estate. The Long-necked tortoise and some resident frogs of South Lake may be affected by the proposal from the removal of upland habitat. The retention of the buffer strip will decrease the impact of the proposal on these species.



## **10. SITE CONTAMINATION (SOIL AND GROUNDWATER)**

### **10.1 DESCRIPTION OF CURRENT CONTAMINATION**

The current and historical use of the site for paper manufacturing operations has resulted in some site contamination through the use of spray irrigation of paper pulp storage areas with effluent, landfill and effluent storage ponds. Through agreement between LandCorp and Amcor Australasia, Lot 502 will be used by Amcor for its waste storage and disposal until the site is sufficiently developed. A site contamination assessment was conducted by Bowman Bishaw Gorham (1999), which has been reviewed by the DEP, to assess the current and potential for further contamination. The assessment was undertaken in general accordance with procedures recommended for an Initial Evaluation by ANZECC and the National Health and Medical Research Council (1992) *Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites*.

The comprehensive soil and groundwater analyses conducted in this assessment found limited low level contamination in certain parts of the site.

#### **10.1.1 Spray irrigation areas**

The Amcor plant generates wastewater in its paper production process that is principally disposed via a spray irrigation system that extends from land on the existing Amcor property through to parts of Lot 502. The effluent characteristics are highly variable depending on the material being fed into the paper recycling process, and typically contains elevated concentrations of total dissolved salts (TDS), chemical oxygen demand (COD), organic nitrogen, phosphorus, sulphate and petroleum hydrocarbons.

The historical spray irrigation of wastewater was identified to have potentially contaminated soils in some cleared areas within the site that were used for such purposes. The contaminants in the wastewater most likely to accumulate in soils include trace metals and petroleum hydrocarbons, which preferentially absorb from the wastewater onto soils.

Contaminant concentrations in all soil samples were below ANZECC B Guideline levels, which represent values to protect human health and the environment and reflect contaminant concentrations that have no observable effect on the most sensitive receptor. In addition, previous studies by Murdoch University indicate that the COD measured in soils at irrigated areas declines to background levels within the surface 1 m of the profile. On this basis, the historical spray irrigation does not appear to have significantly impaired the quality of onsite soils or groundwater.

#### **10.1.2 Effluent ponds**

Wastewater exceeding the irrigation system capacity is disposed via a series of unlined ponds located in the south-western corner of Lot 502.

Groundwater sampling has been conducted in Lot 502 from existing monitoring wells and several new monitoring wells installed for groundwater monitoring purposes. Analysis of samples taken from these wells, which are mostly situated around the landfills and effluent ponds, found:

- Groundwater adjacent to and down gradient from the effluent ponds and the landfill is free from significant concentrations of hydrocarbons and sulphate, which were detected at elevated levels in the wastewater and sludge.
- The infiltration of wastewater from the ponds has elevated COD and TDS levels in the underlying groundwater, evident as a plume of increase COD and TDS down gradient of the effluent ponds. In general, COD and TDS concentrations decrease with distance from the ponds but elevated levels most likely extend west of Lot 502 in the direction of the groundwater flow.



- TDS levels in groundwater are below the maximum guideline level recommended for irrigation water indicating that it would be generally suitable for irrigation of gardens. COD levels do exceed guidelines for boiler and cooling feed water, which may have some significance to industries to be located in the estate.

(Bowman Bishaw Gorham 1999)

### **10.1.3 Landfill areas**

Solid wastes produced at the Amcor facility and disposed of on-site include fibrous sludge recovered from the clarifier and settling ponds and non-fibrous materials (plastic, metal products, glass etc) from the feedstock. There are two sites on Lot 502 that were historically used or are currently being used for landfill of these solid wastes.

The active landfill has been operating for the last 15 years and is located south of the effluent ponds. Several soil samples recovered from the current landfill site have shown elevated levels of copper. The concentrations are below soil guideline levels for the planned general industrial land use.

The previous landfill, located north of the effluent ponds, contains material of variable but slightly elevated levels of petroleum hydrocarbons and copper. Rainfall infiltration through the sludge disposed to the landfill may create leachate that is a potential source of groundwater contamination. However, monitoring has shown that the hydrocarbons and copper are not migrating into the underlying groundwater at detectable levels.

### **10.1.4 Significance to development**

The information currently available is sufficient to support the conclusion that contamination is not a significant constraint on the proposed development and poses no risk to off-site beneficial uses of groundwater. LandCorp has commissioned Aquaterra to carry out regular ongoing groundwater monitoring to confirm that groundwater quality beneath the site is maintained or improved over the long term.

## **10.2 PRELIMINARY EPA OBJECTIVES**

- To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.
- To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.
- To ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate criteria.

### ***LandCorp objective***

- To ensure site contamination levels do not exceed levels acceptable for industrial development or lead to ongoing groundwater pollution.

## **10.3 ASSESSMENT FRAMEWORK OR POLICY**

The EPA objective for this factor provides the framework to conduct assessment of potential environmental impacts and consequences.



## 10.4 POTENTIAL SOURCES OF IMPACT

Aspects of the proposal that have the potential to cause or exacerbate soil and groundwater contamination in and extending from Lot 502, include:

- **Development of the estate** may spread contaminated soil into uncontaminated areas and bury or develop over groundwater contamination sources, making them difficult to remediate in the future.
- **Operation of the estate** may involve industries that may store chemicals/solvents or produce waste that has the potential to contaminate soils and groundwater if spills occur.

Groundwater contamination in Lot 502 has little potential to affect South Lake as the Lake is up gradient to the groundwater flow and not within its groundwater capture zone (see Section 9.5.4). The wetland is effectively isolated from the development.

## 10.5 CONSEQUENCES AND MANAGEMENT MEASURES

### 10.5.1 Development of the estate

The nature of soil and groundwater contamination over Lot 502 has been characterised and is described in Section 10.1.

The development of the Bibra Lake Industrial Estate will involve the preparation and implementation of a Site Contamination Management Plan in consultation with DEP, which will address the management of existing and potential contamination in Lot 502. The plan will involve procedures for the following actions to be carried out prior to the development of the estate:

- decommissioning of effluent ponds and landfill sites prior to estate development, which should prevent further soil contamination and groundwater contamination; and
- removal of solid waste and contaminated soil from previous landfill prior to estate development will remove potential source of contaminated leachate from site.

### *Effluent ponds*

The discontinuance of use of the effluent ponds will be staged in synchronisation with the staged development of the estate, such that in five years the ponds will no longer be in use. The ponds will subsequently be dried and the surface soils removed to a depth such that soils that could potentially be sources of ongoing contaminated leachate are removed, and disposed of at a suitable solids waste facility. The extent to which these soils are removed will be determined following similar sampling to that conducted during the soil assessment of the landfill and irrigation areas, to assess the depth to which significant contamination occurs.

Currently groundwater within Lot 502 down gradient of the effluent ponds is characterised by a plume of elevated COD and TDS. In terms of water quality criteria:

- The TDS levels in the groundwater are below the maximum guideline level for irrigation water, indicating that it would generally be suitable for irrigation of gardens in the estate.
- Within the influence of this plume, COD levels in the groundwater currently exceed guidelines for boiler and cooling feed water, which could potentially discourage industries that require groundwater for such purposes due to the associated pre-treatment costs.



Predictive groundwater modelling was performed by Bowman Bishaw Gorham to provide an estimate of the plume size and duration over time under several scenarios (Bowman Bishaw Gorham 1999). As TDS was not considered to be at levels to concern surrounding industry, only COD was modelled.

Figure 15 shows predicted concentration contours of COD at steady state. The current steady-state plume has a COD concentration of 150 mg/L extending approximately 160 m down gradient from the effluent soak ponds and 40 m west of Lot 502. The edge of the plume where concentrations return to background levels extends approximately 420 m down gradient from the ponds and 320 m west of Lot 502.

The modelling indicates that it will take approximately three years for COD concentrations to decrease to background levels after decommissioning of the ponds. On this basis, the COD plume will be restricted to beneath the Australia Asia Spearwood Distribution Park located west of Lot 502. Therefore, by the time the final stages of the estate are being complete, approximately 10 years from the initial stage of development, there should be no detectable groundwater contamination as a result of the operation of the effluent ponds.

Recent sampling around the effluent ponds showed that the bores down gradient of the effluent ponds had higher COD concentrations than those up gradient (Aquaterra 2001). Groundwater appeared to be flowing more north-west than strictly west but this does not have any significant bearing on the predicted extent and longevity of the COD plume.

In summary, the ongoing use of the effluent ponds for the next five years is not expected to further degrade groundwater quality and following the removal of the effluent ponds, the quality of the groundwater down gradient of the area and the oxygen deficient plume will self remediate over time.

Groundwater will be monitored over the development of the estate, and following the completion of the estate if deemed necessary by the DEP, as part of the Site Contamination Management Plan.

### ***Landfill sites***

Elevated levels of petroleum hydrocarbons and copper are present in the sludge waste of the previous landfill site. To prevent this site being a potential source of groundwater contamination and assist in remediating the site, approximately 20,000 cubic metres of waste and contaminated soil will be extracted, replaced with clean fill sourced on site, and compacted. The extracted waste and soil will be disposed of at an appropriate solid waste facility. Following these procedures, the site will be characterised by negligible soil contamination and will be suitable for industrial lots.

The only contaminant of potential concern at the current landfill site is copper, which is however at concentrations below guideline levels for the planned general industrial land use. This landfill site is planned to be for an area of Public Open Space in the industrial estate. The solid waste will remain in-situ, covered with soil and the new ground surface landscaped and native gardens established. The land will be retained in LandCorp ownership pending the acceptance of other appropriate custodians.

The concentrations of copper in groundwater are not expected to exceed guideline levels in the future. The groundwater in and around the landfill site is being monitored by LandCorp, and a similar program will be implemented as part of the Site Contamination Management Plan.

### ***Potential to impact on South Lake***

The water quality of South Lake is unlikely to be influenced by existing contamination in Lot 502 due to the following factors:



- Relatively larger distance between the lake and effluent ponds (600 m measured from edge of lake and eastern edge of effluent ponds) compared to the predicted extent of the COD plume (450 m as measured from the western edge of the effluent ponds to the 25 mg/L contour as shown on Figure 15). The lake is separated from the landfill sites by a similar distance.
- The extreme unlikelihood of groundwater flowing from under the effluent ponds and landfill sites to South Lake due to the steep hydraulic gradient between them (see Figure 6);
- The implementation of a Drainage and Groundwater Management Plan (DGMP) as described in Section 7.5.2.

### **10.5.2 Operation of the estate**

The potential impact of future tenants of the estate on soils and groundwater is beyond the scope of the PER. Enterprises within the estate are to be non-noxious and not expected to be producing large forms of solid and liquid waste.

Enterprises established in the new estate will be expected to transport, store and dispose of chemicals and solvents according to relevant legislation, regulations and license conditions such that spills, which could potentially cause soil and groundwater contamination, are prevented.

## **10.6 PROPONENT COMMITMENTS FOR CONTAMINATION**

LandCorp has made the following commitments for the prevention of site contamination:

- Prepare and implement a Site Contamination Management Plan to address and manage existing contamination, remove the current source, and remediate the site, to the requirements of the DEP prior to development.

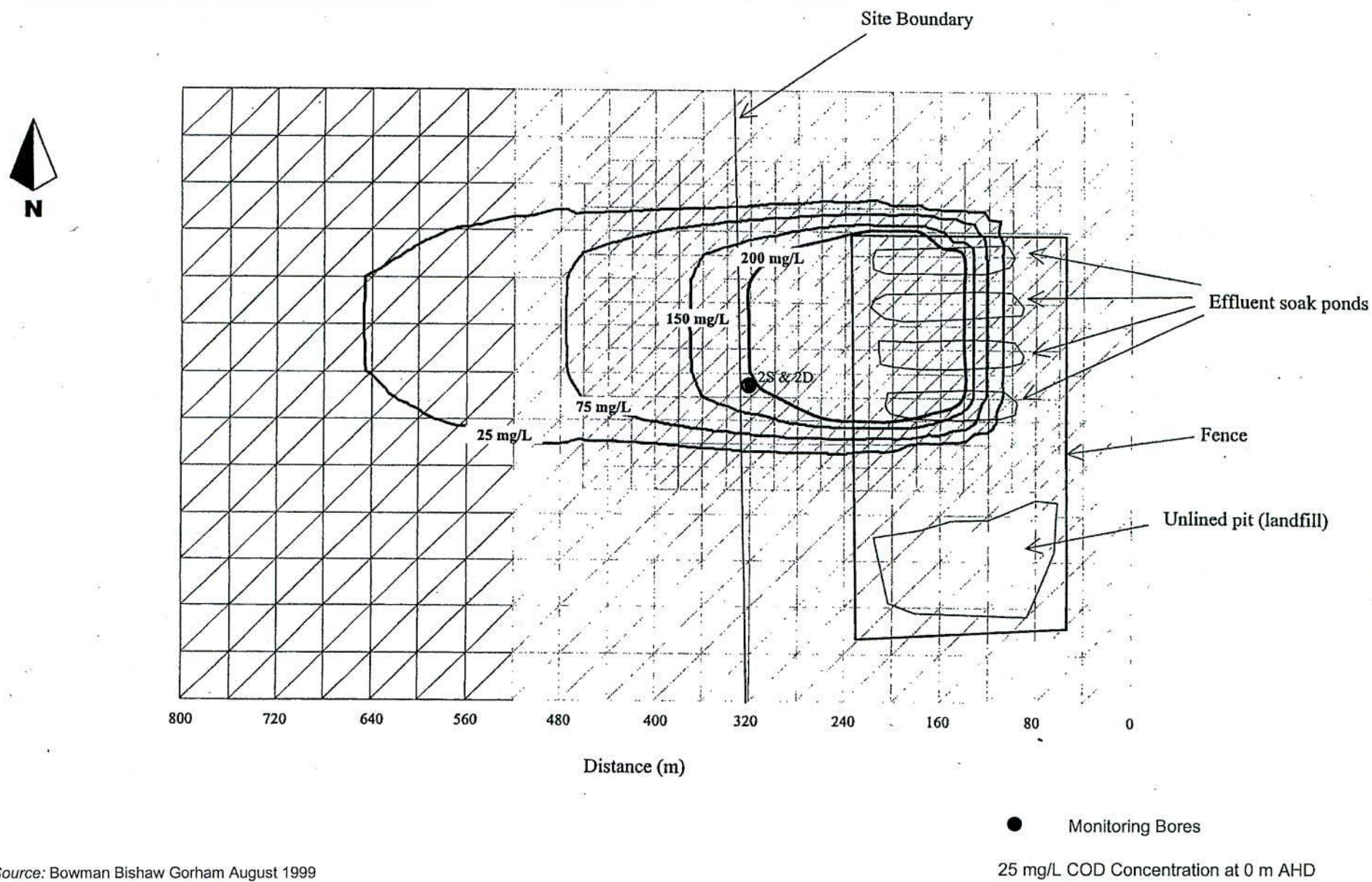
## **10.7 OUTCOME**

The proposal is not anticipated to cause any significant site or groundwater contamination. A Site Contamination Management Plan will be prepared prior to development of site, which will involve the eventual cessation of the landfill and wastewater ponds used by Amcor. The cessation of effluent discharge and removal of sludge waste will reduce current threats to groundwater quality. Current contamination of groundwater is expected to be self-remediated within a relatively short period.

Groundwater contamination in the estate does not represent a significant threat to South Lake.

Enterprises established in the new estate will be expected to transport, store and dispose of chemicals and solvents according to relevant legislation, regulations and license conditions, such that spills are prevented, which could potentially cause soil and groundwater contamination.

Figure 15 Modelled COD Concentration (Bowman Bishaw Gorham 1999)



Source: Bowman Bishaw Gorham August 1999



## 11. DUST AND PARTICULATES

### 11.1 LOCAL SETTING

There are two residential areas that have the potential to be affected by dust generation from the site:

- St Paul's Estate, located approximately 100 m to the north of Lot 502; and
- Yangebup, located approximately 600 m to the southeast of Lot 502.

Currently, some dust is being generated locally from the exposed sand areas and unvegetated sand stockpiles in the adjacent Cocos Park industrial area.

Adventure World, a privately owned amusement park, is located to the northeast of the site, adjacent to Bibra Lake, and is open on a seasonal basis over summer. Its location may make it susceptible to any dust generation on site during the summer months, when south westerly strong winds occur in the afternoons.

### 11.2 PRELIMINARY EPA OBJECTIVE

- To ensure that dust emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

#### *LandCorp objective*

- To ensure that the development of the estate does not temporarily or permanently expose South Lake to higher levels of dust deposition from surrounding cleared land.

### 11.3 ASSESSMENT FRAMEWORK OR POLICY

A National Environment Protection Measure (NEPM) for Ambient Air was endorsed by the National Environment Protection Council in June 1998. This measure contains a standard for particulate matter with an equivalent aerodynamic diameter of 10 microns or less, referred to as PM<sub>10</sub>, which is shown in Table 11.

**Table 11 NEPM standards and goal for particles as PM<sub>10</sub>**

Pollutant	Averaging time	Maximum concentration <sup>(b)</sup>	Goal: (10 years) maximum allowable exceedences in a year
Particles as PM <sub>10</sub>	1 day	50 µg/m <sup>3</sup>	5 days <sup>(a)</sup> a year

<sup>(a)</sup> 1 day is the average over a calendar day.

<sup>(b)</sup> The concentrations are the arithmetic mean concentrations measured in accordance with "Particles as PM10 Determination of Suspended Particulate Matter-PM10 High Volume Sampler with Size Selective Inlet-Gravimetric Method (AS3580.9.6-1990) or "Determination of Suspended Particulate Matter- PM10 Dichotomous Sampler-Gravimetric Method (AS3580.9.7-1990)".

Procedures relevant to controlling dust emissions from land clearing and quarrying activities are to be in accordance with EPA Guidance for the Assessment of Environmental Factors No. 18 - Prevention of air quality impacts from land development sites (EPA 2000b).

## 11.4 POTENTIAL SOURCES OF IMPACT

The area considered in the assessment of this environmental factor is the immediate surroundings of the estate, including any nearby residences.

The main potential sources of airborne dust are described below:

- **Site preparation** including the clearing of vegetation.
- **Movement of vehicles and equipment** during development and operation of the estate.
- **Lift-off during hot, windy conditions** from stockpiles of excavated soil during development.

There is also potential for South Lake to be exposed to higher levels of dust deposition as a result of the removal of vegetation on the ridgeline to the west of South Lake.

## 11.5 CONSEQUENCES AND MANAGEMENT MEASURES

### *Dust control during development*

Windborne dust and sand resulting from earthworks is only likely to have the potential to impact on the St Paul's Estate area during southerly and south easterly winds with speeds greater than 20 km/hour (Bowman Bishaw Gorham 2000). An analysis of wind data from the area indicates that the frequency of these wind events is low. Residential areas in Yangebup, to the south east of Lot 502, are not likely to be prone to wind blown dust if generated, as north westerly winds mostly occur in winter and spring when the potential for dust generation is at its lowest.

Strong south-westerly winds are generally experienced in the afternoon during spring and autumn, and particularly over summer. In the absence of proper dust management, these winds could potentially generate airborne dust.

Bowman Bishaw and Gorham (2000) prepared a dust management plan that addressed dust control for a proposal that would involve sand and limestone extraction during staged development. As this is no longer the case, and excavations will be on a 'cut and fill' need only for suitable landscaping, the potential for dust generation is greatly reduced. However, measures described in this plan would be incorporated into a revised Dust Management Plan including:

- compliance with EPA Guidance for the Assessment of Environmental Factors No. 18 - Prevention of air quality impacts from land development sites (EPA 2000b);
- staged development (progressive clearing and stabilisation) with clearing only in wetter months so soils are moist and less prone to dispersion by wind;
- dust suppression during development, to DEP standards using watering, upwind vegetation screens, stabilisation of stockpiles and finished surface;
- restricting vehicle speeds along the unsealed access roads during development;
- maintaining buffer of vegetation between cleared land and surrounding land users for as long as possible during construction;
- retaining as much vegetation as possible in the estate, particular along roadsides and buffer to South Lake; and
- continuous visual monitoring and logging of public complaints regarding dust.



In light of the prevailing conditions and with the described measures in place, dust concentrations are likely to be within guidelines at the key potentially affected areas of St Paul's Estate, Yangebup and Adventure World.

### **South Lake**

The removal of vegetation from the ridgeline west of South Lake is not expected to permanently expose South Lake to higher levels of wind borne dust from cleared and undeveloped areas south of Lot 502 as vegetation will be retained and restored within the first 150 m area from South Lake, which would filter wind blown dust.

Deposition of particulates into South Lake may actually decrease as a result of this proposal as the rehabilitated buffer strip will progressively increase the filtering of wind borne dust from the south. Several community members consulted during the preparation of this PER stated that dust has been observed (visually) escaping from the adjacent Cocos Park, particularly from a large exposed stockpile of sand 200 – 250 m away from the lake. Currently, there is negligible effective vegetative barrier between the adjacent Cocos Park property and South Lake, and the establishment of a 150 m wide strip of vegetation will contribute to a decrease in dust reaching the lake over time. The rehabilitation program to revegetate the area south of the lake is likely to increase the protection of the lake from windborne dust in the medium to long term.

This proposal will only involve the use of low profile stockpiles for very short terms during development and dust suppression measures as described above will be utilised. Once enterprises have taken up tenancy, native vegetation gardens will be established across the estate in each stage, and the need for measures such as watering and stabilisers on exposed sand will not be necessary.

## **11.6 PROPONENT COMMITMENTS FOR DUST**

The proponent has made the following commitment for the control of dust during the development of the estate:

- Prepare and implement a Dust Management Plan, as part of the estate Development Environmental Management Plan, in accordance with EPA Guidance for the Assessment of Environmental Factors No. 18 - Prevention of air quality impacts from land development sites (EPA 2000b).

## **11.7 OUTCOME**

With the described measures in place, dust emissions during the staged development of the estate should be within EPA guidelines and the activities are not expected to significantly impact on the surrounding residents or the environmental condition of South Lake. The removal of vegetation on the ridgeline west is not expected to cause South Lake to be more susceptible to deposition of windborne dust. The rehabilitation of areas west and south of South Lake may increase its protection from windborne dust.

## **12. NOISE**

### **12.1 LOCAL SETTING**

Lot 502 North Lake Road is surrounded by general industrial activity to the west, south, and most of the north of the lot. The small 'pan' handle of Lot 502 extends north such that it is directly opposite St Paul's Estate, a residential area, on the other side of Phoenix Road. Lot 502 is separated from residential areas to the east by a large vegetated conservation reserve (South Lake).

Current background noise within Lot 502 is relatively low, with the principle noise sources being from traffic along North Lake, Phoenix, and Sudlow Roads and Spearwood Avenue, and operational noise from the Amcor Paper Recycling Mill.

The main contributor to background noise in St Paul's Estate is from traffic along Phoenix Road.

### **12.2 ASSESSMENT FRAMEWORK OR POLICY**

#### **12.2.1 Earthworks and construction noise**

The assigned noise levels in the *Environmental Protection (Noise) Regulations 1997* do not apply to construction activities carried out between 0700 and 1900 hours on any day except Sunday and public holidays provided:

- the construction work is carried out in accordance with section 6 of the Australian Standard 2436–1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites";
- the equipment used is the quietest reasonably available; and
- a noise management plan is submitted at the request of the Chief Executive Officer of the DEP.

Construction may occur outside these hours or on Sundays or public holidays provided the above conditions are met and:

- all nearby residents are advised of the work to be done at least 24 hours before it commences;
- the proponent demonstrates that it is reasonably necessary for the work to be done out of hours; and
- the proponent submits to the Chief Executive Officer of DEP, for approval, a noise management plan at least seven days before the work starts. The noise management plan would be required to include details of the need for the work, type of work, predicted noise levels, control measures, noise and vibration monitoring and complaint response procedures.

### **12.3 PRELIMINARY EPA OBJECTIVE**

- To protect the amenity of nearby residents from noise impacts resulting from activities associated with the proposal by ensuring the noise levels meet statutory requirements and acceptable standards.

### **12.4 POTENTIAL SOURCES OF IMPACTS**

The main contributors of noise and vibration from the development of the industrial estate will be from:

- **Vehicle movements and machinery operation** including earth moving machinery, trucks and small vehicles.



Once established, the estate will contain numerous enterprises, which potentially are sources of noise. The estate is not expected to support tenants that will generate noise of nuisance levels but regardless, these enterprises will be subject to operational noise regulations.

## 12.5 CONSEQUENCES AND MANAGEMENT MEASURES

Herring Storer Acoustics conducted an acoustic assessment for sand and limestone extraction in Lot 502 (Herring Storer Acoustics 2000). Although sand and limestone extraction is no longer part of this proposal, similar equipment at lower intensity will be used to conduct the earthworks for the estate development (front end loaders) and hence the results of the assessment can still be used to conservatively evaluate the maximum possible noise impacts.

The Environmental Protection (Noise) Regulations 1997 stipulate the allowable noise levels that can be received at one premise from another premise. The allowable noise level when received at a residence is determined by the calculation of an influencing factor. Table 12 shows the calculated influencing factors for residence within certain distances from Lot 502 and the allowable (assigned) noise levels at these residences during the day (0700 – 1900), referred to as  $L_{A10}$ .

### Earthworks

Table 12 also shows the calculated noise levels for excavation activities in the estate at different stages of development of the estate. The various stages represent differing locations of the source of noise on site as excavation activities shift according to the order of areas to be developed. The results show that:

- no noise levels experienced at nearby residences will exceed assigned noise levels during the development of the estate;
- the maximum noise levels experienced in St Paul's Estate will be during Stage 2 of development, when land will be cleared in the 'pan-handle' section of Lot 502, but noise levels will not exceed assigned levels.

**Table 12 Calculated influencing factors and noise levels during excavation earthworks at residences in vicinity to Lot 502.**

Location	Influencing factor	Assigned Day $L_{A10}$	Stage of development / Expected Noise level DB(A)			
			1	2	3	5
Residence within 100m of Phoenix Road (in St Paul's Estate)	8 - 10	55	35	49	42	23
Residences between 100 and 450m from Phoenix or North Lake Roads	4 - 6	47	31	43	39	39
Residences to south of railway line	0 - 2	47	35	34	35	33

Measures that would be included to reduce noise from machinery and heavy vehicles during the earthworks and site development within the estate, as part of the Noise Management Plan, would include:

- installation of appropriate noise control equipment (such as mufflers or noise enclosures) on mobile and stationary equipment;
- ensuring that all equipment is in good working order; and
- providing noise attenuation screens as appropriate.

Residents in proximity to Lot 502 would be advised of the proposed working schedule, particularly during development in the north eastern corner of Lot 502, just across Phoenix Road from St Pauls residential estate. In any situations where work would be required to take place outside of the period 0700 – 1900, residents will be informed at least 24 hours before the work is carried out.

### **Truck movements**

The noise assessment conducted by Herring Storer Acoustics shows that there will be negligible noise increase to the St Paul's Estate area resulting from trucks using Phoenix Road during construction of the estate. The calculations were conducted assuming sand extraction, which would involve trucks leaving the site frequently transporting excavated sand. With earthworks being limited to that required for cut and spoil, truck movements from the estate will be of much lower frequency, consequently the noise increase will be lower than calculated in the noise assessment.

The establishment of the estate is not expected to impact on nearby residents in terms of increased noise from traffic associated with the operation of the estate as much of the traffic will be moving through the estate between North Lake Road and Spearwood Avenue (see Section 13) rather than along roads closer to residential areas such as Phoenix Road. Residents of St Paul's Estate are actually likely to experience much lower traffic noise following the development of the estate as traffic volumes are expected to be half of that without the development (see Table 13).

The Noise Management Plan will address the preliminary draft EPA Guidance for the Assessment of Environmental Factors No. 14 – "Road and Rail Transportation Noise (Version 3, EPA 2000c).

## **12.6 PROPONENT COMMITMENTS FOR NOISE**

The proponent has committed to the following:

- Prepare and implement a Noise Management Plan in consultation with DEP.

## **12.7 OUTCOME**

The development of the Bibra Lake Industrial Estate is not expected to impact significantly on the amenity of nearby residents. Noise to the surrounding residences due to earthworks will comply with the requirements of the Noise Management Plan prepared in accordance with the requirements of DEP.

Tenant adherence to operational noise regulations will ensure there is no ongoing generation of noise which will affect the well being of residents.

The establishment of the estate will reduce the frequency and volume of traffic noise experienced by the residents of St Paul's Estate.



## 13. TRAFFIC AND SAFETY

### 13.1 LOCAL SETTING

Lot 502 is situated such that it has direct access to the major roads of North Lake Road, Phoenix Road and Spearwood Avenue. From these three roads, vehicles have access to major arterial roads such as the Kwinana Freeway and Stock Road.

Main Roads WA measured the average weekly traffic (AWT) on the roads adjoining or to be used for access to the site in 1998 and 1999, the results of which are shown in Table 13.

**Table 13 Traffic volumes on major roads near Lot 502 (SKM 2000)**

Road	Current traffic volumes NPV (average over 1998 and 1999)	Future traffic volumes assuming no development NPV in 2021	Future traffic volumes with development NPV in 2021
North Lake Road	17,000	24,200	25,600
Phoenix Road	22,920	26,000	12,600
Spearwood Avenue	11,300	16,000	17,400
Stock Road	24,200	30,000	33,000

NPV - Number of vehicles per day

### 13.2 PRELIMINARY EPA OBJECTIVE

- To ensure that risk from the proposal is as low as reasonably achievable and complies with acceptable standards and EPA criteria.

#### *LandCorp objectives*

- To ensure that the increase in traffic resulting from the proposal does not adversely impact on social surroundings.
- To reduce, as far as is practicable, the impact of traffic resulting from the development.
- To ensure that the development of the estate does not increase the risk to local public safety.

### 13.3 POTENTIAL SOURCES OF IMPACT

The aspects of the proposal that may potentially impact on traffic and safety, include:

- Site works and development of the estate** will cause a temporary increase in local truck traffic.
- Ongoing operation of the estate** may increase the number of vehicles on local roads and the occurrence of fires in the bushlands adjacent to the estate.
- Increased traffic** may increase the potential for motor vehicle accidents on local roads and represent an increase to public risk.

## 13.4 CONSEQUENCES AND MANAGEMENT MEASURES

### 13.4.1 Traffic

#### *During earthworks and development*

There are two route options available for trucks and vehicles accessing the site during estate development (GJL Engineers 2000):

- Option 1 (no right turns onto North Lake Road for Freeway/Armadale bound traffic from new North Lake Road entrance (Figure 16); or
- Option 2 (right turns onto North Lake Road for Freeway/Armadale bound traffic (Figure 17).

Option 1 is likely to be used until satisfactory traffic controls at the intersection of North Lake Road and the new estate entrance road are implemented. Under Option 2, the majority of trucks accessing the site by-pass the sensitive areas, such as St Paul's Estate. However, for this option to be acceptable from a traffic safety standpoint, satisfactory traffic controls at the intersection of North Lake Road and the estate entrance road will be required.

#### *Following development*

The establishment of the estate is not expected to represent a significant traffic safety issue to nearby residents as major intersections servicing the estate are located away from residential areas. Much of the traffic associated with the operation of the estate will be moving through the estate between North Lake Road and Spearwood Avenue rather than along roads closer to residential areas such as Phoenix Road. Table 13 shows that the volume of traffic on major roads adjacent to Lot 502 for scenarios with and without development of the industrial estate (SKM 2000).

The development of the estate will actually halve the traffic volumes along Phoenix Road which is immediately adjacent to St Paul's Estate, and therefore may result in a decrease in the risk of vehicle accidents along this road. The increased volumes of traffic along North Lake Road, Stock Road and Spearwood Avenue are not of large magnitudes compared to this decrease in traffic volume on Phoenix Road and will be well within the capacity of these roads such as not to represent significant increases in traffic hazard. LandCorp will further investigate the most appropriate traffic control measures at entry points into the estate to optimise both traffic safety and flow of traffic through and past the estate.

Little or no truck traffic associated with the proposal will travel past the Waldorf School. Trucks will use Phoenix, Stock or North Lake Roads to access and depart from the site.

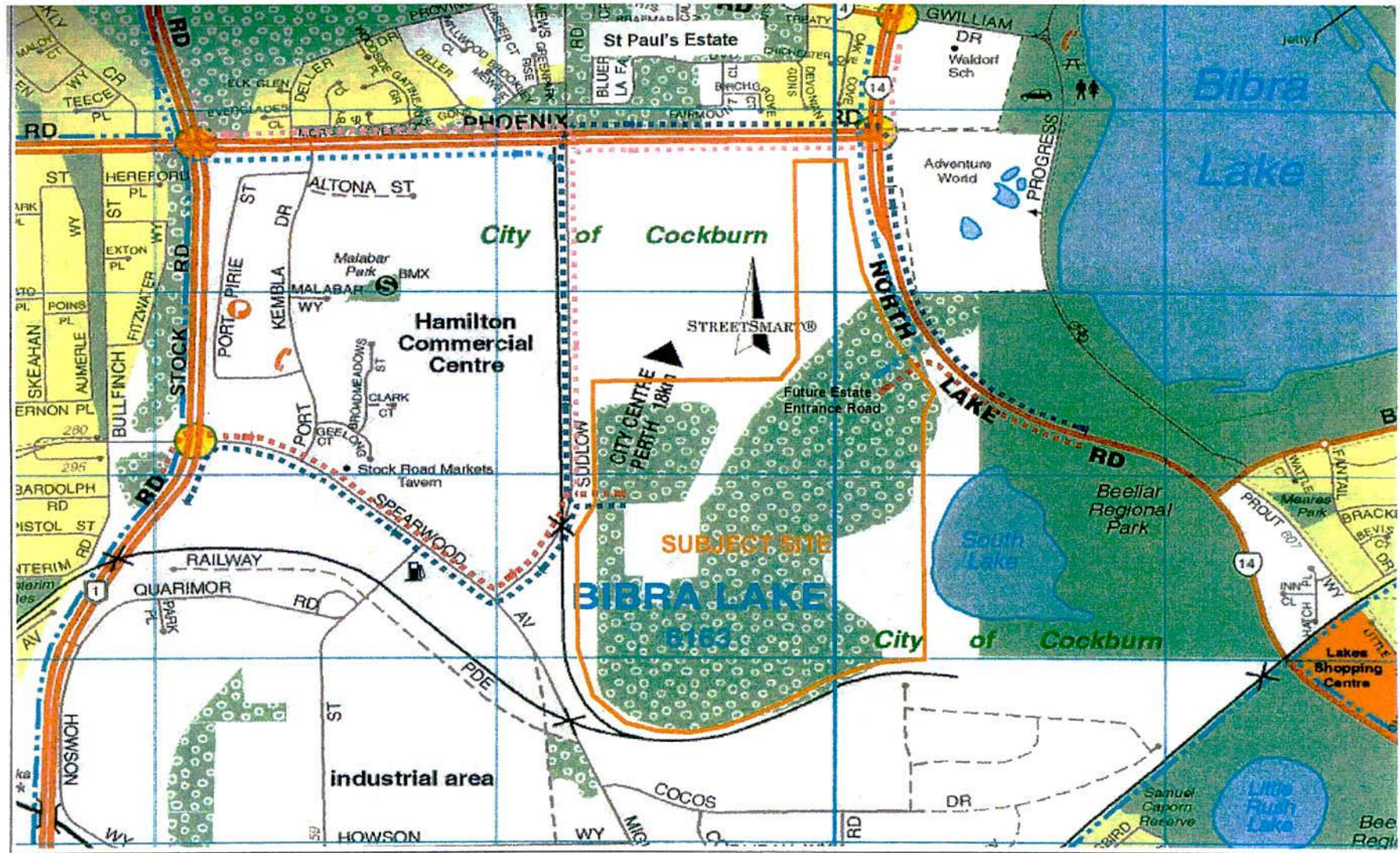
LandCorp will develop a Traffic Management Plan in consultation with the local community groups and the City of Cockburn. The plan will address mitigation measures for traffic, including:

- Appropriate traffic control measures at entry points to the estate;
- preferred haulage routes for machinery and trucks (if it is necessary to remove soil from site);
- speed restrictions along the traffic routes; and
- restricting heavy vehicle movements to agreed times on weekdays and weekends (0700-1900).

The Traffic Management Plan will also address the preliminary draft EPA Guidance for the Assessment of Environmental Factors No. 14 – "Road and Rail Transportation Noise (Version 3, EPA 2000c).



Figure 16 Access to site during estate development – Option 1



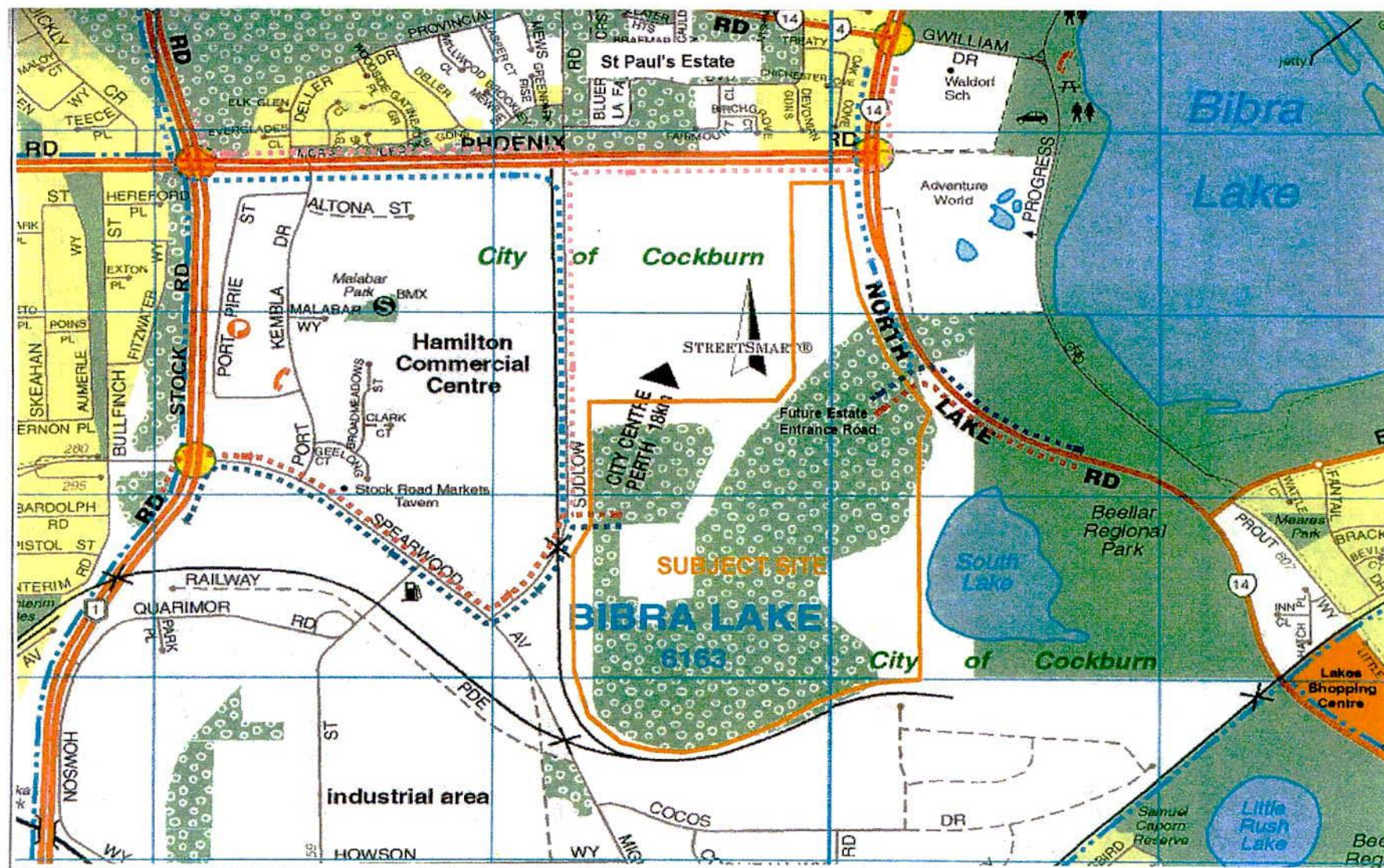
## TRUCK ROUTES - OPTION 1

Source: StreetSmart - 1998, DOLA

- ..... Leaving the Site
- ..... Returning to the Site



Figure 17 Access to site during estate development – Option 2



## TRUCK ROUTES - OPTION 2

Source: StreetSmart - 1998, DOLA

- - - - - Leaving the Site
- - - - - Returning to the Site



#### **13.4.2 Site work safety issues**

The site development would not entail any inherently dangerous activities. All earthworks and construction work would be undertaken in accordance with accepted practices. Relevant occupational health, safety, and welfare requirements would also be satisfied by the contractors involved in the estate development.

The estate development is unlikely to represent a significant risk to public safety.

#### **13.5 PROPONENT COMMITMENTS FOR TRAFFIC**

The proponent has made the following commitments regarding construction traffic:

- Prepare and implement a Traffic Management Plan in consultation with the City of Cockburn and local community groups.

#### **13.6 OUTCOME**

The degree of increase in road traffic during the development and operation of the estate is considered extremely low and is not predicted to have any substantial impacts in terms of safety and amenity on local road users or neighbouring land uses.

Traffic volumes will be approximately halved along Phoenix Road following the development of the roads linking North Lake Road and Spearwood Avenue and Sudlow Road through the estate.

## 14. ABORIGINAL HERITAGE

### 14.1 DESCRIPTION

The areas around Perth's wetlands have a special place of significance for Nyoongar people and this project around South Lake is no exception. Consulting archaeologist Paul Greenfeld, on behalf of Australian Interaction Consultants, completed an archaeological survey of Lot 502 in May 1999. The consultants also undertook a heritage assessment in July 1999, involving site visits with representatives of local Aboriginal groups.

The project area is located in an area that is subject to two Native Title Claims under review, namely WC 99/6 and WC 95/86 (Ballaruks) registered with the Department of Indigenous Affairs (DIA).

One archaeological site is located in Lot 502, a campsite with associated quartz scatter, and has been registered with the Department of Indigenous Affairs (DIA) as AAD site SO1289 – Swamp 81. The site is located in the south east corner of Lot 502 (Parker and Greenfeld 1999). The archaeological material associated with the campsite was located within an area of approximately 16 m (east/west) and 25 m (north/south) and is separated from the South Lake reserve by a degraded area of disturbed soil. This area contains no visible archaeological material. Quartz scatters, possibly associated with the site were also located along the fence line separating the South Lake reserve and Lot 502. The scatters were found only on the South Lake side of the fence line.

Six marked ("scarred") trees were also located and have some significance to the Nyoongar people consulted during the course of the assessment. These have been flagged, their GPS coordinates recorded, and registered with the DIA.

### 14.2 PRELIMINARY EPA OBJECTIVE

- To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

### 14.3 ASSESSMENT FRAMEWORK OR POLICY

The Minister for Indigenous Affairs is responsible for the administration of the *Aboriginal Heritage Act 1972*. The Minister's responsibility is to ensure that all places in Western Australia that are of traditional or current sacred, ritual or ceremonial significance to Aboriginal people should be recorded and their importance evaluated on behalf of the community. Under section 17 of the Aboriginal Heritage Act, it is an offence to disturb any Aboriginal site. The consent of the Minister is required under section 18 of the Aboriginal Heritage Act if a development is likely to impact a site.

The Minister considers recommendations from the Aboriginal Cultural Material Committee (ACMC) and the general interests of the community when making a decision on disturbance to a site. The Minister may also impose conditions on the approval.

The Registrar of Aboriginal Sites is responsible for maintaining the Register of Aboriginal Sites. The Department of Indigenous Affairs (DIA) has a database of all recorded sites.

### 14.4 POTENTIAL SOURCES OF IMPACT

The following aspects of the proposal may potentially impact on Aboriginal heritage sites:

- **Physical disturbance of the land surface** during construction may unearth and/or destroy skeletal remains or other sub-surface artefactual material



- **Clearing of vegetation** may destroy 'scar trees' and may also be inconsistent with Aboriginal values associated with the site.

## **14.5 CONSEQUENCES AND MITIGATION MEASURES**

Lot 502 contains only archaeological sites including scarred trees and a campsite with no spiritual or mythological significance. LandCorp has reached agreement with Aboriginal representatives concerning cultural significance of sites, environmental issues, and other matters in accordance with Section 18 of the Aboriginal Heritage Act.

### **14.5.1 Camp site**

LandCorp personnel and its contractors will be made aware of, and will avoid any damage to the site. The site is outside the planned subdivision area and is not under direct threat from the development.

LandCorp will protect the site within the South Lake buffer area during the estate development, by ensuring approximate location is known by contractors and earthworks are carried out in such a manner to avoid disturbing or burying the site. The campsite will be permanently protected in Regional Open Space following the completion of works as part of the South Lake buffer area.

### **14.5.2 Scar trees**

The development of the site will mean some trees identified as 'scar trees' will need to be removed as the land will be subject to earthworks requiring the total removal of vegetation in some areas.

A small area of Public Open Space is to be retained in the southwest corner of Lot 502, in which four of the scar trees are to be retained (see Figure 3). These scar trees are all sufficiently set back away from the planned roads as not to be disturbed. The Aboriginal representatives consulted have agreed to the removal of two scar trees that are not located in this Public Open Space, and this action has subsequently gained s18 approval under the Aboriginal Heritage Act. These trees will be cut above and below the scarification marks and relocated to near the campsite archaeological site within the South lake buffer area. LandCorp will subsequently provide explanatory notices in that area, explaining the significance of the markings and attesting to the previous and ongoing Nyoongar connection to the land.

### **14.5.3 Unearthed archaeological material**

LandCorp will monitor earthworks, making contractors aware of the possibility of encountering further archaeological material, such as skeletal remains or sub-surface artefactual material, during the estate development. Contingency procedures for situations in which such material is encountered will be prepared by LandCorp such that the nature of the material is verified, correct authorities are notified and further consultation with the key Aboriginal groups is implemented. LandCorp would consult with these groups and the DIA on its responsibilities and its significance to the estate development.

### **14.5.4 Values associated with native bushland**

The consultation with Aboriginal people, claiming to have connection with the project area, revealed many concerns with the clearing of vegetation and the inherent loss of native flora and fauna of Lot 502. This is consistent with the general Nyoongar attitude to the preservation of the environment, and some key attributes identified by the people consulted and LandCorp's response in the design of the estate are shown below:

- The shores of South Lake, extending out to the woodland edge west of the degraded area, are viewed as being significant because of their role as breeding ground for tortoise. The provision of the 150m buffer area should retain areas important for tortoise breeding.
- Large Eucalypt trees, which some felt should be relocated where possible. Subsequent investigation into this possibility revealed that the tree would not survive such translocations.
- Native mammals, such as the Quenda, which people thought should be subject to a relocation program if practicable. LandCorp will be implementing such a program in cooperation with CALM if determined to be feasible by appropriate experts with the department.

#### **14.6 PROPONENT COMMITMENTS FOR ABORIGINAL HERITAGE**

The proponent has made the following commitment in relation to Aboriginal Heritage:

- Protect the camp site within South Lake buffer area and four scar trees in Public Open Space.
- Remove two scar trees not able to be retained in Lot 502 to area of Regional Open Space (South Lake buffer) as approved under s18 of the Aboriginal Heritage Act.
- Prepare and implement a contingency plan in case further artefactual materials of Aboriginal heritage importance are discovered during construction.

#### **14.7 OUTCOME**

LandCorp has addressed and consulted with key member of the local Nyoongar community on all spiritual and environmental issues raised by the Nyoongar community during the course of the Aboriginal Site Identification Survey. The registered Aboriginal site and the majority of scar trees will be retained in Public Open Space, with two trees outside of these areas relocated into the Regional Open Space (South Lake buffer) for display.

A contingency plan will be in place in the event of uncovering further archaeological material.



## **15. ENVIRONMENTAL MANAGEMENT PLAN**

### **15.1 MANAGEMENT DURING CONSTRUCTION**

The proponent will prepare a Development Environmental Management Plan to be implemented prior to the commencement of earthworks at Lot 502, which will contain a:

- Rehabilitation Plan
- Dieback and Weed Management Plan;
- Landscape Protection and Management Plan;
- Fauna Management Plan;
- Drainage and Groundwater Management Plan;
- Site Contamination Plan;
- Dust Management Plan;
- Noise Management Plan; and
- Traffic Management Plan.

A Contingency Plan for uncovering of Aboriginal archaeological material will also be prepared.

### **15.2 MANAGEMENT OF INDUSTRIAL ESTATE**

Although eventually the estate will not be under the management authority of LandCorp, until occupancy has been filled at the estate, the following management plans shall be in place, prepared in consultation with CALM and DEP, as described previously in this document:

- Dieback and Weed Management Plan;
- Site Contamination Plan; and
- Landscape Protection and Management Plan.

A separate plan for the potential rehabilitation program for the southern area of the South lake reserve would most likely be prepared by CALM in consultation with LandCorp and is not addressed in detail here. The program may however adopt many of the concepts described below.

### **15.3 CONCEPTUAL BUFFER REHABILITATION PLAN**

#### ***Rehabilitation objectives***

- To re-establish native vegetation in the degraded areas contained within the 150 m buffer area between South Lake and the Bibra Lake Industrial Estate such that it is consistent with the original vegetation communities located around the lake.
- To rejuvenate the wetland habitat to the west of South Lake and re-establish suitable fauna habitat in degraded areas within the 150 m buffer area between South Lake and the Bibra Lake Industrial Estate.
- To establish native gardens in the estate using local species and utilising best practice rehabilitation techniques to maximise the potential of the existing seed stock and plant material being removed during the estate development.

### 15.3.1 Description

The degraded areas contained within the 150 m buffer area west of South Lake will be rehabilitated as part of LandCorp's environmental commitments to the estate development.

Prior to topsoil placement, earthworks will be undertaken at the boundary of the degraded area within the 150 m buffer. Such works will take the form of earth bunds to act as aesthetic, sightline, and surface drainage control measures (see Section 8.5.2). The additional soil used to construct these bunds will be the underlying soils of areas cleared and levelled during the first stage of the development. Topsoil removed from these areas will be subsequently placed over these bunds to utilise the existing seed banks in the soils and maximise the establishment of vegetation. The area pertaining to Aboriginal Site SO1289, as listed with the AAD and described in Section 14.1 will be avoided and the bunds designed around this site.

The rehabilitation of the buffer will commence as part of the initial site works of the estate to increase the potential for the buffer to compensate for loss of habitat caused by the development of the other vegetated areas. Development will be timed such that topsoil removal and placement takes place in late summer / early autumn to maximise the potential for seedlings to germinate over winter and spring in the rehabilitation area.

The establishment of native gardens will commence following Stage Two of the development, once tenancy increases and it is clear what land will be available for the establishment of such gardens. Soil and plant material from areas subsequently cleared during the remaining stages will be used to establish these garden areas along edges and frontage of lots and along road verges.

### 15.3.2 Factors affecting revegetation

The revegetation program will recognise the complex relationships between vegetation community types, landform topography, soil characteristics and hydrological function. Subtle differences in surface topography, altitude, slope incline and direction, soil compaction and impedance contribute to variability in soil moisture conditions at any given site, and consequently will also influence vegetation establishment outcomes in the long term. Lower lying areas in proximity to South Lake will be revegetated with more phreatophytic (groundwater dependent) species such as *Eucalyptus rudis* (Flooded Gum) while the more elevated degraded areas will contain principally more dryland species such as *E. marginata* (Jarrah).

The presence of *Phytophthora* in soils may decrease the success of re-establishing vulnerable species. Resistant plant species should therefore be included in revegetation projects within Dieback uninterpretable areas.

### 15.3.3 Baseline information

Information collected and studies conducted in the PER process will serve as baseline information on which to establish a rehabilitation plan and set performance criteria. Bennett Environmental Consulting (2001) has provided mapping of the existing vegetation communities in Lot 502 and a description of their relationship to soils, topography and proximity to South Lake. The report also contains a detailed list of species recoded in Lot 502.

Bamford (2002) have also provided a description of material of importance to fauna for habitat such as old logs and wetland vegetation.



### 15.3.4 Best practice rehabilitation techniques

The rehabilitation of the South Lake buffer is likely to involve the following techniques considered as best practice in the mining industry, which is considered a suitable standard considering the importance of increasing the protection around South Lake;

- Removal of topsoil during the earthworks following clearing and direct placement onto highly degraded areas in buffer. The surface 5 to 10 cm of topsoil should be stripped and immediately placed into prepared areas in the buffer areas to be rehabilitated. This layer of soil is rich in seed stock and its viability is increased by directly placing on the areas to be rehabilitated. The land can be pre-prepared by removing the cover of weeds. The freshly placed topsoil should be subsequently scarified.
- Collection of local seed from vegetation before clearing (typically in summer) or in nearby similar vegetation to maintain local genetic diversity in vegetation. Seed stock to be used for direct seeding.
- LandCorp will also assess the practicality of using the technique of 'block translocating' for the rehabilitation of the South Lake buffer and for the establishment of native gardens in the estate. In contrast to topsoil stripping, this technique involves excavating blocks of topsoil to 40 cm depth, removed in sections from uncleared areas, with plant stems and roots intact. These are directly placed onto pre-prepared areas, which will typically involve some soil excavation, such that the 'blocks' will fit into the natural contours of the landscape. Recruitment of seedlings from this technique has been shown to be relatively high and rapid from this method.
- Salvaging materials – a component of the clearing procedures will be the salvaging of fauna habitat (logs) and collection of vegetation debris (brush and branches) for placement back into the buffer area to encourage fauna and flora recruitment. Brush cover placement in the degraded buffer area will decrease the risk of erosion, dust generation, and increase the rate of revegetation. Brush cover can also be a valuable source of seed.
- Transplanting of small mature tree or shrub species from areas to be cleared into rehabilitation areas where practicable and where other methods are likely or shown to be unproductive following monitoring of rehabilitation performance).

### 15.3.5 Monitoring and assessment of performance

Performance indicators for the success of rehabilitation will be established in consultation with DEP and CALM. The rehabilitation area will be monitored after 6 months, 12 months, and annually for ten years or before, if DEP and CALM are satisfied with the performance of the rehabilitation. If monitoring or regulatory advice indicates that the rehabilitation is not meeting performance criteria, contingency measures will be implemented. Depending of the level of further work required, these contingency measures will most likely involve nursery grown seedling plantings, possible further hand seeding, and weed removal.

## 15.4 PROPONENT COMMITMENTS

LandCorp has made a number of commitments for this proposal that relate to both the construction and operation phases of the proposal. These commitments will be included in the management plans described in this document. Table 14 contains a summary of proponent commitments.

Table 14 Summary of commitments

No	Topic	Objective	Action	Timing	Advice
1	Flora and vegetation	To protect South Lake from the potential impacts of development by maintaining a separation between the proposal and South Lake	Provide a 150 m buffer strip between development on Lot 502 and South Lake to be vested in a suitable management authority as an extension to the existing South lake Reserve.  Buffer to be fenced off from estate before commencement of earthworks.	Before construction	DEP CALM, City of Cockburn
2	Development Environmental Management Plan (DEMP)	To minimise environmental impacts from implementation of the proposal and enhance the environmental values of the portion of the South Lake buffer on Lot 502.	To prepare a DEMP which addresses the following: <ul style="list-style-type: none"> <li>• Rehabilitation plan for degraded areas (up to 6ha) in the buffer including fauna habitat restoration techniques, such as log placement and niche creation</li> <li>• Dieback and weed management plan</li> <li>• Landscape Protection and Management Plan to ensure landscape value of Beeliar Regional Park and South are protected, to include <ul style="list-style-type: none"> <li>• natural landscaping program as part for the establishment of native gardens within the estate</li> <li>• retention of the area containing a stand of tall Tuarts (<i>E. gomphocephala</i>) near Spearwood Avenue entrance as Public Open Space as shown in Figure 3.</li> </ul> </li> <li>• provision of replacement fauna habitat using techniques such as log placement and niche creation.</li> <li>• mapping of existing vegetation to be retained</li> <li>• screening establishment plan</li> <li>• bund design and revegetation of buffer area in consultation with CALM.</li> <li>• allowable building heights and colours for estate</li> <li>• Fauna Management Plan to include a Quenda relocation program and possibly relocation programs for other mammals if deemed feasible.</li> <li>• Drainage and Groundwater Management Plan to include stormwater management plan as pertaining to EPA Guidance No. 26 (EPA 1999) and groundwater monitoring program.</li> <li>• Site Contamination Management Plan</li> <li>• Dust Management Plan</li> <li>• Noise Management Plan</li> <li>• Traffic Management Plan</li> </ul>	Before construction	DEP, WRC, CALM, City of Cockburn
3	DEMP	Achieve objective of Commitment 2	Implement DEMP	During and following construction	DEP CALM, City of Cockburn
4	Flora, Fauna and South Lake	Potential to further offset loss of vegetation from Lot 502 and increase conservation value of South Lake.	Establish collaborative rehabilitation program with CALM for area south of South Lake.	ASAP, initial discussion has already taken place.	DEP CALM, City of Cockburn



No	Topic	Objective	Action	Timing	Advice
5	Public access	To control public access into Beeliar Regional Park from estate and rehabilitation area.	Provide signage directing to suitable entry points to South Lake area consistent with CALM specifications.	During and following construction	CALM
6	Aboriginal Heritage sites	To protect Aboriginal heritage sites	Protect the following Archeological sites <ul style="list-style-type: none"> <li>• camp site within South Lake buffer area and four scar trees in Public Open Space</li> <li>• Remove two scar trees not able to be retained in Lot 502 to area of Public Open Space in south western corner of Lot 502 as approved under s18 of the Aboriginal Heritage Act.</li> <li>• Prepare and implement a contingency plan in case further artefactual materials of Aboriginal heritage importance are discovered during construction</li> </ul>	During and following construction	DIA

## 16. CONCLUSIONS

The key environmental factors identified by the proponent, the EPA, and the community, in regard to the development of an industrial estate in Lot 502 North Lake Road, Phoenix Road and Sudlow Road, in the suburb of Bibra Lake are:

- Vegetation and flora – Regional biodiversity, remnant vegetation issues, conservation flora.
- Fauna – Loss of habitat, affect on local and regional fauna values.
- South Lake – proximity to industrial land, buffering issues, loss of associated upland vegetation, and drainage and water quality.
- Landscape and visual amenity.
- Soil and groundwater contamination.
- Aboriginal heritage values.

The community consultation program indicated that the most important issues regarding this proposal for community and environmental groups were related to the role of the upland vegetation in Lot 502 to local fauna, particularly those species associated with South Lake, the visual and environmental effect of removing vegetation from the ridge to the west of South Lake, the provision of a buffer between South Lake and the industrial estate, and Aboriginal heritage issues.

### 16.1 ENVIRONMENTAL COSTS AND BENEFITS

#### 16.1.1 Costs

The major environmental cost associated with the development of Bibra Lake Industrial Estate in Lot 502 is the clearing of 64 ha of mostly Jarrah-Banksia woodland, representative of the Karrakatta Complex - Central and South, west of South Lake. The clearing of vegetation will result in a decrease of 1.1% of the current extent of the Karrakatta Complex - Central and South in the Perth Metropolitan Region. Approximately 2,590 ha of the complex are protected under Bush Forever, compared to the 64 ha being cleared for this proposal.

The clearing of vegetation will mean a loss of representation of upland habitat in the vicinity of South and Bibra Lakes. The loss of upland vegetation will cause local (Lot 502 and South Lake) decline in abundance and distribution of some local fauna in proportion to the area cleared, through loss of habitat and subsequent increased susceptibility to predation. Some of the affected species are regionally significant and/or specially protected under legislation or Priority listing. The rehabilitation of degraded areas within the buffer area to be retained between the estate and South Lake will compensate for some of this loss. The buffer area makes up a significant proportion (25-30%) of an area identified as having highest value to fauna in Lot 502. The rehabilitation of the southern area of the South Lake reserve and creation of fauna habitat will also replace a proportion of that cleared for development and in an area of potentially high importance to fauna. The implementation of the described measures should decrease the local declines in species abundance and minimise the risk of some susceptible species being lost locally or sub-regionally (City of Cockburn and adjacent areas). The regional (Perth Metropolitan Region) abundance of species is not expected to be significantly affected by the proposal.

The loss of upland vegetation in Lot 502 will affect local visual amenity with a change in the vista to the west of South Lake from intact woodland to a mixture of trees and buildings established within the industrial estate. The impact of the estate on local visual amenity will be decreased by retaining



vegetation within 150m of South Lake and constructing a bund on which to establish trees. In the medium to long term, this will provide a greater visual buffer between South Lake and the estate.

The development of the estate reduces the size of an upland area of vegetation between the lake and industrial activity to the west. The proposed estate however poses no significant threat to the water quality or water levels of South Lake. Retaining vegetation and rehabilitating degraded areas will serve to sufficiently protect the lake from wind blown dust from the south west.

Formal agreement has been made with local Aboriginal representatives for the retention of vegetation within the South Lake buffer area. Two scar trees of cultural importance to local Aborigines will be relocated from areas to be cleared in accordance with the agreement with local representatives and Section 18 of the Aboriginal Heritage Act. The campsite and remaining scar trees will not be disturbed during the development and operation of the estate.

Development works on the site will introduce a temporary noise source to the local environment. This shall however remain within guideline levels. The introduction of some traffic associated with estate construction will occur on local major roads. Dust management within the development area will prevent the dust generation being a problem to local residents.

There is likely to be a small increase in traffic on local major roads as a result of the occupancy of the industrial estate. However, Phoenix Road is anticipated to have a substantial decrease in traffic volume.

### **16.1.2 Benefits**

There are a number of potential environmental benefits that may not have occurred without the implementation of this proposal:

- Rehabilitation of 4 to 5 ha of completely degraded vegetation around the south-western side of South Lake, which will increase the conservation value of the lake.
- Establishment of a collaborative rehabilitation program with CALM for an area of up to 10 ha on the south side of South Lake. This would improve the condition of an area of potentially high importance to fauna, improve the condition of vegetation around the lake, and potentially increase the conservation value of the lake.
- Improvement in the condition of an area of potentially high importance to local fauna adjacent to South Lake. This is particularly so for fauna directly associated with the lake such as tortoise, bandicoots, and frogs.
- Establishment of a formal buffer area around the western side of South Lake, which will increase the conservation value of the lake.
- Addition of approximately 6 ha of remnant and rehabilitated vegetation into Beeliar Regional Park.
- Remediation of localised site contamination within Lot 502.
- Cessation of wastewater disposal in Lot 502.
- Reduction in the volume of traffic on Phoenix Road through the establishment of link roads between North Lake Road and Sudlow Road and Spearwood Avenue through the estate.

## **16.2 ENVIRONMENTAL RISKS AND MANAGEABILITY**

The approach taken in this environmental review has been based on a risk assessment approach to characterise environmental factors, determine potential impacts and develop mitigation measures.

The proponent has considerable recent experience in managing the construction of similar projects and this experience is anticipated to lead to a greater certainty in achieving desirable environmental outcomes.

The environmental aspects of the proposal will be managed through the implementation of the Development Environmental Management Plan, for aspects of the proposal related to the construction of the estate, the Site Contamination Plan and Landscape and Protection and Management Plan, and the implementation of environmental management commitments as described in this document.

The proponent has extensively consulted with the community (including Government agencies) to scope the potential impacts of the proposal and to determine the significance of environmental issues and the acceptability of mitigation. This process substantially improves the likelihood that all significant environmental issues have been identified, investigated, mitigated and offset as far as practicable.



## 17. REFERENCES

### *Availability*

References marked with an asterisk (\*) preceding the Author are available from LandCorp to members of the public for review. Interested persons should contact:

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PERTH, WA 6000

Phone: (08) 9482 7478

Facsimile: (08) 9482 7484

Email: john.silla@landcorp.com.au

### *Reference list*

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## **APPENDIX 1**

**MAIL OUT TO RESIDENTS OF ST  
PAUL'S ESTATE**

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### **An invitation to comment on LandCorp's plans for Bibra Lake Estate**

LandCorp proposes to develop a high quality 89 ha general industrial estate at Bibra Lake in the area bounded by Phoenix Road, North Lake Road, Sudlow Road and the disused rail reserve to the south. As part of its consultation with the community, residents of the St Paul's Estate are invited to comment on the proposal.

The aim is to develop a high quality industrial estate, incorporating best practice in land planning and development, in an economically and environmentally sustainable manner. The land to be developed is zoned industrial under the Metropolitan Region Scheme and General Industry under City of Cockburn's Town Planning Scheme No.2. The estate is proposed to meet the increasing need for industrial land and employment opportunities in the area over the next 10 years.

On the reverse side of this page is an aerial photograph of the development site and surrounding areas. The area bordered by the black line shows the full extent of the land proposed to be developed.

### **What assessment has been made so far?**

The Environmental Protection Authority (EPA) is the Government body responsible for assessing environmental impacts of developments. The EPA initially decided that the level of assessment for the proposal should be an Environment Protection Statement (EPS). As part of the EPS, LandCorp outlined how it would develop the site, the potential environmental impacts and how these would be managed.

While the EPA accepted LandCorp's environmental commitments, public submissions led to this decision being reviewed by an independent Appeals Convenor. As a result, the level of environmental assessment was increased to a Public Environmental Review (PER).

LandCorp has engaged Welker Environmental Consultancy to assist it in preparing the PER. As part of the review process, members of the wider community with an interest in the development, and conservation and community groups, are being consulted to gather their views regarding potential impacts of the proposal and how these can be managed.

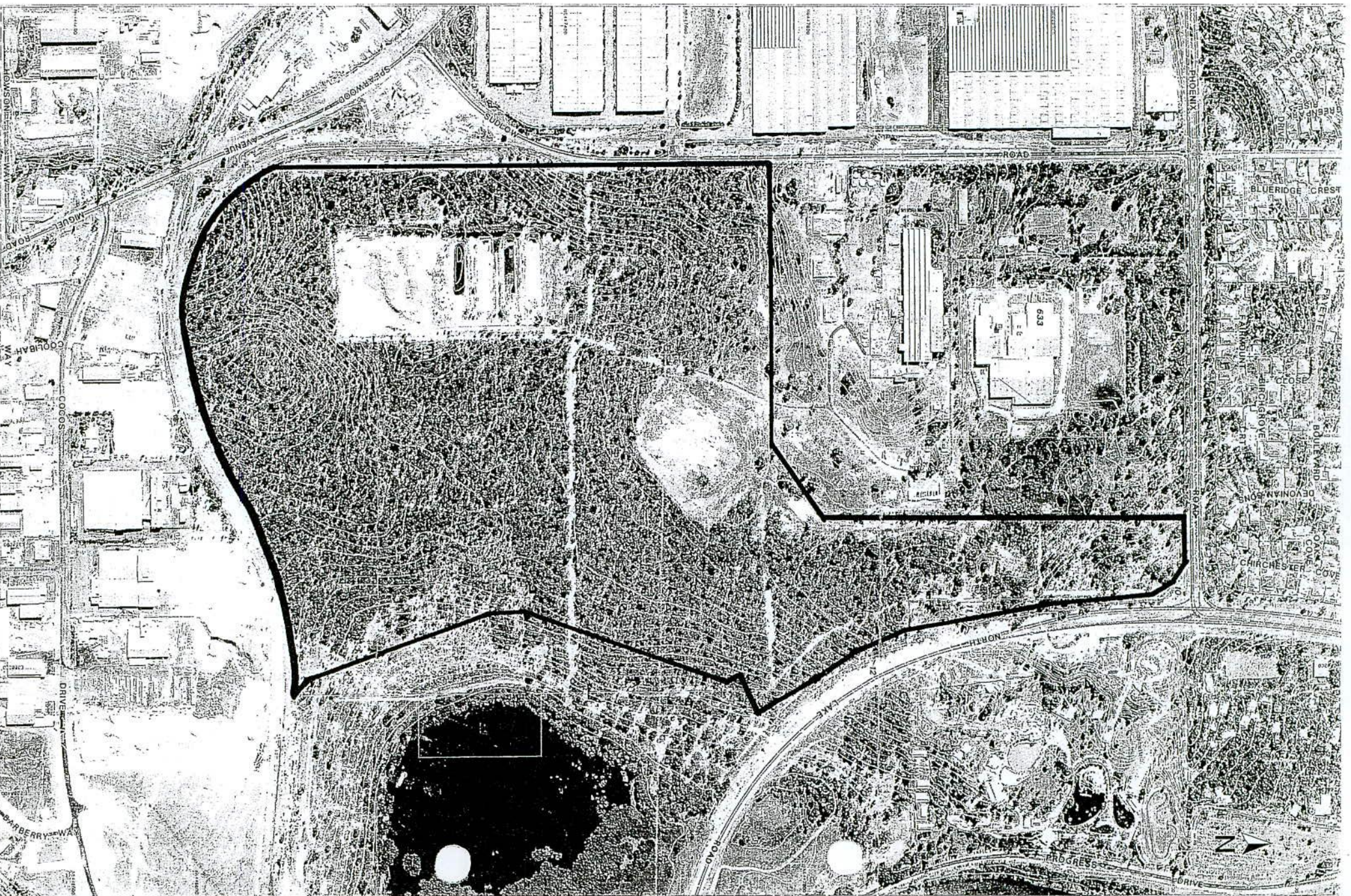
### **How can you find out more and have your say?**

Experienced community facilitator Ross Colliver is conducting the community consultation. If you wish to comment on the proposal, or obtain more information, phone him on 9386 1412 during business hours or by e-mail, [colliver@mpx.com.au](mailto:colliver@mpx.com.au).

Your input will assist LandCorp in its consideration of development options for the proposed estate. Community members will have the opportunity to review the PER document once it has been released by the EPA, and, if desired, can lodge a submission during the public submission period.



AMCOR SITE  
 BIBRA LAKE  
 1:2000 DIGITAL ORTHOPHOTO MAP  
 SOURCE DATA  
 DATE 12/01/00  
 SCALE 1:2000  
 PROJECT NO. 1000000000  
 DRAWN BY 1000000000  
 CHECKED BY 1000000000  
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 DATE 12/01/00



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## **APPENDIX 2**

### **FLORA LIST**

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**Table 1: List of Rare, Priority and Significant Plant Taxa that may occur in the area (From Weston, 2000)**

<b>Taxon Name</b>	<b>Code</b>	<b>Flowers</b>	<b>Habit</b>	<b>Habitat</b>
<i>Caladenia huegelii</i>	DRF	Aug-Oct	Orchid	Deep sandy lower slopes
<i>Diuris micrantha</i>	DRF	Aug-Sep	Orchid	Winter-wet sedge flats
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle	P1	May-Sep	Shrub	Winter-wet sandy to clay soil
<i>Trueterococcus paniculatus</i>	P1	Nov-Dec	Herb	Sandy winter-wet flats
<i>Aotus cordifolia</i>	P3	Aug-Dec	Shrub	Winter-wet thickets
<i>Jacksonia sericea</i>	P3	Dec-Feb	Prostrate shrub	Sand
<i>Phlebocarya pilosissima</i> subsp. <i>pilosissima</i>	P3	Aug-Sep	Grass-like	Sand often with lateritic gravel
<i>Anthotium junciflorum</i>	P4	Dec-Mar	Grass-like	Winter-wet, lowlying flats
<i>Dodonaea hackettiana</i>	P4	Jul-Oct	Shrub, small tree	Sand, or with limestone
<i>Microtis media</i> subsp. <i>quadrata</i>	P4	Dec-Jan	Orchid	Clayey winter-wet swamps
<i>Lysinema elegans</i>	p,s,e	Oct-Nov	Shrub	Sand
<i>Villarsia violifolia</i>	p,s	Nov-Feb	Prostrate herb	Winter-wet depressions

#### EXPLANATION OF CODES

<b>Code</b>	<b>Code Declared Rare and Priority Flora Categories</b>
R	DRF (Declared Rare Flora) -Extant Taxa. Taxa, which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X	DRF (Declared Rare Flora) -Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.
p	Taxa considered to be poorly reserved
s	Significant populations
e	Taxa endemic to the Swan Coastal Plain



**Table 2: List of Vegetation Units in Lot 502**

Abbreviation	Vegetation Unit
Em,Ba	Closed Forest to Woodland of <i>Eucalyptus marginata</i> subsp. <i>marginata</i> and <i>Banksia attenuata</i> with occasional to dense <i>Corymbia calophylla</i> over an Open Heath dominated by <i>Xanthorrhoea preissii</i> or <i>Hibbertia hypericoides</i>
Hp,Jf,Kg	Tall Open Scrub to Tall Shrubland of <i>Hakea prostrata</i> , <i>Jacksonia furcellata</i> and <i>Kunzea glabrescens</i> over a Low Open Shrubland over a Grassland dominated by <i>*Briza maxima</i>
Er,Bg	Open Woodland of <i>Eucalyptus rudis</i> and <i>Banksia grandis</i> over an Open Shrubland of <i>Hakea prostrata</i> over a Herbland of weeds
Degraded	Vegetation could not be assessed

NOTE: \*indicates the plant is an introduced "weed" species

**Table 3: List of Plant Taxa in the Different Vegetation Units**

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
AIZOACEAE	<i>*Carpobrotus edulis</i>	+	+	+	+
AMARANTHACEAE	<i>Ptilotus polystachyus</i>			+	
ANACARDIACEAE	<i>*Schinus teberinthifolia</i>	+			
ANTHERICACEAE	<i>Caesia parviflora</i>			+	
	<i>Chamaescilla corymbosa</i>			+	
	<i>Dichopogon preissii</i>			+	
	<i>Laxmannia squarrosa</i>			+	+
	<i>Sowerbaea multiflora</i>			+	
	<i>Thysanotus manglesii</i>			+	+
APIACEAE	<i>Eryngium rostratum</i>			+	
	<i>Hydrocotyle callicarpa</i>	+			
	<i>Trachymene pilosa</i>		+	+	+
	<i>Xanthosia huegelii</i>			+	
ARACEAE	<i>*Zantedeschia aethiopica</i>			+	+
ASPHODELACEAE	<i>*Trachyandra divaricata</i>	+		+	
ASTERACEAE	<i>*Arctotheca calendula</i>	+	+	+	+
	<i>*Conyza bonariensis</i>			+	
	<i>Cotula australis</i>	+			
	<i>*Gamochaeta falcata</i>			+	
	<i>Gnephosis angianthoides</i>		+		
	<i>*Hypochaeris glabra</i>	+	+	+	+
	<i>*Lactuca serriola</i>	+			
	<i>Podolepis gracilis</i>			+	
	<i>Podotheca angustifolia</i>			+	+
	<i>Quinetia urvillei</i>			+	+
	<i>Siloxerus humifusus</i>			+	
	<i>*Sonchus asper</i>	+			+
	<i>*Sonchus oleraceus</i>	+		+	
	<i>*Urospermum picroides</i>			+	
	<i>*Ursinia anthemoides</i>	+		+	+
BRASSICACEAE	<i>*Brassica tournefortii</i>			+	
	<i>*Heliophila pusilla</i>			+	+
	<i>*Raphanus raphanistrum</i>			+	

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
CARYOPHYLLACEAE	<i>*Petrorhagia velutina</i>	+		+	+
	<i>*Polycarpon tetraphyllum</i>	+		+	
	<i>*Silene gallica</i>	+		+	+
	<i>*Stellaria media</i>		+	+	
CASUARINACEAE	<i>Allocasuarina fraseriana</i>		+	+	
CENTROLEPIDACEAE	<i>Centrolepis drummondiana</i>		+	+	
COLCHICACEAE	<i>Burchardia umbellata</i>			+	
CRASSULACEAE	<i>Crassula colorata</i>	+	+	+	+
	<i>*Crassula decumbens</i>	+	+	+	
CYPERACEAE	<i>Isolepis marginata</i>			+	
	<i>Lepidopserma squamatum</i>			+	
	<i>*Leptospermum laevigatum</i>				+
CYPERACEAE	<i>Mesomelaena pseudostygia</i>			+	+
	<i>Schoenus clandestinus</i>			+	
	<i>Tetraria octandra</i>			+	
DASYPOGONACEAE	<i>Acanthocarpus preissii</i>			+	
	<i>Dasypogon bromeliifolius</i>			+	
	<i>Lomandra caespitosa</i>			+	
DILLENACEAE	<i>Hibbertia huegelii</i>			+	
	<i>Hibbertia hypericoides</i>			+	
	<i>Hibbertia racemosa</i>			+	
DROSERACEAE	<i>Drosera erythrorhiza</i>			+	
	<i>Drosera glanduligera</i>		+	+	+
	<i>Drosera macrantha</i>			+	
	<i>Drosera pallida</i>			+	
	<i>Drosera stolonifera</i>			+	
EPACRIDACEAE	<i>Astroloma pallidum</i>			+	
	<i>Conostephium pendulum</i>			+	
	<i>Leucopogon propinquus</i>			+	+
EUPHORBIACEAE	<i>*Euphorbia peplus</i>	+	+	+	
	<i>*Euphorbia terracina</i>			+	
	<i>Phyllanthus calycinus</i>			+	
	<i>Poranthera microphylla</i>		+	+	+
	<i>*Ricinus communis</i>	+		+	
FUMARIACEAE	<i>Fumaria capreolata</i>	+		+	
GENTIANACEAE	<i>*Cicendia filiformis</i>	+			
GERANIACEAE	<i>*Erodium botrys</i>	+	+		
	<i>*Geranium molle</i>		+		
	<i>*Pelargonium capitatum</i>	+	+	+	+
GOODENIACEAE	<i>Scaevola canescens</i>			+	+
HAEMODORACEAE	<i>Anigozanthos humilis</i>			+	
	<i>Anigozanthos manglesii</i>			+	+
	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>			+	+
	<i>Phlebocarya ciliata</i>			+	
IRIDACEAE	<i>*Freesia hybrid</i>			+	
	<i>*Gladiolus caryophyllaceus</i>	+		+	+
	<i>*Moraea flaccida</i>		+	+	



FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
	<i>Patersonia occidentalis</i>			+	+
	* <i>Romulea rosea</i>	+		+	
JUNCACEAE	* <i>Juncus capitatus</i>	+			
	<i>Juncus pallidus</i>	+			
	<i>Luzula meridionalis</i>			+	
MIMOSACEAE	<i>Acacia cyclops</i>		+		+
	* <i>Acacia dealbata</i>	+			
	<i>Acacia huegelii</i>				+
	<i>Acacia pulchella</i> var. <i>pulchella</i>			+	+
	<i>Acacia saligna</i>			+	+
MYRTACEAE	<i>Calytrix angulata</i>				+
	* <i>Chamelaucium uncinatum</i>			+	
	<i>Corymbia calophylla</i>			+	
	* <i>Eucalyptus camaldulensis</i>	+			
	<i>Eucalyptus gomphocephala</i>			+	
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>			+	
	<i>Eucalyptus rudis</i>		+		
	<i>Hypocalymma robustum</i>			+	+
	<i>Kunzea glabrescens</i>				+
OLEACEAE	* <i>Olea europaea</i>		+		
ORCHIDACEAE	<i>Caladenia flava</i>		+	+	
	<i>Caladenia latifolia</i>		+	+	
	<i>Caladenia longicauda</i> subsp. <i>calcigena</i>			+	+
	<i>Diuris corymbosa</i>			+	
	<i>Pterostylis vittata</i>			+	
OXALIDACEAE	* <i>Oxalis pes-caprae</i>	+		+	
	* <i>Oxalis purpurea</i>			+	
PAPILIONACEAE	<i>Bossiaea eriocarpa</i>			+	
	<i>Daviesia divaricata</i>		+	+	+
	<i>Daviesia nudiflora</i>			+	
	<i>Gompholobium tomentosum</i>			+	+
	<i>Hardenbergia comptoniana</i>			+	+
	<i>Isotropis cuneiformis</i>			+	
	<i>Jacksonia furcellata</i>		+		+
	<i>Jacksonia sternbergiana</i>			+	
	<i>Kennedia prostrata</i>			+	+
	* <i>Lotus suaveolens</i>	+			
	* <i>Lupinus consentinii</i>			+	
	* <i>Melilotus indicus</i>	+			
	<i>Nemcia capitata</i>			+	+
	* <i>Trifolium arvense</i>	+	+		
	* <i>Trifolium campestre</i>		+	+	+
	* <i>Trifolium dubium</i>	+		+	
	* <i>Vicia hirsuta</i>	+			
	* <i>Vicia sativa</i>	+	+	+	

FAMILY	TAXA	VEGETATION COMMUNITY			
		Degraded	Er,Bg	Em,Ba	Hp,Jf,Kg
PHORMIACEAE	<i>Dianella revoluta</i>		+	+	+
PHYTOLACCACEAE	* <i>Phytolacca octandra</i>	+			
PINACEAE	* <i>Pinus pinaster</i>	+			
POACEAE	* <i>Aira caryophyllea</i>		+	+	+
	<i>Austrodanthonia occidentalis</i>			+	
	* <i>Avena barbata</i>	+	+	+	
	* <i>Briza maxima</i>	+		+	+
	* <i>Briza minor</i>				+
	* <i>Bromus diandrus</i>	+	+	+	
	* <i>Cynodon dactylon</i>	+			
POACEAE	* <i>Ehrharta calycina</i>	+	+	+	+
	* <i>Ehrharta longiflora</i>		+	+	
	* <i>Eragrostis curvula</i>	+		+	
	* <i>Lagurus ovatus</i>	+	+	+	+
	* <i>Pennisetum setaceum</i>	+			
	* <i>Triticum aestivum</i>	+			
	* <i>Vulpia myuros</i> var. <i>myuros</i>	+	+	+	+
POLYGONACEAE	* <i>Acetosella vulgaris</i>		+		
PORTULACAEAE	<i>Calandrinia granulifera</i>		+	+	
PRIMULACEAE	* <i>Anagallis arvensis</i>	+	+	+	
PROTEACEAE	<i>Banksia attenuata</i>		+	+	
	<i>Banksia grandis</i>		+	+	
	<i>Banksia ilicifolia</i>			+	
	<i>Banksia menziesii</i>			+	
	<i>Hakea prostrata</i>		+	+	+
	<i>Persoonia sacculata</i>				+
	<i>Petrophile linearis</i>			+	
	<i>Petrophile macrostachya</i>			+	
	<i>Stirlingia latifolia</i>			+	
	<i>Synaphea spinulosa</i>				+
	<i>Xylomelum occidentale</i>			+	
RESTIONACEAE	<i>Desmocladius flexuosus</i>			+	
	<i>Lyginia barbata</i>			+	+
RUBIACEAE	* <i>Galium murale</i>	+	+	+	+
RUTACEAE	<i>Philotheca spicata</i>			+	
SCROPHULARIACEAE	* <i>Zaluzianskya divaricata</i>				+
SOLANACEAE	* <i>Nicotiana glauca</i>	+			
	* <i>Solanum americanum</i>	+			
	* <i>Solanum nigrum</i>	+			
STYLIDIACEAE	<i>Stylidium brunonis</i>				+
	<i>Stylidium piliferum</i>			+	+
	<i>Stylidium schoenoides</i>			+	
THYMELAEACEAE	<i>Pimelea rosea</i>			+	
XANTHORRHOEACEAE	<i>Xanthorrhoea brunonis</i>		+	+	
	<i>Xanthorrhoea preissii</i>			+	
ZAMIACEAE	<i>Macrozamia riedlei</i>		+	+	
	<b>Grand Total</b>	<b>52</b>	<b>44</b>	<b>131</b>	<b>56</b>



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## **APPENDIX 3**

### **FAUNA LISTS FOR STUDIES OF LOT 502 (BAMFORD 2002)**

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Table 1 Frog and reptile species known from the Swan Coastal Plain of the Perth region (south of the Swan River) and which were either observed (\*) or are expected (+) on the site. Species for which no suitable habitat is available, or that are extinct in the region, are not included

Species	Status
<b>Myobatrachidae</b> (ground frogs)	
Glauert's Froglet <i>Crinia (Ranidella) glauerti</i>	*
Sandplain Froglet <i>Crinia (Ranidella) insignifera</i>	*
Moaning Frog <i>Heleioporus eyrei</i>	+
Pobblebonk <i>Limnodynastes dorsalis</i>	+
Turtle Frog <i>Myobatrachus gouldii</i>	+
Guenther's Toadlet <i>Pseudophryne guentheri</i>	+
<b>Hylidae</b> (tree frogs)	
Slender Tree Frog <i>Litoria adelaidensis</i>	+
Motorbike Frog <i>Litoria moorei</i>	*
<b>Chelidae</b> (side-neck tortoises)	
South-West Long-necked Tortoise <i>Chelodina oblonga</i>	+
<b>Gekkonidae</b> (geckoes)	
Southern Spiny-tailed Gecko <i>Diplodactylus spinigerus</i>	+
Marbled Gecko <i>Phyllodactylus marmoratus</i>	+
<b>Pygopodidae</b> (legless lizards)	
Sand-Plain Worm-Lizard <i>Aprasia repens</i>	+
Fraser's Legless Lizard <i>Delma fraseri</i>	+
Burton's Legless Lizard <i>Lialis burtonis</i>	+
Common Scalefoot <i>Pygopus lepidopus</i>	+
<b>Agamidae</b> (dragon lizards)	
Western Bearded Dragon <i>Pogona minor</i>	+
Sandhill or Heath Dragon <i>Tympanocryptis adelaidensis</i>	+
<b>Varanidae</b> (monitors or goannas)	
Gould's Sand Goanna <i>Varanus gouldii</i>	*
Rosenberg's Goanna <i>Varanus rosenbergi</i>	+
Black-headed Tree Goanna <i>Varanus tristis</i>	+
<b>Scincidae</b> (skink lizards)	
South-West Cool Skink <i>Acritoscincus (Bassiana) trilineatum</i>	+
Fence Skink <i>Cryptoblepharus plagiocephalus</i>	*
West Coast Ctenotus <i>Ctenotus fallens</i>	+
<i>Ctenotus impar</i>	+
Western Limestone Ctenotus <i>Ctenotus australis (lesueurii)</i>	+
King's Skink <i>Egernia kingii</i>	+
Mourning Skink <i>Egernia luctuosa</i>	+
Salmon-bellied Skink <i>Egernia napoleonis</i>	+
Two-toed Earless Skink <i>Hemiergis quadrilineata</i>	*
West Coast Four-toed Lerista <i>Lerista elegans</i>	+
Perth Lined Lerista <i>Lerista lineata</i>	+
Worm Lerista <i>Lerista praepedita</i>	+
Dwarf Skink <i>Menetia greyii</i>	*
West Coast Morethia <i>Morethia lineocellata</i>	+



Species	Status
Dusky Morethia <i>Morethia obscura</i>	+
Western Bluetongue <i>Tiliqua occipitalis</i>	+
Bobtail <i>Tiliqua rugosa</i>	*
<b>Typhlopidae</b> (blind snakes)	
<i>Ramphotyphlops australis</i>	+
<b>Elapidae</b> (front-fanged snakes)	
Crowned Snake <i>Drysdalia coronata</i>	+
Black-naped Snake <i>Neelaps (Vermicella) bimaculatus</i>	+
Black-striped Snake <i>Neelaps (Vermicella) calonotus</i>	+
Western Tiger Snake <i>Notechis scutatus</i>	+
Dugite <i>Pseudonaja affinis</i>	*
Gould's Snake <i>Suta (Rhinoplocephalus) gouldii</i>	+
Jan's Bandy-Bandy <i>Simoselaps (Vermicella) bertholdi</i>	+
Narrow-banded Snake <i>Simoselaps (Vermicella) fasciolata</i>	+
Half-ringed Snake <i>Simoselaps (Vermicella) semifasciatus</i>	+
<b>Number of species observed or expected:</b>	
<b>Frogs:</b> 8	
<b>Reptiles:</b> 38	

Table2 Bird species known from the Swan Coastal Plain of the Perth region (south of the Swan River) and which were either observed (\*) or expected (+) on the site. Species for which no suitable habitat is available, such as many waterbirds, or that are extinct in the region, are not included. Introduced species (Int) are noted in the status column.

Species	Status
<b>Phasianidae</b> (pheasants and quails)	
Stubble Quail <i>Coturnix pectoralis</i>	+
<b>Anatidae</b> (ducks, geese and swans)	
Australian Shelduck <i>Tadorna tadornoides</i>	+
Pacific Black Duck <i>Anas superciliosus</i>	+
Grey Teal <i>Anas gibberifrons</i>	+
Australian Wood Duck <i>Chenonetta jubata</i>	*
<b>Ardeidae</b> (herons and egrets)	
White-faced Heron <i>Egretta novaehollandiae</i>	+
<b>Plataleidae</b> (ibis and spoonbills)	
Australian White Ibis <i>Threskiornis molucca</i>	*
<b>Accipitridae</b> (kites, hawks and eagles)	
Black-shouldered Kite <i>Elanus notatus</i>	+
Square-tailed Kite <sup>2</sup> <i>Lophoictinia isura</i>	+
Whistling Kite <sup>2</sup> <i>Haliastur spheurnus</i>	+
Brown Goshaw <sup>2</sup> k <i>Accipiter fasciatus</i>	+
Collared Sparrowhawk <sup>2</sup> <i>Accipiter cirrhocephalus</i>	+
Wedge-tailed Eagle <sup>2</sup> <i>Aquila audax</i>	+
Little Eagle <sup>2</sup> <i>Hieraaetus morphnoides</i>	*

<b>Species</b>	<b>Status</b>
<b>Falconidae</b> (falcons)	
Peregrine Falcon <sup>2</sup> <i>Falco peregrinus</i>	+
Australian Hobby <i>Falco longipennis</i>	*
Nankeen Kestrel <i>Falco cenchroides</i>	+
<b>Turnicidae</b> (button-quails)	
Painted Button-quail <sup>2</sup> <i>Turnix varia</i>	+
<b>Scolopacidae</b> (sandpipers)	
Common Sandpiper <i>Tringa hypoleucos</i>	+
<b>Charadriidae</b> (plovers and lapwings)	
Black-fronted Dotterel <i>Elseya melanops</i>	+
<b>Columbidae</b> (pigeons and doves)	
Rock Dove (feral pigeon) <i>Columba livia</i>	+ Int.
Spotted Turtle-Dove <i>Streptopelia chinensis</i>	* Int
Laughing Turtle-Dove <i>Streptopelia senegalensis</i>	* Int
Common Bronzewing <sup>1</sup> <i>Phaps chalcoptera</i>	+
<b>Cacatuidae</b> (cockatoos)	
Short-billed Black-Cockatoo <sup>2</sup> <i>Calyptorhynchus latirostris</i>	+
Corella <i>Cacatua</i> spp.	+ Int
Galah <i>Cacatua roseicapilla</i>	*
<b>Psittacidae</b> (lorikeets and parrots)	
Rainbow Lorikeet <i>Trichoglossus haematodus</i>	* Int
Purple-crowned Lorikeet <i>Glossopsitta porphyrocephala</i>	+
Red-capped Parrot <i>Purpureicephalus spurius</i>	*
Australian Ringneck (twenty-eight) <i>Bamardius zonarius</i>	*
Elegant Parrot <i>Neophema elegans</i>	+
<b>Cuculidae</b> (cuckoos)	
Pallid Cuckoo <i>Cuculus pallidus</i>	+
Fan-tailed Cuckoo <i>Cuculus pyrrhophanus</i>	+
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalis</i>	+
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>	+
<b>Strigidae</b> (hawk-owls)	
Southern Boobook Owl <i>Ninox novaeseelandiae</i>	+
<b>Tytonidae</b> (barn owls)	
Barn Owl <i>Tyto alba</i>	+
<b>Podargidae</b> (frogmouths)	
Tawny Frogmouth <i>Podargus strigoides</i>	+
<b>Apodidae</b> (swifts)	
Fork-tailed Swift <i>Apus pacificus</i>	+
<b>Halcyonidae</b> (forest kingfishers)	
Laughing Kookaburra <i>Dacelo novaeguineae</i>	* Int
Sacred Kingfisher <i>Todiramphus sanctus</i>	+
<b>Meropidae</b> (bee-eaters)	
Rainbow Bee-eater <i>Merops ornatus</i>	+
<b>Maluridae</b> (fairy-wrens)	
Splendid Fairy-wren <sup>1</sup> <i>Malurus splendens</i>	*



<b>Species</b>	<b>Status</b>
<b>Pardalotidae</b> (pardalotes)	
Spotted Pardalote <i>Pardalotus punctatus</i>	*
Striated Pardalote <i>Pardalotus striatus</i>	*
White-browed Scrubwren <i>Sericornis frontalis</i>	+
Weebill <i>Smicromis brevirostris</i>	*
Western Gerygone <i>Gerygone fusca</i>	*
Inland Thornbill <i>Acanthiza apicalis</i>	*
Western Thornbill <i>Acanthiza inornata</i>	+
Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i>	*
<b>Meliphagidae</b> (honeyeaters)	
Red Wattlebird <i>Anthochaera carunculata</i>	*
Little Wattlebird <i>Anthochaera chrysoptera</i>	+
Yellow-throated Miner <sup>2</sup> <i>Manorina flavigula</i>	+
Singing Honeyeater <i>Lichenostomus virescens</i>	*
Brown Honeyeater <i>Lichmera indistincta</i>	*
New Holland Honeyeater <sup>2</sup> <i>Phylidonyris novaehollandiae</i>	*
White-cheeked Honeyeater <sup>2</sup> <i>Phylidonyris nigra</i>	*
Tawny-crowned Honeyeater <sup>2</sup> <i>Phylidonyris melanops</i>	+
Western Spinebill <i>Acanthorhynchus superciliosus</i>	+
<b>Petroicidae</b> (Australian robins)	
Scarlet Robin <sup>1</sup> <i>Petroica multicolor</i>	+
<b>Neosittidae</b> (sittellas)	
Varied Sittella <sup>1</sup> <i>Daphoenositta chrysoptera</i>	*
<b>Pachycephalidae</b> (whistlers)	
Rufous Whistler <i>Pachycephala rufiventris</i>	*
Golden Whistler <sup>1</sup> <i>Pachycephala pectoralis</i>	+
Grey Shrike-thrush <sup>1</sup> <i>Colluricincla harmonica</i>	+
<b>Dicruridae</b> (flycatchers)	
Magpie-lark <i>Grallina cyanoleuca</i>	*
Grey Fantail <i>Rhipidura fuliginosa</i>	*
Willie Wagtail <i>Rhipidura leucophrys</i>	*
<b>Campephagidae</b> (cuckoo-shrikes)	
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>	+
White-winged Triller <i>Lalage sueurii</i>	+
<b>Artamidae</b> (woodswallows)	
Black-faced Woodswallow <sup>2</sup> <i>Artamus cinereus</i>	+
Grey Butcherbird <i>Cracticus torquatus</i>	*
Australian Magpie <i>Gymnorhina tibicen</i>	*
<b>Corvidae</b> (ravens and crows)	
Australian Raven <i>Corvus coronoides</i>	*
<b>Motacillidae</b> (pipits and true wagtails)	
Richard's Pipit <i>Anthus novaeseelandiae</i>	+
<b>Dicaeidae</b> (flower-peckers)	
Mistletoebird <i>Dicaeum hirundinaceum</i>	+

Species	Status
<b>Hirundinidae (swallows)</b>	
White-backed Swallow <i>Cheramoeca leucosternus</i>	+
Welcome Swallow <i>Hirundo neoxena</i>	*
Tree Martin <i>Hirundo nigricans</i>	*
<b>Zosteropidae (white-eyes)</b>	
Silvereye <i>Zosterops lateralis</i>	*
<b>Number of species observed:</b>	<b>34</b>
<b>observed or expected:</b>	<b>80</b>

<sup>1</sup> Listed as habitat specialists with reduced distribution on the Swan Coastal Plain in Bush Forever Volume 2 Table 15 (Government of WA 2000)

<sup>2</sup> Listed as wide ranging species with reduced populations on the Swan Coastal Plain locally extinct in Bush Forever Volume 2 Table 15 (Government of WA 2000)

Table 3 Mammal species known from the Swan Coastal Plain of the Perth region and which were either observed (\*) or expected (+) on the site. Species for which no suitable habitat is available, or that are extinct in the region, are not included. Introduced species (Int) are noted in the status column

Species	Status
<b>Tachyglossidae (echidnas)</b>	
Echidna <i>Tachyglossus aculeatus</i>	+
<b>Peramelidae (bandicoots)</b>	
Quenda or Southern Brown Bandicoot <i>Isodon obesulus</i>	*
<b>Tarsipedidae (honey possum)</b>	
Honey Possum <i>Tarsipes rostratus</i>	
<b>Phalangeridae (possums)</b>	
Brush-tailed Possum <i>Trichosurus vulpecula</i>	*
<b>Macropodidae (kangaroos and wallabies)</b>	
Brush Wallaby <i>Macropus irma</i>	(*)
<b>Mollosidae (mastiff bats)</b>	
White-striped Bat <i>Nyctinemus (Tadarida) australis</i>	+
<b>Vespertilionidae (vesper bats)</b>	
Gould's Wattled Bat <i>Chalinolobus gouldii</i>	+
Chocolate Wattled Bat <i>Chalinolobus morio</i>	+
<i>Falsistrellus mackenziei</i>	+
<i>Vespedalus (Eptesicus) regulus</i>	+
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>	+
Gould's Long-eared Bat <i>Nyctophilus gouldii</i>	+
Greater Long-eared Bat <i>Nyctophilus major (timoriensis)</i>	+
<b>Muridae (rats and mice)</b>	
Rakali or Water-Rat <i>Hydromys chrysogaster</i>	+
House Mouse <i>Mus musculus</i>	* Int
Black Rat <i>Rattus rattus</i>	+ Int
<b>Leporidae (rabbits and hares)</b>	
Rabbit <i>Oryctolagus cuniculus</i>	* Int
<b>Canidae (foxes and dogs)</b>	
European Red Fox <i>Vulpes vulpes</i>	* Int
<b>Felidae (cats)</b>	
Feral Cat <i>Felis catus</i>	* Int
<b>Number of species observed or expected:</b>	
<b>introduced:</b>	



**Table 4 Summary of significant vertebrate species recorded or expected to occur in or use Lot 502.**

Scientific name	Common name	Presence	C'wealth EPBC list *	State WC Act list *	CALM Priority list	Other listings	Regionally restricted distribution	Factors decreasing significance of Lot 502 to species	Local** impact if present	Regional impact	Measures likely to reduce impact of development
<b>Reptiles</b>											
<i>Lerista lineata</i>	Perth lined Lerista	Expected	No	No	No	Cogger <i>et al.</i> 1993 - Rare or Insufficiently Known	At northern limit of range	Persists in suburban gardens Just as likely to be within Beeliar Regional Park	Moderate	Very low	Buffer rehabilitation Establishing native gardens in estate
<i>Neelaps (Vermicella) calonotus</i>	Black-striped Snake	Expected	No	No	No	Cogger <i>et al.</i> 1993 - Endangered	No	Just as likely to be within Beeliar Regional Park	High	Moderate (if present)	Buffer rehabilitation Establishing native gardens in estate
<i>Tympanocryptus adalaidensis</i>	Sandhill Dragon	Expected	No	No	No	Nil	At southern limit of range		High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Varanus tristis</i>	Black-headed Tree Goanna	Expected	No	No	No	Nil	At southern limit of range		High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Lerista praepedita</i>	Worm Lerista	Expected	No	No	No	Nil	At southern limit of range	Persists in suburban gardens	Moderate	Very low	Buffer rehabilitation Establishing native gardens in estate
<i>Tiliqua occipitalis</i>	Western Bluetongue	Expected	No	No	No	Nil	At southern limit of range		High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Simoselaps (Vermicella) fasciolata</i>	Narrow-banded Snake	Expected	No	No	No	Nil	At southern limit of range		High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Simoselaps (Vermicella) semifasciatus</i>	Half-ringed Snake	Expected	No	No	No	Nil	At southern limit of range		High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Varanus ronsenbergi</i>	Rosenberg's Goanna	Expected	No	No	No	Nil	At northern limit of range	Just as likely to be within Beeliar Regional Park	High	Low	Buffer rehabilitation Establishing native gardens in estate

<i>Drysdalia coronata</i>	Crowned Snake	Expected	No	No	No	Nil	At northern limit of range	Just as likely to be within Beeliar Regional Park	High	Low	Buffer rehabilitation Establishing native gardens in estate
<b>Birds</b>											
<i>Lophoictinia isura</i> )	Square-tailed Kite	Possibly visits	No	No	Priority 4	Nil	No	Infrequent visitors Just as likely to be within Beeliar Regional Park	N/A	Low	Buffer rehabilitation Retaining some large trees in site
<i>Falco peregrinus</i> )	Peregrine Falcon	Possibly visits	No	Schedule 4	No	Nil	No	Infrequent visitors Just as likely to be within Beeliar Regional Park	N/A	High if using for nesting (unlikely)	Buffer rehabilitation Retaining some large trees in site
<i>Calyptrorhynchus latirostri</i>	Carnaby's Black Cockatoo	Possibly utilises	Endangered	Schedule 1	No	Nil	No	All woodland containing Banksia in region utilised by species Just as likely to be utilising areas within Beeliar Regional Park	High	Low	Buffer rehabilitation Retaining large Banksias in site
<i>Tringa hypoleucos</i>	Common Sandpiper	Possibly utilises	No	No	No	Listed under JAMBA/CAMBA	No	Just as likely to be within Beeliar Regional Park	High	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Pachycephala pectoralis</i>	Golden Whistler	Possibly utilises	No	No	No	Nil	No longer common in region	Known to be utilising Beeliar Regional Park	High	Moderate (if present)	Buffer rehabilitation Establishing native gardens in estate
<b>Mammals</b>											
<i>Isodon obesulus</i>	Quenda (Southern Brown Bandicoot)	Recorded	No	No	Priority 4 'Conservation Dependent'	Nil	No	Higher use in closer proximity to lake BR Park areas of much higher importance to this species	Moderate to low (over long term)	Low	Buffer rehabilitation Establishing native gardens in estate
<i>Hydromys chrysogaster</i>	Rakali (Water Rat)	Low occurrence	No	No	Priority 4	Nil	No	Stays close to wetlands, not likely to frequent the elevated woodland.	Very low	Very low	Buffer rehabilitation

\* Statutory requirements apply

\*\* Local area includes Lot 502 and South Lake

\*\*\* Regional area refers to Easter Beeliar area (City of Cockburn)



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# **APPENDIX 4**

## **BENEFITS OF REHABILITATION AROUND SOUTH LAKE**

**BY DR M.J. BAMFORD 07/08/2002**

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## Background

As part of the proposed development of the Bibra Lake Industrial Estate on Lot 502, west of South Lake, Landcorp has proposed a collaborative rehabilitation program with CALM to include that part of the Lot closest to South Lake, and an area of 10-11 ha on the southern edge of the lake that lies within Beeliar Regional Park. We have been asked to comment on the extent to which this rehabilitation will offset the loss of fauna habitat across most of Lot 502, and the benefit to South Lake and its fauna that are likely to result.

## Clearing offset

The total area of rehabilitation proposed will be up to the order of 15 ha, compared with approximately 64 ha of vegetated habitat and 25 ha of degraded and cleared habitat to be disturbed. Although there is the potential for some habitat protection and development within the industrial estate, there is clearly a discrepancy with a net loss of fauna habitat, although this loss would not be as great as if no rehabilitation were undertaken. Habitat value is not simply a matter of area, however, and the value of the rehabilitated habitat can be enhanced by designing it to favour species of conservation significance. Of particular interest at Lot 502 are Carnaby's (or Short-billed) Black-Cockatoo, which is a non-breeding visitor mainly in autumn and winter, the Splendid Fairy-wren which is most abundant in the "panhandle" section of Lot 502, and the Quenda or Southern Brown Bandicoot, also most abundant in this "panhandle" area.

Carnaby's Black-Cockatoo feeds on the seeds of Banksias, hakeas and introduced pine trees, and therefore the rehabilitation can be designed to favour this species by using favoured food plants such as *Banksia menziesii*, *Banksia attenuata* and *Hakea prostrata* furthest from the water's edge, and *Banksia littoralis* close to the water.

The Splendid Fairy-wren and Quenda favour the "panhandle" area because the vegetation structure is more complex than elsewhere on Lot 502, with dense shrubs and open areas providing the sort of patchy cover that these species utilise. There may also be differences in food supply between the dense shrubs and patches of degraded vegetation in the "panhandle", compared with the eucalypt woodland that occurs over most of the rest of Lot 502. This vegetation structure can be replicated in the rehabilitated area. For the Splendid Fairy-wren and Quenda, important features in the rehabilitation area would be: a low density of tall trees, such as eucalypts, to avoid shading that can result in the understorey becoming sparse; and dense clumps of understorey providing cover right around South Lake, but interspersed with open, foraging areas.

It is not really possible to provide an estimate of the value of the rehabilitated habitat compared with the value of habitat that would be lost due to the development of the Bibra Lake Industrial Estate across most of Lot 502, as there are too many variables to consider. For example, the success of rehabilitation can vary, while the value of the habitat will change as the trees and bushes mature. In the case of the Splendid Fairy-wren and Quenda, however, the area of rehabilitation is greater than the area of the "panhandle" section of Lot 502, where these two species are particularly abundant. The rehabilitation could therefore replace the value of this "panhandle" section for these two species, and probably go some way to replacing the value of the rest of Lot 502, where the Fairy-wren and the Quenda occur at low densities. The rehabilitated area could therefore support in the order of 50-75% of the former populations of these two species.

The Fairy-wrens in particular could be fairly easily surveyed and it would therefore be possible to quantify the current population in Lot 502 and around South Lake, and compare this with the population in the rehabilitated area in 5 or 10 years. Such quantification would be more difficult for the Quendas, which may vary in abundance seasonally and annually. For the Black-Cockatoo,



quantification of habitat value would be difficult, as the same number of birds may visit the area, but they may spend only a third or half the time on the site depending on the food resource available.

Rehabilitation tailored to the requirements of these three species has the potential to give the rehabilitated site a value out of proportion with its area. The rehabilitation would also support many other species, and would improve linkage for wildlife between South Lake and other parts of Beeliar Regional Park.

### ***Benefit of rehabilitation to South Lake fauna***

The area being considered for rehabilitation is close to South Lake and is currently very degraded, with few native plants and an abundance of mostly annual weeds. Rehabilitation would mainly be of benefit to terrestrial species, but will need to be extended into the riparian zone for weed control. This can be expected to benefit aquatic species (waterbirds, frogs, aquatic invertebrates) in the long term through the replacement of weeds with native riparian plant species. Rehabilitation away from the water's edge will also be of benefit to aquatic fauna such as frogs that use upland habitats for part of their life cycle, and waterbirds that nest in tree hollows. There may also be some benefit from upland vegetation removing nutrients from water leaching towards the wetland.

Despite these benefits, it does need to be recognised that weeds growing on the edge of wetlands provide cover for nesting waterbirds and other wildlife. Therefore, removal of such weeds should be progressive, allowing time for native plants to provide replacement habitat.