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DIANELLA REGIONAL OPEN SPACE RESERVE
DRAFT MANAGEMENT PLAN

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Revision	Date	Approved	Details of Revision
1.1	23/07/2009	D. Rajah (CoS)	Inserted references to: Dept of Transport / Dept of Planning - required traffic management study; Level 2 flora survey along the proposed western entry
1.2	27/07/2009	J. Bridge (CoS)	Inserted reference to: groundwater drawdown response and quality plans; and bore metering recommendation
1.3	3/08/2009	W. Van Der Loo	Typographic edits and inclusion of additional Hydrozone comment p 12.
1.4	17/08/2009	K.Gibbs	Typographic edits and inclusion of Bush Forever liaison recommendation p 5.
1.5	18/08/09	J. Rosenwax	Typographic and formatting edits, incorporation of Biodiversity Strategy; inserted new sections 4.9 & 4.10. Inserted preface and abstract. Moved Recommendations section to front.

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PREFACE

This document is a deliverable for Agreement 2.7.4.450 – Appointment of a consultant for the formulation of Dianella Regional Open Space Reserve Management Plan. The Management Plan provides a comprehensive assessment of all aspects of the reserve with a view to providing a balance between conservation ideals and recreational need. It will ensure the protection, conservation and enhancement of ecologically sensitive areas as well as consider how public enjoyment and general recreation use can be optimised by improvements/ upgrading to existing facilities rather than jeopardise ecologically sensitive areas.

EXECUTIVE SUMMARY

The City of Stirling manages the Dianella Regional Open Space (ROS) Reserve located between Light Street, Alexander Drive and Morley Drive in the suburb of Dianella on the Swan Coastal Plain of Western Australia. The reserve has a landform typical of the Bassendean geomorphic unit comprising low sandy mounds with an interdunal swale (depression) that is utilised as a drainage compensation basin and artificial wetland. Parts of the reserve's original landform have been modified to incorporate flat turf ovals. Topographic relief varies across the reserve from approximately 25 to 34 metres Australian Height Datum (m AHD). Groundwater depth is interpreted from levels recorded by the Department of Water in 2003 to be around 20 m AHD. Groundwater flow is to the south.

The reserve is used for recreation with several buildings, cleared areas and sporting grounds but it also has substantial areas of bushland (Banksia and Jarrah / Marri Open Woodland) categorised as "Bassendean – Central and South Vegetation Complex". The bushland at the reserve is important as very little Bassendean Vegetation Complex is preserved within the City of Stirling (around 3 per cent of the original pre-European extent remains), making it the most under-represented vegetation complex within City of Stirling's borders. Recognising this, the bushland at Dianella ROS is listed as a Bush Forever site and as an Environmentally Sensitive Area. The reserve is tenured as Crown Land vested to the City of Stirling under the terms of a Management Order. This Management Plan provides a framework to assist the balance between conservation ideals and recreational need. Recommendations are set down within the Management Plan to enable proper conservation and enhancement of ecologically sensitive areas as well as providing ongoing public enjoyment and general recreation use. The proposed term of this Management Plan is ten (10) years.

Mapping conducted as part of this Management Plan found no known occurrences of Threatened Ecological Communities or any species of Declared Rare Flora or Priority Flora. The majority of the remnant bushland at the site was determined to be in "Good" condition, according to the Keighery (1994) scale. Some areas of "Very Good" condition vegetation were identified and mapped and there were also areas of a more degraded quality. Relatively high species diversity was noted and recorded. Occurrences of one Declared Plant *Acacia longifolia* subsp. *longifolia* were recorded. Dieback (*Phytophthora cinnamomi*), a pathogenic disease affecting native vegetation species such as Banksia and Jarrah has affected approximately 4 hectares of the reserve and seems to have been present for some time. Parts of the bushland are fragmented by unofficial tracks and pathways that can increase the risk of foot traffic spreading weeds and pathogens (dieback).

One Aboriginal Site (comprising artefacts / scatter) is recorded within the reserve. A review of the site history showed that the reserve was likely to have been a way point

along a path travelled by aboriginals in pre-European times. One occurrence of acid sulfate soil (ASS), associated with the natural soils within the artificial wetland was reported during a limited site investigation in 2009. However, the majority of the reserve has only low to moderate risk of ASS occurring within three (3) metres of the surface. The reserve has a stormwater drain that connects to the Bayswater Creek that drains into the Swan River. The reserve's drain runs from Light Street into an artificial wetland and then through a culvert beneath Morley Drive. The drain is uncovered at the Light Street end. The reserve's irrigation is supplied by bores that abstract groundwater under licence from the Department of Water. Irrigation for landscaped and turf areas is currently managed using Hydrozone Principles where summer irrigation is apportioned to provide high-use, active recreation zones (where turf is under greater wear-and-tear) with a greater amount of the available water than less-utilised areas. Ancillary turf areas are left to 'brown-off' until they receive autumn and winter rains. Bushland is not irrigated.

Recreation facilities on the reserve are accessed from either of two separate car parks. One is entered via a vehicular entrance off Morley Drive and the other off Light Street. The Light Street car park has had drainage (flooding) problems in the past. Except within car parks, there is no internal circulation for public vehicles within the reserve. Emergency vehicle access is via stabilised limestone paths. A network of formal footpaths and sealed tracks provides pedestrian access to and within the reserve. Due to the large amount of native bushland within the reserve, some footpaths intersect dense vegetation. As a result, pedestrian access through large portions of the reserve is not open to passive surveillance, posing some safety concerns. Incidents of theft and vandalism have occurred in the car parks and around the reserves buildings in the past. The presence of all facility buildings to the surrounding streets is poor and some suggested major upgrades have been made to improve the existing facilities on the reserve including:

1. Jim Satchell Community Recreation Centre – reconfigure entry
2. Tennis Courts – reconfigure layout , remove one court and consolidate bush edge
3. New vehicle entry/exit from Alexander Drive
4. Improve the Light Street Drain to incorporate a *Living Stream* environment
5. Refurbishment (planting and minor earthworks) of the artificial wetland

These upgrades have been previously endorsed by the City of Stirling as part of a consultative Master Planning process during 2008. This Management Plan ties into the Master Plan and substantiates many of the decisions made during the 2008 study. It is anticipated that the proposed upgrades will not impact adversely on the conservation values of the reserve. The thirty-two recommendations that follow have been developed during a multiple stage investigation and consultation process involving EDAW and

AECOM personnel, City of Stirling Staff, community members and state government agencies.

RECOMMENDATIONS

1. The City of Stirling (as the management body for Dianella Regional Open Space) should continue to liaise with the Western Australian Planning Commission (WAPC)'s Bush Forever Department regarding further plans for the site.

2. Further clearing of native vegetation should cease at Dianella Regional Open Space due to the Site's listing as an ESA, a Bush Forever Site and in accordance with the Biodiversity Strategy.

3a. Consult with the South West Aboriginal Land and Sea Council to determine any traditional values and incorporate these into the history of the reserve.
3b. In the event that an Aboriginal site, artefacts or other material is uncovered during earthworks, cease work immediately and inform the Department of Indigenous Affairs.

4. Develop an acid sulfate soils management plan (ASSMP) and DEC-approved dewatering strategy prior to any excavations within wetland areas or drainage corridors

5a. Incorporate Dianella Regional Open Space into the City' groundwater monitoring program (annual) to monitor potential changes in water table levels and/or quality parameters that may affect the health of dependent bushland.
5b. Develop a groundwater drawdown and quality response plan based on the outcomes of the monitoring to show responses to indicators such as groundwater depth, vegetation decline, bore quality data and vegetation health/decline.

6. Improve on existing *'Living Stream'* environmental restoration of the open parts of the drain and investigate the feasibility of opening up further sections of this drain for *'Living Stream'* restoration.

7. Review and upgrade the drainage infrastructure of the Light Street car park subjected to winter flooding.

8a. Review Hydrozones and consolidate bushland areas to reduce overspray into bushland. Create additional artificial "ecozones" or "xeriscape" areas where possible to reduce water demand.
8b. Install meters on bores and monitor irrigation/abstraction rate and volume to compare with data obtained from the proposed groundwater monitoring (Recommendation 5).
8c. Balance groundwater abstraction to achieve a sustainable groundwater resource.

9. Review the drainage function of the wetland and progressively restore wetland flora species as indicated by the Master Plan (CoS, 2008) to enhance the wetland's biodiversity and improve the aquatic ecology of this degraded feature. Restoration should be proceeded by developing a local wetland management plan by following the: *Guidelines checklist for preparing a wetland management plan DEC* (2008) & *Environmental Protection Policy Wetlands of the Swan Coastal Plain* (2004).

10. Introduce interpretive material and/or signage within the Reserve to celebrate the Aboriginal History of the site.

11. Progressively replace outdated signs with "*way finding*" (map-based) and/ or interpretive material to celebrate the site's unique features, increase site legibility for users and provide users with an opportunity to identify with the site.

12a. Actively consult with DEC to assess DRF, Priority and Conservation Flora within the Alexander Drive Entry "Clearing Corridor" (incorporating a site visit during Spring) prior to vegetation clearing.
12b. Retain existing native flora species where possible, including isolated trees and shrubs, as part of proposed clearing activities.
12c. Control dust, noise and vibration as far as practicable during any construction activities.

13. Conduct a Level 2 Assessment of native fauna (to EPA Guidance Statement 5b requirements) within the area of possible impact by the proposed road to ensure no fauna or fauna habitat is inadvertently destroyed (e.g. nesting or burrowing animals).

14. Undertake a traffic planning/management study to substantiate the entry road concept and to enable necessary approvals *viz.* Department for Planning and Department of Transport.

15a. Bushland in "Very Good" and "Good" condition (Keighery, 1994) should be prioritised for protection by adequate fencing and consolidated where possible.
15b. Closed pathways within communities of Banksia Low Open Woodland (BmBaLOW) and Marri and Jarrah Open Woodland (CcEmOW) should be fenced and any compacted ground should be ripped and rehabilitated with local endemic species.

16. Control occurrences of the Declared Plant *Acacia longifolia* subsp. *longifolia* as required under the Agriculture and Related Resources Protection Act (1976).

17. Conduct a Level 2 (EPA, 2004) Spring Flora and Vegetation Assessment in areas of remnant native vegetation to assess DRF and Priority Flora within the term of this plan 2009-19.

18. Protect large areas of native flora not yet infected by *Phytophthora cinnamomi* by following appropriate hygiene requirements.

19. Conduct a Level 2 Assessment for native fauna (to EPA Guidance Statement 5b requirements) to establish baseline data to which future surveys can be compared to measure the success of fauna habitat management.

20. Retain mature trees that may provide nesting habitat for birds and small mammals.

21. Monitor for fox activity and set baits or traps as necessary to effect control according to accepted procedures.

22. Monitor for rabbit activity and set baits or traps as necessary to effect control.

23a. Remove weeds & rehabilitate bushland edges to join fragmented areas where practicable
23b. Remove of non-local trees and replace progressively with local species
23c. Rationalise and clearly delineate pedestrian paths / eliminate informal tracks

24a. Remove eucalypts in parkland areas as necessary to create defined areas of open space
24b. Where turf growth is poor, introduce groundcover planting/gravel/mulch beneath remaining stands of eucalyptus trees

25a. Install entrance barriers to prevent night entry
25b. Improve lighting
25c. Prune understory vegetation selectively to make "view corridors" and improve visibility

26a. Introduce new entry road from Alexander Drive
26b. Consider realignment of this road to prevent bushland fragmentation Install entrance

27. Relocate playground to improve its standard and rehabilitate the former playground location

28. Convert under-utilised, decommissioned netball and tennis courts into a central consolidated car park area

29. Replace narrow strips of grass along bush side of paths with appropriate ground cover to enable pathways to act as management edges

30. Provide improved spectator viewing areas with suitable aspects for viewing sport

31. Utilise graffiti-repellent coatings on susceptible facilities and regularly inspect and remove graffiti to discourage repeated attacks

32. Construct universally accessible toilets

1.00 INTRODUCTION

The City of Stirling (CoS) issued a Master Plan (**Appendix I**) and Master Plan Support Strategy (MPSS) document for the Dianella Regional Open Space (ROS) (the site) during 2008. These documents identified most of the issues, needs and constraints affecting the future development and maintenance of the site. As the site is listed as a Bush Forever Site (Department of Environmental Protection, 2000) the next stage in the strategic planning process for Dianella ROS is the development and adoption of this Draft Management Plan. Once finalised, the intent of the management plan is to mainly analyse the environmental considerations of the reserve but to also include details of proposed developments for the purpose of review and endorsement by the Western Australian Planning Commission (WAPC). This is a draft issue of the plan intended for review by the City of Stirling, Departments of Planning & Infrastructure (DPI) and Environment & Conservation (DEC) and stakeholders representing the community. Following public consultation, feedback from all stakeholders will be incorporated in to the final issue of the plan scheduled for July 2009.

1.01 AIM

To enable the retention and enhancement of the natural character and aesthetic value of the reserve and retain or enhance the biodiversity through the preservation of the natural flora and fauna; and provide recreation opportunities for people locally and from within the region.

1.02 RATIONALE

The Management Plan follows and integrates with the Council-approved Master Plan (CoS, 2008). The final management plan will be issued to the WAPC for endorsement; thereby providing a degree of certainty in the planning, development and management processes for Dianella ROS.

1.03 OBJECTIVES

This management plan investigates the implications of addressing community needs and recreation trends as well as opportunities and constraints upon the site. The management plan seeks to establish principles for conservation, future development, infrastructure provision, parking and sport management. Public consultation with users of the reserve and surrounding residents has been allowed for during the development of this Draft Management Plan.

In detail the management plan integrates the following into a single document:

- Requirements for an Environmental Management Plan under the "Bush Forever" Regional Conservation Sites System
- Recent field surveys of flora, vegetation, fauna, dieback and bushland condition undertaken as part of the Perth Biodiversity Project
- Additional baseline biotic data (flora, vegetation, fauna, weeds, condition) as well as abiotic data (landform, soil, drainage, hydrology and water quality)
- Recommended measures to manage and improve wetland habitat with reference to: a. Guidelines checklist for preparing a wetland management plan DEC (2008) & b. Environmental Protection Policy Wetlands of the Swan Coastal Plain (2004)
- Site-specific strategies to align the planning of the reserve to CoS Green Plan 2
- Awareness of and compatibility with the recently-completed Master Plan and MPSS, particularly recreational planning concerns, community needs and consideration for redevelopment of existing amenities
- Requirements by the Western Australian Planning Commission (WAPC) for endorsement of the final Management Plan. Endorsement by WAPC will provide a degree of certainty to the reserve's planning and Development Application (DA) process. (An endorsed management plan will supersede the current requirement that each development proposal for the reserve be forwarded as a DA to WAPC for formal approval, thus avoiding unnecessary consumption of the City's resources by individual DA submissions)
- Allow a cohesive vision for the future – including necessary strategic development
- Incorporate sustainable principles and practices applicable to Dianella ROS planning and management initiatives over the next ten (10) to twenty (20) years to promote intergenerational equity.

1.04 SCHEDULE

The schedule for the process and methodology behind the development of this Draft Management Plan is summarised in the following dot points:

- ► Engagement of Consultant – February 2009
- ► Background Information Review – March 2009
- ► Site visits including Flora/Fauna survey – March 2009
- ► Issues Paper reviewed by CoS staff – April 2009
- ► Flora/Fauna report draft issue – May 2009
- ► Flora/Fauna report final issue – June 2009
- ► Management Plan Preliminary Draft issue – June 2009
- ► Community Open Day Preliminary Draft issue – July 2009
- ► Management Plan Final Draft issue – August 2009

1.05 METHOD

It should first be noted that this Draft Management Plan is developed to align with the existing Master Plan (CoS, 2008). Secondly, there have been no prior management plans for this reserve. This draft management plan was developed following site analysis and the release of an "Issues Paper" reviewed by CoS staff in April 2009. The Issues Paper distilled key management "issues" from available information and ranked these in order of perceived importance. Ranks were ascribed by EDAW based on the commentary within the Master Plan Support Strategy (CoS, 2008), other sources including State Government and Local Government Guidelines and in consultation with CoS staff.

The ranked "issues" were then matched to recommendation actions and resubmitted to CoS for further comment. The "Issues" and recommended actions then underwent minor internal revision before the issue of this Draft Management Plan.

Field and desktop assessments of flora, vegetation, fauna and other biotic (as well as abiotic) components were conducted concurrently with the development of the Issues Paper. This information was compiled together with existing data and assembled into the Draft Management Plan. In the process of developing the Draft, a number of other recommendations were made, further to those identified during the Issues Paper. These recommendations are highlighted in coloured boxes throughout this draft document and are summarised in the executive summary together with those from the Issues Paper.

1.06 CONSULTATION

Consultation with CoS staff, Council working groups, community and feedback of consultation outcomes into the management plan will ensure that the management is supported by those that use and value the park.

1.07 TERM OF THE PLAN

The term of this Management Plan is intended to be ten years from 2009 to 2019. Dianella Regional Open Space is situated in an urban environment with constantly changing recreation needs and amenity requirements. With this in mind, the term of the Plan has been set for ten years with the recommendation that the plan be reviewed in 2014 and updated if necessary to accommodate changes to the way the Reserve is utilised.

2.00 SITE DETAILS

2.01 STUDY AREA

Dianella Regional Open Space is located approximately 8km northeast from the Perth CBD within the City of Stirling in the suburb of Dianella. The reserve is adjacent to the nearby suburbs of Morley and Noranda in the City of Bayswater. The study area is bound by Light Street to the North/East, Morley Drive to the South and Alexander Drive to the West (**Figure 1**). Topographic relief across the reserve varies from approximately 25 metres Australian Height Datum (mAHD) to 34 mAHD (**Figure 2**).

2.02 RESERVE PURPOSE

The City of Stirling's Dianella Regional Open Space is of high value to the City. It performs many important roles including: general, active and passive recreation; high level sporting competition; bushland and environmental conservation and providing substantial 'green relief' to the built environment. The City is committed to the good management of all reserves and is preparing master plans and management plans for each regional open space, to manage the complexity of issues and uses of each reserve and to plan for ongoing improvements and facility provision in a sustainable manner. Dianella Regional Open Space is the largest reserve in the area, accommodating many users and visitors from both the local community and from across Perth. The space is intensely used, particularly by sporting groups, and the need has arisen to develop a management plan to guide balanced use, ongoing amenity and development of facilities.

2.03 ZONING

Dianella Regional Open Space is listed as *Reserve: Parks and Recreation* under the Metropolitan Region Scheme. The surrounding land is zoned *Urban* (**Figure 3**).

2.04 PARK LAYOUT AND SECURITY

Dianella Regional Open Space is approximately 35 hectares in area, about half of which comprises *Bush Forever* vegetation. Open spaces within the reserve include paths, grassland, ovals, a stormwater drain and a modified wetland. The two vehicular entrances to the reserve are off Morley Drive and Light Street. Due to the large amount of native bushland within the reserve the footpaths frequently intersect dense vegetation. As a result, large portions of the reserve are not open to passive surveillance and therefore pose a safety concern to some users. Incidents of theft and vandalism have occurred in the car parks and around the reserves buildings. Screening from vegetation and inadequate lighting are listed in the MPSS (CoS, 2008) as major

reasons for the antisocial behaviour. Fly dumping (rubbish) was noted on some parts of the reserve during the field visit (**Figure 4**).

2.05 INFRASTRUCTURE

Dianella Regional Open Space contains a network of footpaths, open grass ways, cycle paths, stabilised limestone paths and informal bush tracks (**Figure 5**). Fencing includes bollards, "copper log & mesh" fence and chain-mesh fence (**Figure 6**).

2.06 REGULATORY FRAMEWORK

2.06.01 Environmentally Sensitive Areas

A search of the Department of Environment and Conservation's Native Vegetation Viewer indicates that the entire area of Dianella Regional Open Space is classified an Environmentally Sensitive Area (ESA) declared under the Environmental Protection (Environmentally Sensitive Areas) Notice 2005. ESA's are areas where it is not permitted to clear native vegetation.

2.06.02 Bush Forever

Bush Forever is a 10 year strategic plan to identify, protect and manage around 51,000 ha of regionally significant bushland, identified as bush forever sites, within the Perth Metropolitan Regions. Bush Forever aims to conserve, where possible, at least 10% of each of the original 26 vegetation complexes of the Perth Metropolitan portion of the Swan Coastal Pain (Government of Western Australia, 2000). Dianella Regional Open Space is wholly contained within Bush Forever Site No. 280 (DEP, 2000). Bush Forever (DEP, 2000) lists an area of 16.04 hectares of Bassendean Complex – Central and South bushland with >70% categorised as being "Very Good to Excellent" and <30% categorised as "Good to Degraded" according to the Keighery (1994) scale, with additional areas of severe localised disturbance. Table 3, Volume 1 of Bush Forever states: *The existing care, control and management of the reserve are endorsed. The purpose of the reserve should be amended to include conservation and appropriate mechanisms applied in consultation with the management body.*

Recommendation

1. The City of Stirling (as the management body for Dianella Regional Open Space) should continue to liaise with the Western Australian Planning Commission (WAPC)'s Bush Forever Department regarding further plans for the site.

2.06.03 Green Plan 2

The City of Stirling's Green Plan 2 lists Dianella Regional Open Space as a "Regionally Significant Conservation Reserve (Group A- partial bushland)". Of the 38 hectares that makes up the Reserve, approximately 17.5 hectares comprise natural bushland, including fragmented sections. These areas are dissected by numerous informal tracks that do not assist the high incidence of dieback already affecting the bush.

2.06.04 Biodiversity Strategy

The City of Stirling's Biodiversity Strategy details the level of protection and retention of native vegetation as a proportion of pre-European extent for each Swan Coastal Plain Vegetation Complex within the City of Stirling. The vegetation of Dianella Regional Open Space falls within the *Bassendean Complex – Central and South*. This complex is under-represented within the City of Stirling. As a proportion of the original pre-European extent of *Bassendean Complex – Central and South* vegetation, only around 3 per cent (or about 22 hectares) remains within City of Stirling's borders. The bush at Dianella Regional Open Space makes up about 16 hectares of the 22 hectares. Moreover, the *Bassendean Complex – Central and South* is the most under represented vegetation complex of the five listed in the CoS Biodiversity Strategy.

Recommendation

2. Further clearing of native vegetation should cease at Dianella Regional Open Space due to the Site's listing as an ESA, a Bush Forever Site and in accordance with the Biodiversity Strategy.

2.07 LAND TENURE

State of Western Australia comprising Lot 201 on Plan 18169 (33.67ha) and crown Reserve No. 34538 (5.06ha). Lot 201 was previously owned by the WAPC and leased to the City for a 25-year term from April 1975 for the purpose of using and developing the land for Parks and Recreation. On the 4 July 2000 Council agreed to the proposal by WAPC to transfer Lot 201 to the State for creation as a reserve with vesting in the City under the terms of a Management Order. Transfer of the land was affected and the land vested in the City 18 October 2001. The bulk of Dianella Regional Open Space is now contained in 2 Crown Reserves:

1. Reserve 34538 (vesting order 467)
2. Reserve 46683 (vesting order 705)

Both reserves are managed by the City under two separate Management Orders, for the purpose of "Recreation" and "Community Recreation", with power to lease the land for a period not exceeding 21 years, subject to the approval of Minister for Lands. The WAPC granted approval to excise a small portion of the reserve (83m2) for a

telecommunication facility (Reserve 34538 (Property ID 238813). The State Government then leased the site to the telecommunication carriers - vesting order 467. Two easements were then granted by the City over the area of Dianella ROS under its management control for the purpose of "underground cable" and "access". (As per Council resolution 4 March 2003, Item 11.2/F4).

2.08 ADJOINING LANDUSES

Suburban residential development surrounds the site on all sides.

2.09 ABORIGINAL SITE REGISTER

The Aboriginal Site Register is held under Section 38 of the State's *Aboriginal Heritage Act 1972*. It protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System indicates that one Aboriginal heritage site (Artefacts / Scatter) is located within the survey area. Site details are presented in **Table 1**. Site 3165 is situated on a small hill at the location of the playground accessed from Light Street. Written notice from the Minster for Aboriginal Affairs (**Appendix II**) indicates that the Section 18(3) of the *Aboriginal Heritage Act 1972* is not required for this site.

Table 1 – Aboriginal Heritage Sites at Dianella Regional Open Space

Site ID	Site Name	Site Type	Status
3165	Location S00691	-	Not a site

It should be noted that a search under the DIA database does not constitute a full assessment under the *Aboriginal Heritage Act 1972*. This would require consultation with Aboriginal people with knowledge of the area (usually, but not necessarily Native Title Claimants) and an archaeological survey.

The wetland area on the south western corner of the reserve is currently undergoing a Section 18(3) investigation as some rehabilitation earthworks are proposed for this area within the Master Plan (CoS, 2008).

Recommendation

3a. Consult with the South West Aboriginal Land and Sea Council to determine any traditional values and incorporate these into the history of the reserve.

3b. In the event that an Aboriginal site, artefacts or other material is uncovered during earthworks, cease work immediately and inform the Department of Indigenous Affairs.

2.10 NATIVE TITLE

The following native title claim exists over Dianella Regional Open Space:

- Single Noongar Claim (Area 1), Active, WC03/6

3.00 PHYSICAL ENVIRONMENT

3.01 CLIMATE

Dianella regional Open Space lies within the Swan Coastal Plain. It has a warm Mediterranean climate characterized by having 5-6 dry summer months per year and winter precipitation. Recorded climatic data for the Perth Metro Bureau of Meteorology weather station is summarised below:

- Mean Daily Maximum Temperature: 18.4°C (July) – 31.1°C (Feb)
- Mean Daily Minimum Temperature: 7.9°C (July) – 17.9°C (Dec)
- Annual Rainfall: 748.9 mm
- Mean Annual Rain Days: 82.3 days
- Annual Pan Evaporation: 1805 mm

(Source: Bureau of Meteorology, 2009)

3.02 LANDFORM

The landform of the site is classified as Bassendean Dunes and interdunal swales. The highest point of the site is a small hill located just southeast of the corner of Light Street and Alexander Drive at approximately 34 metres Australian Height Datum (AHD). This location also corresponds to Location S00691 listed on the Department of Indigenous Affairs website. The lowest point of the site is the wetland at the south western corner (25 m AHD). Much of the site is flat or of low relief. The average height above sea level for the site is approximately 28 metres (**Figure 2**).

3.03 REGIONAL GEOLOGY

Dianella regional Open Space is situated on sedimentary deposits of the Swan Coastal Plain of Western Australia. The Swan Coastal Plain contains several geomorphologic units (McArthur and Bettenay, 1960) that are distributed parallel to the coastline, increasing in age and eastward from the Indian Ocean to the Darling Scarp. The Dianella Regional Open Space is located upon sediments of the Bassendean Dune System (Gozzard, 2007). The Bassendean Dune System developed during an interglacial period some 240,000 to 100,000 years ago. The Bassendean Dunes consist of low hills of quartz sand with sandy swamps in depressions (swales) between the dunes.

3.04 SOILS & SURFACE GEOLOGY

A review of the Environmental Geology Series maps prepared by the Geological Survey of Western Australia (1986) was undertaken to determine the soils and surface geology of the project area. The project area is located on Perth Sheet 2034-II (Geological Survey of Western Australia, 1986). The project area falls within areas shown in published geological mapping (Geological Survey of Western Australia, 1986) as follows:

- **S8 Bassendean Sand** - very light grey sand at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin occurs over most of the site, except for the northern and south western corners.
- **S10 Bassendean Sand** (as S8 above) over sandy clayey to clayey sand over the north western portion of the reserve; and
- **Cps Peaty Clay** - dark grey and black with variable sand content of lacustrine origin associated with the wetland area in the south western corner of the site.

3.05 ACID SULFATE SOILS

Acid sulphate soils risk for the Swan Coastal Plain has been mapped by the DEC. Based on this mapping, most of the reserve has been classed has having *"moderate to low risk of ASS occurring within 3 m of natural soil surface"*. One area of the site mapped as having "*high to moderate risk of ASS occurring within 3 m of natural soil surface*" is associated with the wetland area in the south west corner of the site. Sites with high-risk acid sulfate soils are natural and under normal conditions they do not create any management issues. However, any alteration in the hydrology and the natural surface that results in exposure and drying out of the subsurface soils may result in the generation of acid sulfate run-off.

A limited intrusive investigation for acid sulfate soils (ASS) was undertaken by Chadwick T&T (2009) to determine the presence of actual ASS (AASS) or potential ASS (PASS) associated with the wetland area (south western corner of the site). The study was made in preparation for proposed earthworks to deepen the wetland. The study included soil sampling at six (6) sampling locations, laboratory analysis of twenty six (26) selected samples for Suspension Peroxide Oxidation Combined Acidity & Sulfate (SPOCAS) and reporting. Chadwick T&T (2009) found that all encountered soil types within the proposed excavation envelope of the wetland are identified as ASS and that prior to disturbance of any materials, an acid sulfate soils management plan (ASSMP) will need to be developed and implemented to manage risks associated with oxidation of sulfidic sediments via exposure to air during earthworks. Managing the disturbance to groundwater *via* the adoption of an appropriate dewatering strategy will also be required.

Recommendation

4. Develop an acid sulfate soils management plan (ASSMP) and DEC-approved dewatering strategy prior to any excavations within wetland areas or drainage corridors

3.06 HYDROGEOLOGY

Groundwater beneath the Dianella Regional Open Space is held within the superficial aquifer - a major unconfined aquifer extending throughout the Swan Coastal Plain. Locally the aquifer is known as the Gnangara Mound (south). The mound has developed because the rate of vertical rainfall infiltration is greater than the rate of horizontal groundwater flow through the aquifer. The upper surface of the Gnangara mound is the watertable, whose variation in depth fluctuates seasonally by about 1 metre (Davidson, 1995). The watertable elevation is highest during September to October and lowest during April and May (Davidson, 1995). Groundwater within the Gnangara Mound is recharged directly by rainfall infiltration. Monitoring by the Department of Water in recent years has shown a declining trend in groundwater levels within the superficial aquifer and the deeper Leederville and Yarragadee Formations. Groundwater is interpreted at 20m AHD based on 2003 recorded levels (Perth Groundwater Atlas). The dependence of vegetation upon groundwater must be mentioned here as Banksias make up a large proportion of the vegetation on the reserve. Banksias are a phreatophyte plant (deep-rooted and obtain a significant portion water requirements from groundwater). They are thus susceptible to groundwater drawdown that can cause morphological and physiological responses and mortality. Declining water levels can result in tree stress and even tree death during times of protracted drought. Most of the *Banksia* species within Dianella Regional Open Space reserve have root systems that have adapted to the current groundwater regime and depend on this for survival. To ensure appropriate data is available to allow adaptive management in response to climate change, it is considered prudent to monitor fluctuations in the water table within the reserve.

3.07 GROUNDWATER QUALITY

Groundwater within the Perth Region contains high nitrate levels in the superficial aquifer in areas of urbanisation, intensive horticulture and recreation reserves with areas of turf. High nitrate levels (frequently exceeding 20 mg/L) result from direct leaching of nitrate from fertilizers and ammonia (oxidized to nitrate) from septic tanks. Beneath native bushland, nitrate concentration in groundwater is generally less than 1 mg/L (Davidson and Jack, 1983). On the Swan Coastal Plain, phosphorus concentrations within the superficial aquifer are generally less than 0.1 mg/L (Davidson, 1995) except in areas where septic tanks are common or were previously commonplace.

Parts of the surrounding suburbs adjacent to Dianella ROS Reserve were not serviced by deep sewer until recent times (post 2000). It is anticipated that groundwater surrounding the site would still be impacted to an extent by nutrients from the residues of decommissioned septic tanks. Groundwater quality data was not available for this study. However, as much of the native vegetation community comprises *Banksia*, a species intolerant to elevated phosphorus concentrations, the following recommendation is suggested:

Recommendation

5a. Incorporate Dianella Regional Open Space into the City' groundwater monitoring program (annual) to monitor potential changes in water table levels and/or quality parameters that may affect the health of dependent bushland.

5b. Develop a groundwater drawdown and quality response plan based on the outcomes of the monitoring to show responses to indicators such as groundwater depth, vegetation decline, bore quality data and vegetation health/decline.

3.08 WATER & SURFACE DRAINAGE

Stormwater drains through the reserve along a Water Corporation drain (both open and buried sections) that enters into the reserve from the Light Street end (emerging from an easement to the north of the reserve between Seabrook Street and Collingwood Streets). The drain extends through the reserve to the wetland area and from there into another artificial wetland at The Strand that is connected by pipe beneath Morley Drive. Stormwater from here eventually drains to the Bayswater Main Drain, otherwise known as Bayswater Creek (**Figure 7**).

Within the reserve, the channel is piped for most of its length, creating an open, grassed 'fairway' lawn space between oval one bushland and oval three. The open section of the drain near Light Street was revegetated during 1992/93 with wetland species in an attempt to establish a '*Living Stream'* environment. This revegetation was not successful as it was damaged by Water Corporation operations soon after planting. However the opportunity still exists to enhance the open drain further through additional restoration work and appropriate maintenance.

Recommendation

6. Improve on existing '*Living Stream'* environmental restoration of the open parts of the drain and investigate the feasibility of opening up further sections of this drain for *'Living Stream'* restoration.

The upgrade of the drain could also incorporate Water Sensitive Urban Design (WSUD) elements including *Treatment Trains* (trash racks, pollutant traps and sediment traps) to

improve the quality of water entering the wetland. WSUD treatments could help prevent the build-up of silt which must be seasonally removed from the wetland in order to prevent shallowing of the lake and reduction in the extent of available open water. Recent dry seasons and lowering of the water table has made the lake more ephemeral and less reliable as a wild life environment for wading birds and amphibians.

Part of the south eastern corner of the Light Street car park becomes periodically flooded during winter (**Figure 7**).

Recommendation

7. Review and upgrade the drainage infrastructure of the Light Street car park subjected to winter flooding.

3.09 IRRIGATION

Irrigation water is abstracted from bores licensed by the Department of Water. Irrigation is applied primarily to the ovals and to a lesser extent to the general parkland. Reticulated irrigation (automated) of ovals 1 and 2 commenced in 1994. Oval 3 commenced automated irrigation in 1998. The strip of public land south of Morley Drive and the prominent roundabout at the Morley Drive and Alexander Drive intersection commenced automated irrigation in 1997. Native bush is not irrigated (**Figure 8**). Irrigation regimes are monitored by the CoS according to Hydrozoning principles. This management plan endorses the use of Hydrozoning on Dianella ROS. However, the parts of Hydrozones where high irrigation occurs directly adjacent to native bushland should be reviewed to ensure that overspray does not adversely affect the bushland.

Recommendation

8a. Review Hydrozones and consolidate bushland areas to reduce overspray into bushland. Create additional artificial “ecozones” or “xeriscape” areas where possible to reduce water demand.

8b. Install meters on bores and monitor irrigation/abstraction rate and volume to compare with data obtained from the proposed groundwater monitoring (Recommendation 5).

8c. Balance groundwater abstraction to achieve a sustainable groundwater resource.

3.10 GEOMORPHIC WETLANDS OF THE SWAN COASTAL PLAIN

Wetlands of the Swan Coastal Plain have been classified according to management categories and levels of protection. There are three management levels:

1. Conservation Category Wetlands are wetlands that support high levels of attributes and functions.

2. Resource Enhancement Wetlands are those that have been partly modified but still support substantial functions and attributes.
3. Multiple Use Wetlands are classified as those wetlands with few attributes that still provide important wetland functions.

The AECOM Flora and Fauna Survey (2009) reports that the wetland located at the intersection of Morley Drive and Alexander Drive is listed by the atlas of *Geomorphic Wetlands of the Swan Coastal Plain* as 'Conservation Category'. However, the wetland is described as an "artificial lake, artificial channel" under the Bush Forever listing (DEP, 2000).

The wetland is utilised as a Water Corporation detention basin. Few natural attributes remain intact. The opportunity exists to enhance the biodiversity of this wetland by undertaking restoration utilising native flora as indicated by the Master Plan (Cos, 2008). This restoration can assist in providing an offset against any required clearing associated with the new entrance road from Alexander Drive proposed in the Master Plan (CoS, 2008).

Recommendation

9. Review the drainage function of the wetland and progressively restore wetland flora species as indicated by the Master Plan (CoS, 2008) to enhance the wetland's biodiversity and improve the aquatic ecology of this degraded feature. Restoration should be proceeded by developing a local wetland management plan by following the *Guidelines checklist for preparing a wetland management plan DEC* (2008) & *Environmental Protection Policy Wetlands of the Swan Coastal Plain* (2004).

4.00 CULTURAL HERITAGE, INTERPRETATION, RECREATION & EDUCATION

4.01 ABORIGINAL HISTORY

The following history is extracted from the MPSS (CoS, 2008). The earliest visitors to the site and its environs were the indigenous hunter and gathers of the tribal lands of Yellagonga, whose group was one of several based around the Swan River, known collectively as the Whadjug. The Whadjug was a part of the greater group of 13 or so dialect groupings which formed the south west sociolinguistic block still known today as Nyungar ("The People"), or sometimes by the name Bibbulmun. Three registered Aboriginal Sites (where Aboriginal artefacts have been found) are listed within the Dianella Local Area (MPSS, CoS, 2008). One of these sites is at the northern corner of Dianella ROS Reserve demonstrating that Aboriginal people lived or travelled within the area.

Recommendation

10. Introduce interpretive material and/or signage within the Reserve to celebrate the Aboriginal History of the site.

4.02 EUROPEAN HISTORY

Following the declaration of the Swan River Colony for Britain by Captain Fremantle on 2nd May 1829 the land that now forms Dianella was originally distributed to Robert Thomson then in the period between 1829 and 1930 passing to George Darby, James Drummond and James Birkett. Much of Dianella was subdivided in the 1880s by the Intercolonial Investment Company of Sydney but the sandy soil hampered agricultural activity and local growth. As agriculture was generally unsuccessful (blamed on infertile soil) in the area, it remained substantially undeveloped throughout the nineteenth and early twentieth century, aside from some poultry farms and market gardens. Development was also constrained by accessibility, with no roads penetrating through the dense *Banksia* woodland, making subdivided land difficult to sell to new settlers.

4.03 SUBURBAN DEVELOPMENT

In the year 1919, the only development in Dianella was along Walter Road, which was then a track leading to dairy farms in the Morley area. At this time, Dianella consisted of four localities known as North Inglewood, East Yokine, Morley Park and Bedford Park, which were amalgamated to form Dianella in 1958 - and a growth boom occurred soon after. Dianella got its name from a small blue lily, known botanically as *Dianella revoluta*; a narrow-leafed plant plentiful in the area before residential redevelopment.

4.04 RESERVE CREATION

The following In November 1961 the Town Planning Board endorsed for Dianella the provision of over 1,000 building lots, public open space and regional roads. At this time, the WAPC leased Dianella Regional Open Space to the City for a 25-year term from April 1975 for the purpose of using and developing the land for Parks and Recreation. On the 4 July 2000 Council agreed to the proposal by WAPC to transfer Lot 201 to the State for creation of a reserve vested to the City under the terms of a Management Order. Transfer of the land was affected and the land vested in the City 18 October 2001.

4.05 DIANELLA ROS DEVELOPMENT

The main oval was cleared and levelled in 1976. The present Oval Two Clubrooms (utilised by Lacrosse WA) was the first club building constructed on the reserve at the same time as the two ovals were developed (1976). Jim Satchell Community Recreation Centre was built the following year (1977). The multipurpose tennis courts were constructed in 1977; the larger netball courts constructed the following year. The Scout/Guide Hall was constructed in 1982. Following significant debate and consideration of a proposal to develop a major 50,000 seat Rugby League facility on the reserve (Oval three) an associated car park was developed in 1984 and the clubrooms currently utilised by the Dianella White Eagles and Little Athletics were built on the site in 1985.The separate change rooms and storage facilities developed ten years later. The Clubrooms (Oval Two) currently utilised by the Dianella Morley Football and Dianella Cricket Clubs was the last major building to be developed on the reserve in 1989.

4.06 FACILITIES

Approximately half of the site is altered from its original bushland condition to allow for primarily recreational facilities. There are three main sporting ovals. Two of these, ovals 1 and 2 are accessed by vehicle from a car park entered off Light Street. The third oval incorporates an athletics track and soccer pitch and is accessed by vehicle from a car park entered off Morley Drive. The following facilities occupy parts of the site: BBQ; clubrooms; car parking; shelter / seats; a recreation centre; drinking fountains; power; a scout hall; and picnic benches (**Figure 9**). Recreational (sporting) facilities include provision for: athletics; children's playground; practice nets; hit-up wall (tennis); cricket; lacrosse; tennis; basketball and netball; tee ball; football; and soccer (**Figure 10**).

Essential facilities management requirements to satisfy the recreation needs of users are treated in detail in the Master Plan Support Strategy (2008) and will not be repeated in detail in this document. However the major facilities management upgrade

requirements are shown schematically in the Master Plan (CoS, 2008) itself (**Appendix I**). Possible effects of the proposed major upgrades upon the environmental management of the reserve are treated later in Section 6 of this Draft Management Plan.

4.07 SIGNS

Four types of signs erected on the site are:

1. Directional (providing information as to where facilities are located)
2. Regulatory (informing the public what activities are permitted)
3. Entrance (indicating the name of the reserve and the management authority)
4. Educational (showing information about the natural environment e.g. dieback)

Some of these signs are aging or affected by graffiti such that their impact on the users of the site is of minimal benefit.

Recommendation

11. Progressively replace outdated signs with "*way finding*" (map-based) and/ or interpretive material to celebrate the site's unique features, increase site legibility for users and provide users with an opportunity to identify with the site.

4.08 LANDSCAPE CHARACTER

The three sporting ovals, wetland area, northwest "turf and trees" area and the open corridors of turf linking these together provide the site with a diverse park landscape. The remaining native bushland provides the space-making element and unifying feature throughout the reserve. The main landscape character types (**Figures 11** & **12**) for Dianella Regional Open Space include:

1. Native bushland: this is adjacent to many of the reserves paths and also defines the perimeters of the sporting ovals and much of the Morley Drive and Light Street boundaries.
2. Built areas: including buildings, courts, car parks, fencing and access roads.
3. Wetland areas: including the wetland and associated drainage zones.
4. Open active recreation spaces: sporting ovals and associated facilities.
5. Parkland: open to semi-open grass areas with paths, shade trees, picnic and play areas. This also includes the open "avenue" of grass that extends across the reserve.
6. Bounding roads: including both the residential road (Light Street) and the arterial roads (Morley and Alexander).

4.09 RECREATIONAL NEEDS

The recreational needs considerations for Dianella regional Open Space Reserve were reviewed via a survey and consultation process (internal and external stakeholders) that is discussed in detail in the MPSS (CoS, 2008). In summary, the needs identified included:

1. the maintenance of the pedestrian environment (including dog walking)
2. accommodation of school carnivals
3. provision of amenity infrastructure (playgrounds, BBQs, bicycle paths, drinking fountains, toilets etc.)
4. provision of adequate parking and safe traffic flow
5. accommodation of sporting needs requiring designated areas (soccer, football, cricket, lacrosse, tennis, athletics, basketball and others)
6. provision of facilities for indoor activities and community gatherings (bridge, badminton etc.)
7. access to natural open spaces to facilitate community health and wellbeing
8. provision of outdoor gathering places (for a range of community and family events and functions such as children's parties and extended family gatherings, festivals and other night time events such as movies etc.)
9. accessibility and non-exclusive amenity for all public (allowing engagement with a range of cultural groups and ages)

4.10 MASTER PLAN DEVELOPMENT PROPOSALS

The recreational needs considered in the section above led to a planning process to rationalise the recreation facilities on the reserve. This resulted in a series of planning decisions that are incorporated into the Master Plan (CoS, 2008). This section summarises the major development proposals established under the Master Plan (CoS, 2008) as follows:

6. Jim Satchell Community Recreation Centre – reconfigure entry
7. Tennis Courts – reconfigure layout , remove one court and consolidate bush edge
8. New vehicle entry/exit from Alexander Drive
9. Improve the Light Street Drain to incorporate a *Living Stream* environment
10. Refurbishment (planting and minor earthworks) of the artificial wetland

Of these proposals, the new vehicle entry may impact on the bushland north of Oval 1. AECOM personnel conducted a flora and vegetation survey on the 30th March 2009 (**Appendix III**). The whole reserve was assessed to a Level 1 (EPA Guidance, 2004) standard. A proposed "Clearing Corridor", covering the area of a the planned new entry from Alexander Drive was assessed to a Level 2 assessment detail in accordance with Guidance Statement No. 51. This corridor was found to support a single main

vegetation community (a Banksia Woodland) and was recorded to be in 'Good' condition (Keighery, 1994). The survey's timing was not considered optimal for the identification of the majority of annual and ephemeral species potentially occurring within the site, and this timing was the only factor that did not meet EPA Guidance requirements. This data will also form the basis of the City's submission to the DEC with regard to necessary approvals / permits under the Bushland Clearing Regulations of the Environmental Protection Act (1996).

The following recommendations apply before proceeding to develop the proposed new entry:

Recommendation

12a. Actively consult with DEC to assess DRF, Priority and Conservation Flora within the Alexander Drive Entry "Clearing Corridor" (incorporating a site visit during Spring) prior to vegetation clearing.

12b. Retain existing native flora species where possible, including isolated trees and shrubs, as part of proposed clearing activities.

12c. Control dust, noise and vibration as far as practicable during any construction activities.

Recommendation

13. Conduct a Level 2 Assessment of native fauna (to EPA Guidance Statement 5b requirements) within the area of possible impact by the proposed road to ensure no fauna or fauna habitat is inadvertently destroyed (e.g. nesting or burrowing animals).

In addition, informal consultation with the Department for Planning and Department of Transport regarding the entry road found that a further traffic study is necessary to substantiate the concept for the proposed vehicle entry/exit from Alexander Drive.

Recommendation

14. Undertake a traffic planning/management study to substantiate the entry road concept and to enable necessary approvals *viz.* Department for Planning and Department of Transport.

5.00 BIOLOGICAL ENVIRONMENT

The biological environment at Dianella ROS Reserve has previously been studied in an *ad hoc* manner with prior limited biological surveys conducted as part of the Perth Biodiversity Project. AECOM (2009) conducted a Level 1 Flora, Vegetation and Fauna survey in March 2009 and most of the summary in the following sections is sourced from that report. The AECOM (2009) report is included in this Draft Management Plan as **Appendix III**.

5.01 SITE SPECIFIC VEGETATION ASSOCIATIONS

Across the site, two major vegetation communities (in areas of intact native vegetation) were:

- Marri and Jarrah Open Woodland (CcEmOW)
- *Banksia* Low Open Woodland (BmBaLOW)

A third vegetation community was mapped in one small area as:

- Paperbark shrub land (MpTOS)

Another three vegetation communities were recorded within the project area, consisting of planted and/or cleared areas.

5.02 REMNANT BUSHLAND CONDITION

The majority of the remnant bushland at the site was determined to be in "Good" condition, according to the Keighery (1994) scale. Some areas of "Very Good" condition vegetation were identified and mapped and there were also areas of a more degraded quality. Relatively high species diversity was noted and recorded, however more species inventory would be achieved during a supplementary spring survey that would capture annual and ephemeral species.

5.03 VEGETATION CONNECTIVITY

The remnant bushland of the site is separated into several fragments of varied size. The fragmenting elements are areas of turf, ovals and pathways. Larger areas of 'Good' and 'Very Good' condition [Keighery (1994) scale] vegetation are considered to be more sustainable, whereas pockets of 'Degraded' vegetation and of small size with a high edge to area ratio are considered more susceptible to edge effects and fragmentation. Weed infestations are considered likely to be a significant issue at the site in areas adjacent to cleared areas (e.g. parklands, etc.), however, with annual weeds not being present at the time of the survey, this was difficult to assess. A network of unofficial pathways through the larger remnants further increases the fragmentation of remnant vegetation and this is likely to have facilitated the spread of dieback and weeds. To reduce the likelihood of this occurrence, AECOM (2009) makes the following recommendation:

Recommendation

15a. Bushland in "Very Good" and "Good" condition (Keighery, 1994) should be prioritised for protection by adequate fencing and consolidated where possible.

15b. Closed pathways within communities of *Banksia* Low Open Woodland (BmBaLOW) and Marri and Jarrah Open Woodland (CcEmOW) should be fenced and any compacted ground should be ripped and rehabilitated with local endemic species.

5.04 WEEDS

Nineteen introduced species were recorded during the field survey in 2009. One species *Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) is a Declared Plant (pest weed). This weed is required to be controlled under the Agriculture and Related Resources Protection Act (1976). Control recommendations are included in the AECOM Flora and Vegetation Survey (**Appendix III**).

Recommendation

16. Control occurrences of the Declared Plant *Acacia longifolia* subsp. *longifolia* as required under the Agriculture and Related Resources Protection Act (1976).

5.05 DRF, PRIORITY OR CONSERVATION SIGNIFICANCE FLORA

AECOM personnel conducted a flora and vegetation survey to a Level 1 (EPA Guidance, 2004) standard on 30th March 2009 (**Appendix III**). No known occurrences of Threatened Ecological Communities (TECs) were recorded during the March 2009 survey. Furthermore, no species of Declared Rare Flora (DRF) or Priority Flora or other flora species of conservation significance were found. However, in order to adequately assess all potential occurrences of DRF or Priority Flora, we make the following recommendation:

Recommendation

17. Conduct a Level 2 (EPA, 2004) Spring Flora and Vegetation Assessment in areas of remnant native vegetation to assess DRF and Priority Flora within the term of this plan 2009-19.

5.06 DIEBACK

Glevan Consulting conducted a recent assessment of the site for Dieback Disease *Phytophthora cinnamomi* in April 2009 (**Appendix IV**) and found that the bushland at the site is "*a mosaic of Unmappable, Infested and Uninfested, with changes made to the disease boundaries since the previous assessment".* Glevan mapped 4.1 hectares as infected in the 2009 study and notes that the dieback disease appears to have been present for a number of years and must be actively managed to prevent its spread.

Detailed recommendations presented in the Glevan report can be summarised by following the broad recommendation:

Recommendation

18. Protect large areas of native flora not yet infected by *Phytophthora cinnamomi* by following appropriate hygiene requirements.

5.07 NATIVE FAUNA – BASELINE SURVEY

AECOM conducted a Level 1 assessment of fauna values at the site (**Appendix III**). This survey found that a large proportion of the reserve is considered far too degraded to provide suitable long-term habitat for native fauna, particularly in terms of nesting, breeding and feeding use. However, some areas of intact vegetation exist and are considered to provide good quality habitat for native vertebrate species. In order to measure the habitat performance of this Bush Forever site into the future, a comprehensive survey of fauna present on site needs to be conducted to establish baseline data.

Recommendation

19. Conduct a Level 2 Assessment for native fauna (to EPA Guidance Statement 5b requirements) to establish baseline data to which future surveys can be compared to measure the success of fauna habitat management.

Observed fauna species reported in the MPSS (CoS, 2008) and that were sighted during the Natural Areas Field Assessment (Mattiske, 2006) include the birds:

1. Willy Wagtail
2. Brown Honey-eater
3. Rainbow Bee-eater
4. Red Wattle Bird
5. Magpie
6. Magpie Lark
7. Galah

The AECOM (2009) Flora and Fauna survey (**Appendix III**) sighted one native bird species: The Little Wattle Bird *Anthochaera chrysoptera.* However, based on the results of DEC database searches and the recorded habitat present at the site, AECOM (2009) considered possible that three threatened fauna species may be supported by the bushland remnants within the ROS. These species are Carnaby's Black Cockatoo, the Graceful Sunmoth and the Native Bee. The AECOM (2009) report makes the following recommendation regarding habitat preservation:

Recommendation

20. Retain mature trees that may provide nesting habitat for birds and small mammals.

5.08 FERAL FAUNA

Foxes

Foxes have been a concern in the past, especially in the vicinity of the wetland area where they pose a threat to nesting native fauna. Foxes are not uncommon in urban bush areas. They commonly occupy distinct areas called home ranges that typically range in size from 280 to 1600 hectares (WA Dept of Ag, 2004). Evidence of fox activity was reported (Mattiske, 2006) including scats, a duck kill and a den underneath some bushes.

Recommendation

21. Monitor for fox activity and set baits or traps as necessary to effect control according to accepted procedures (WA Dept of Ag, 2004).

Rabbits

Evidence of rabbit activity was reported (AECOM, 2009) including scats.

Recommendation

22. Monitor for rabbit activity and set baits or traps as necessary to effect control.

Introduced Birds

Three species of introduced birds were opportunistically recorded during the field survey. These are:

1. Feral Pigeon
2. Laughing Kookaburra
3. Rainbow Lorikeet

5.09 DOMESTIC FAUNA

Dogs

Dogs can cause damage to fauna if unleashed or unsupervised. Community response received during the development of this management plan suggested replacing bollards with fencing to exclude dogs from bushland. Appropriate signage can also educate dog owners to the importance of keeping animals supervised and away from areas utilised for native habitat.

6.00 MANAGEMENT PLAN

6.01 THE CHALLENGE AND OPPORTUNITY

The challenge and opportunity for this Draft Management Plan can be summarised as follows:

- ► Accommodate natural area functions and contribute to local needs
- ► Blend and balance these functions successfully
- ► Enhance and protect all parts of the reserve with special attention paid to the remaining “very good” and “good” (Keighery, 1994) areas of native vegetation
- ► Ensure the sustainable use of resources – following the principle of intergenerational equity

6.02 METHOD

To this point the Draft Management Plan investigation shows twenty-two (22) recommendations separated from the body of the text in boxes. In addition to the 22 recommendations resulting from the study, a separate set of ten (10) management issues and recommendations originated from an *Issues Paper* study during the initial scoping stage of this investigation. Recommendations from the *Issues Paper* are shown below.

6.03 ISSUES PAPER SUMMARY OF RECOMMENDATIONS

Key management issues and recommendations from the *Issues Paper* that have not been previously mentioned in this report are as follows:

Issue: Fragmented bushland areas

Recommendation
23a. Remove weeds & rehabilitate bushland edges to join fragmented areas where practicable
23b. Remove of non-local trees and replace progressively with local species
23c. Rationalise and clearly delineate pedestrian paths / eliminate informal tracks

Issue: Difficult to grow lawn under eucalyptus trees

Recommendation
24a. Remove eucalypts in parkland areas as necessary to create defined areas of open space
24b. Where turf growth is poor, introduce groundcover planting/gravel/mulch beneath remaining stands of eucalyptus trees

Issue: Antisocial behaviour and rubbish dumping (fly dumping) in car parks and bush adjacent to car parks

Recommendation
25a. Install entrance barriers to prevent night entry 25b. Improve lighting 25c. Prune understory vegetation selectively to make “view corridors” and improve visibility

Issue: Non-optimal internal vehicular access and traffic circulation

Recommendation
26a. Introduce new entry road from Alexander Drive 26b. Consider realignment of this road to prevent bushland fragmentation Install entrance

Issue: Safety to playground area - lack of passive surveillance

Recommendation
27. Relocate playground to improve its standard and rehabilitate the former playground location

Issue: Insufficient parking for multiple sporting events

Recommendation
28. Convert under-utilised, decommissioned netball and tennis courts into a central consolidated car park area

Issue: Many bush/ turf/ path/ bollards interfaces require rationalisation to a management edge to impede weed encroachment.

Recommendation
29. Replace narrow strips of grass along bush side of paths with appropriate ground cover to enable pathways to act as management edges

Issue: Lack of suitable spectator viewing areas for sporting ovals

Recommendation
30. Provide improved spectator viewing areas with suitable aspects for viewing sport

Issue: Graffiti to walls and signage

Recommendation

31. Utilise graffiti-repellent coatings on susceptible facilities and signs and regularly inspect and remove graffiti to discourage repeated attacks

Issue: Access to universally accessible toilets is currently restricted to sporting event times

Recommendation

32. Construct universally accessible toilets

All thirty-two (32) recommendations are presented as a complete set at the beginning of this document.

7.00 GRAPHICAL REPRESENTATION OF ISSUES AND ACTIONS

The management issues described in the above section together with their accompanying recommendations are graphically presented in **Figures 13** to **16**. Most of the recommended actions are based on the Master Plan (CoS, 2008) (**Appendix I**) and should be viewed in conjunction with that document.

8.00 ADOPTION

It is proposed that the Draft Management Plan will be endorsed by Council and adopted by stakeholders following the process outlined below:

- ► Council Endorsement of Draft Management Plan – August 2009
- ► Community feedback period – September 2009
- ► Issue of Final Management Plan – October 2009

9.00 REFERENCES

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10.00 ACKNOWLEDGEMENTS

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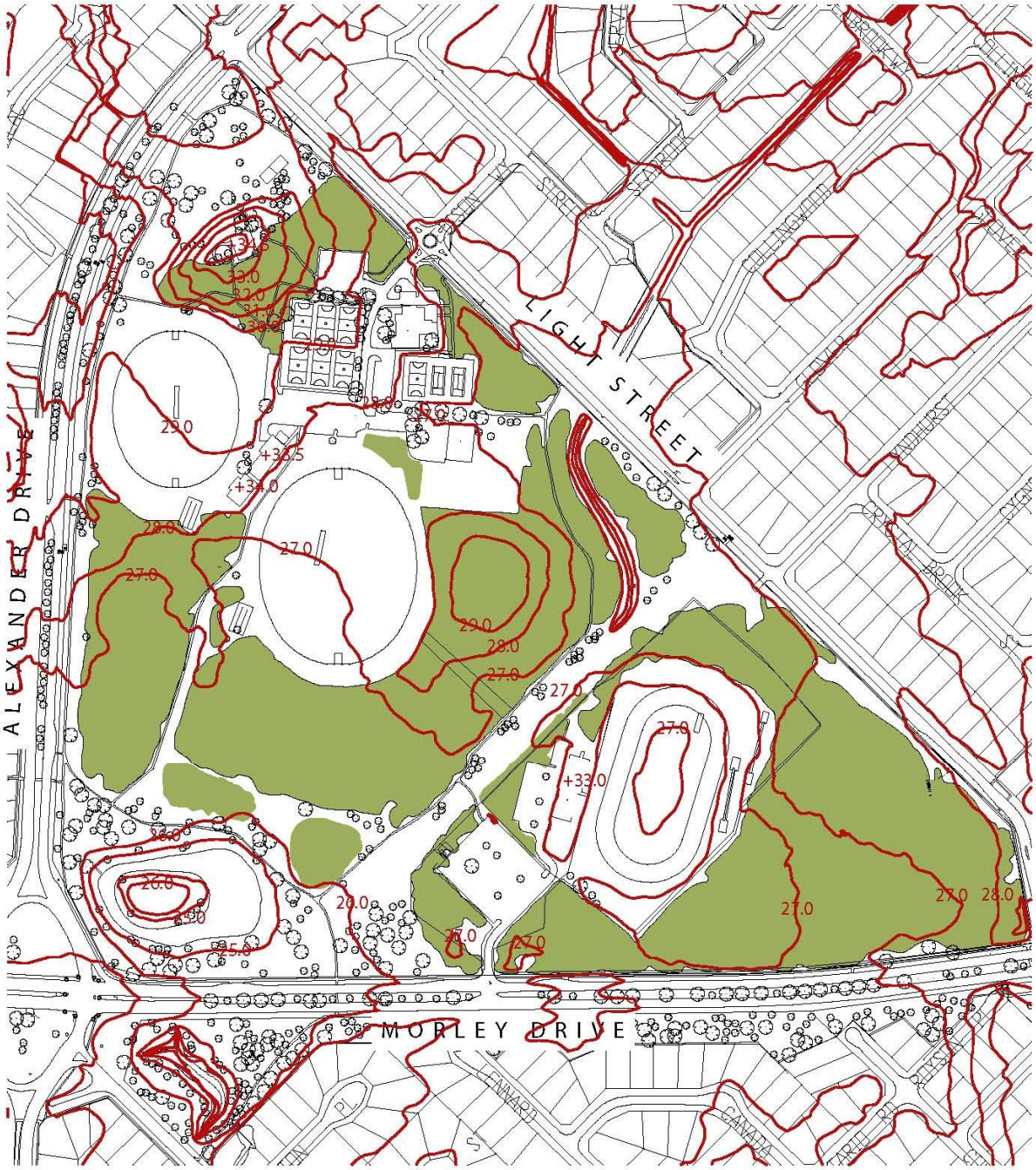
FIGURES

Figure 1

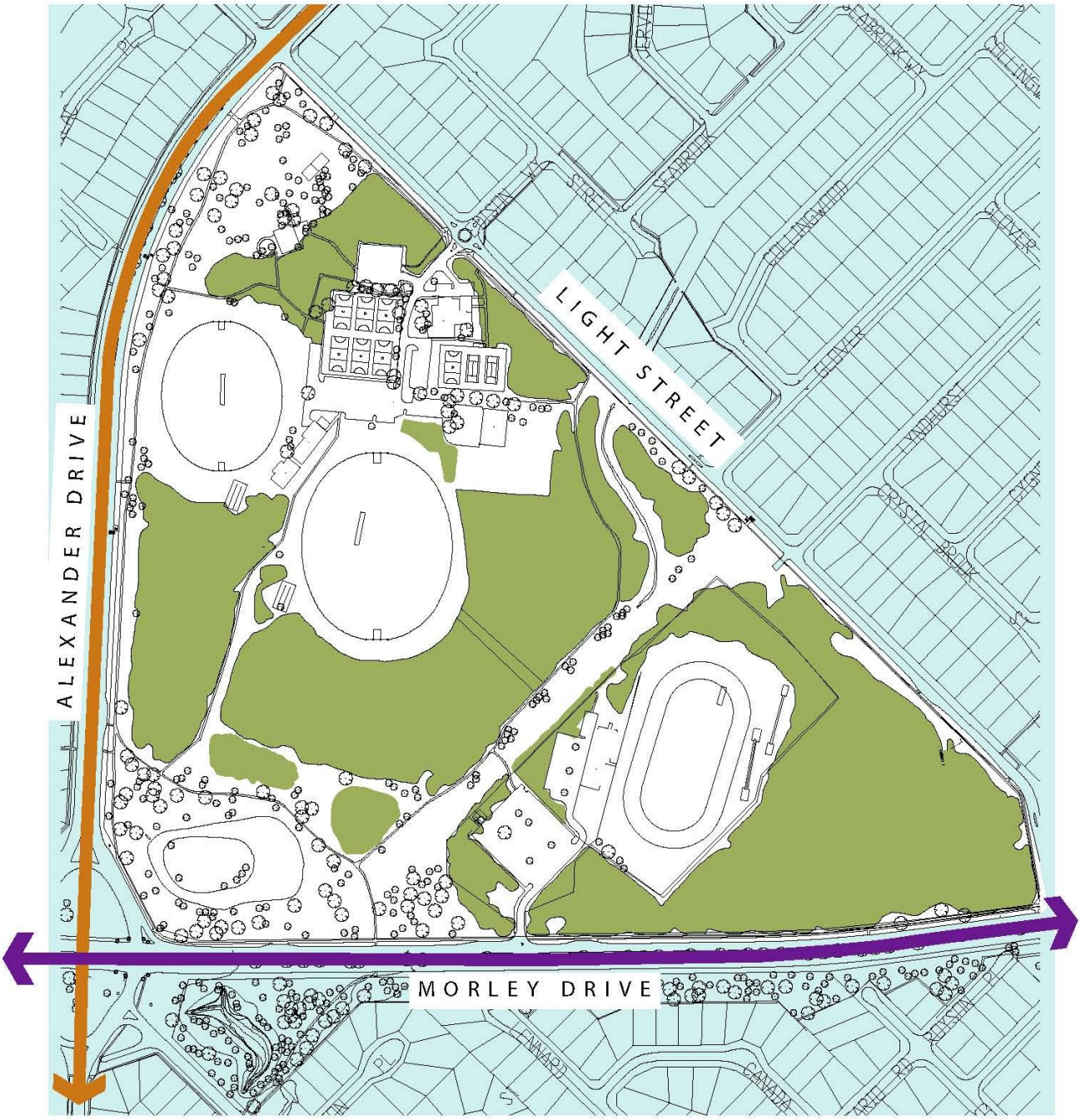
Location

Figure 2



Levels

Figure 3



Planning Framework

- urban
- other regional road
- primary regional road
- native bushland

informed by the West Australian Planning Commission's Metropolitan Region Scheme Maps

Figure 4

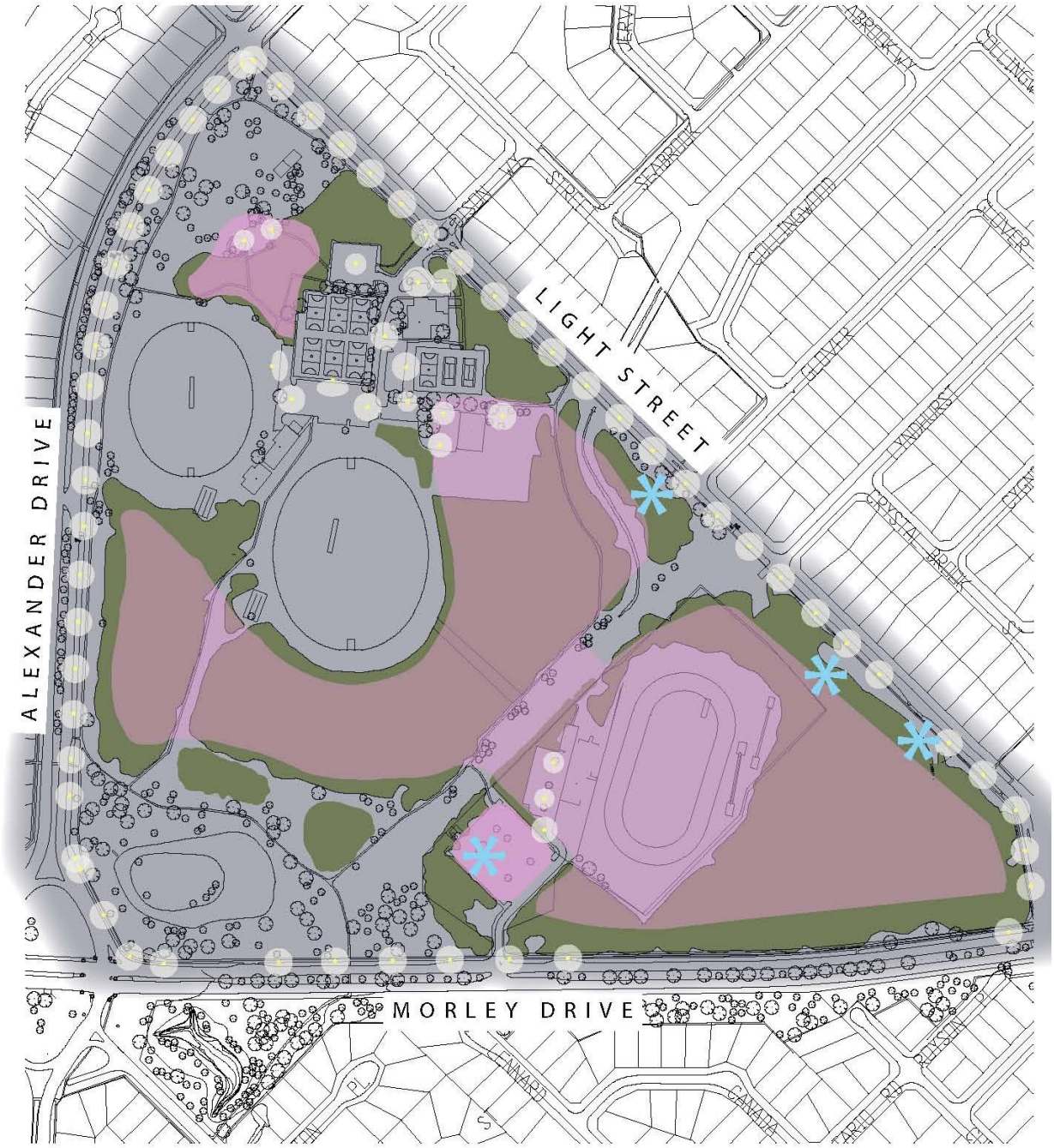
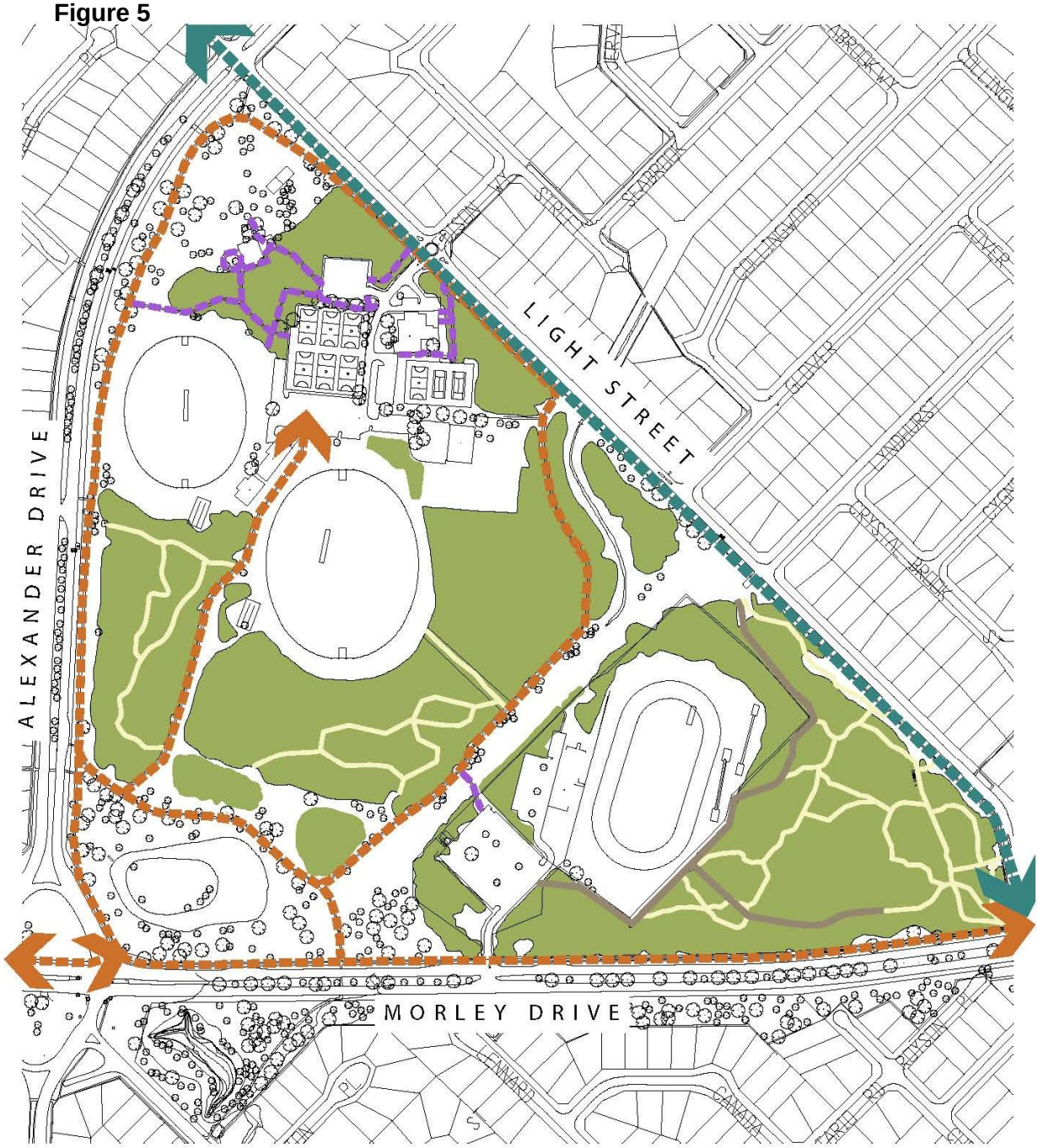

LIGHT STREET
ALEXANDER DRIVE
MORLEY DRIVE
Security + Surveillance
no passive surveillance
street + car park lighting
fly dumping locations

Figure 5



Infrastructure - Paths

- footpath
- shared cycle / footpath
- Perth Bicycle Network cycle path
- limestone path
- informal bush tracks
- native bushland

informed by the Department for Planning and Infrastructure's Perth Bike Map Series (Stirling)

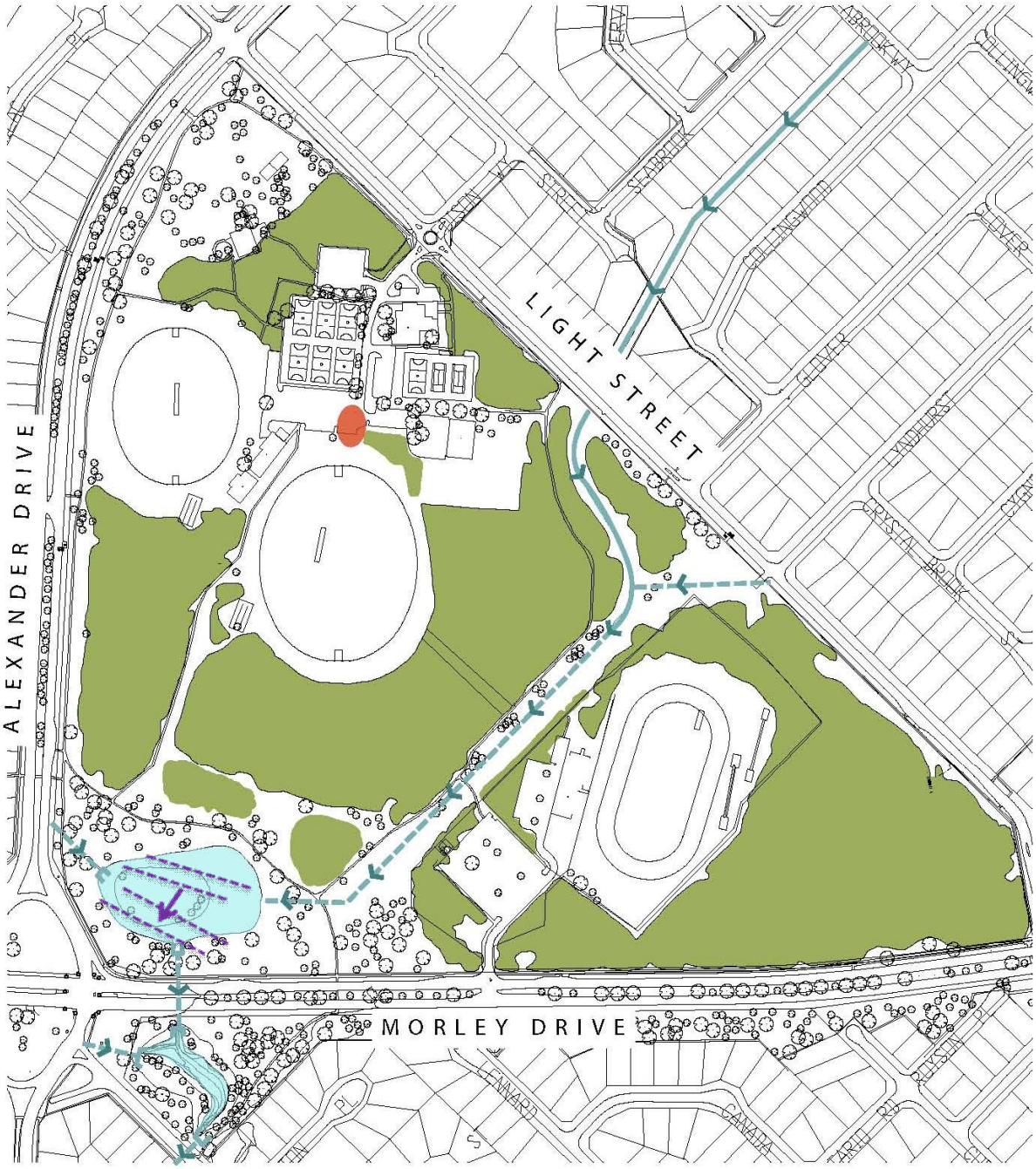
Figure 6

Infrastructure - Fences

- bollards
- copper log fence
- court fence
- chain mesh fence (1.8m)
- native bushland

informed by the latest GPS mappings and site analysis drawings provided by the City of Stirling

Figure 7



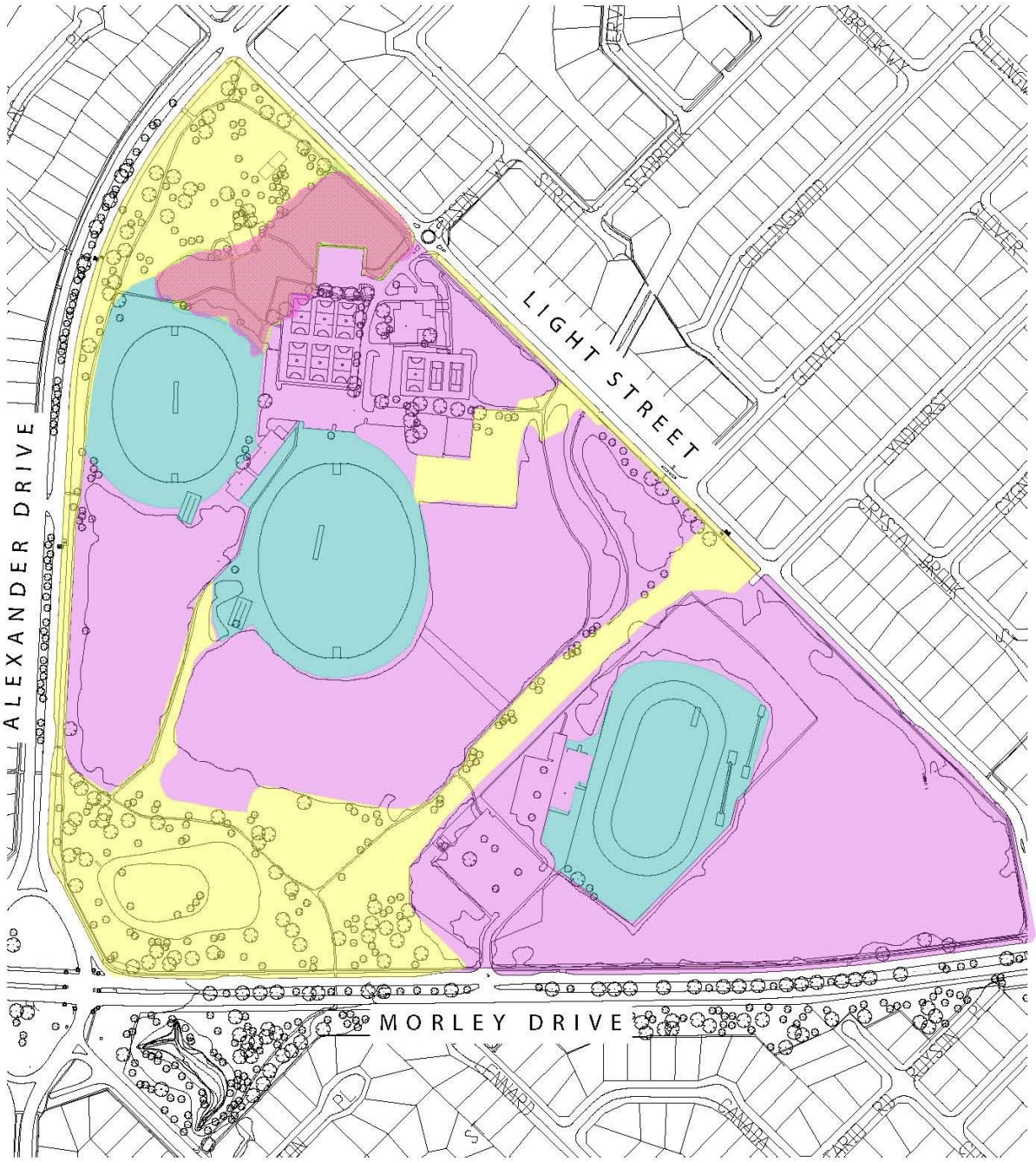
Water

- wetland
- buried pipe
- open drain
- flooding
- native bushland
- groundwater flow direction

informed by site analysis drawings provided by the City of Stirling

groundwater depth in wetland – 0.1 to 0.3 mBGS, January 2000

Figure 8

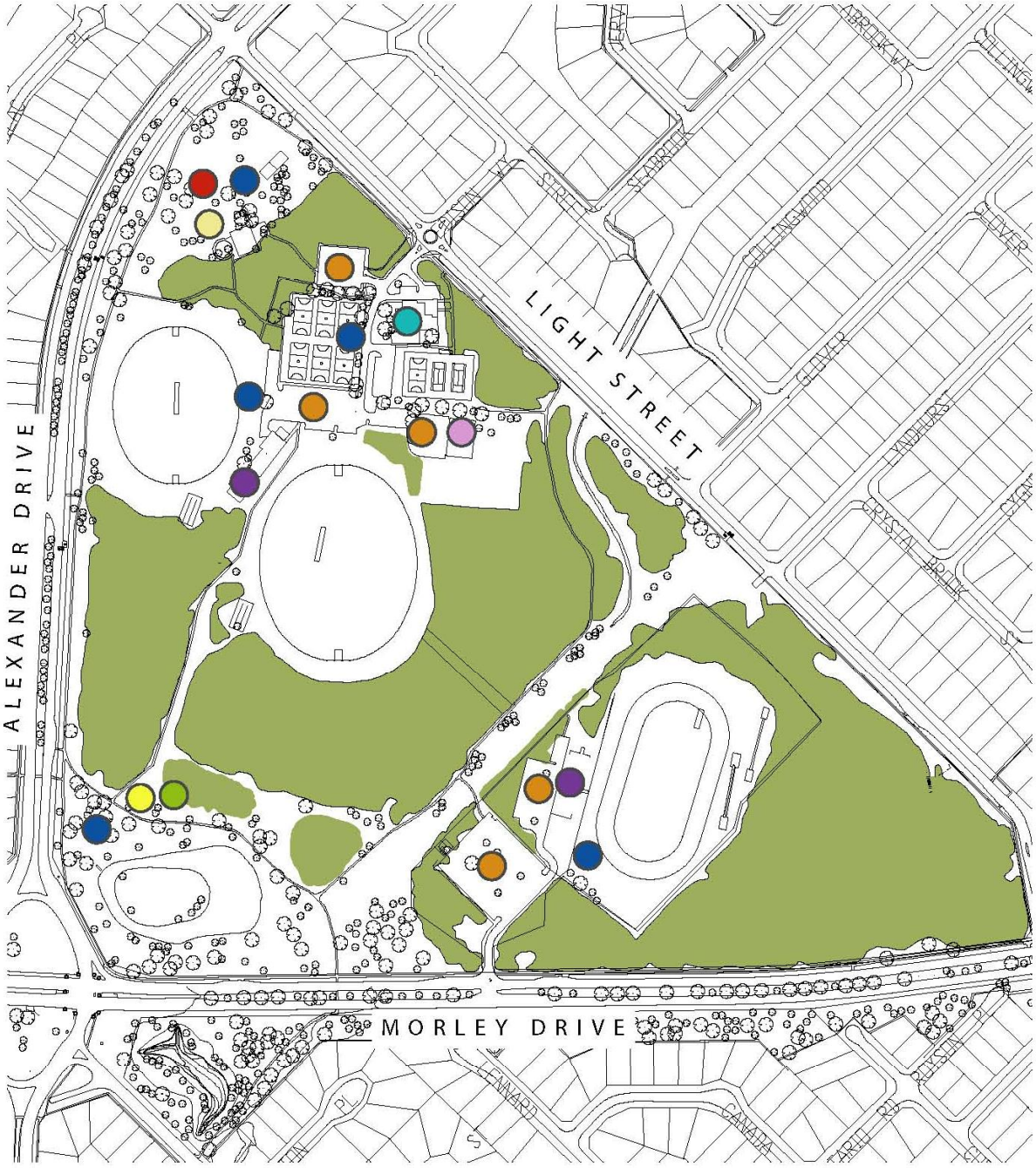


Irrigation

informed by the City of Stirling's hydroplan

- 45mm - high quality heavily used lawn
- 20mm - general parkland
- 0mm - non irrigated area within bore license

Figure 9



Infrastructure - Facilities

- BBQ
- clubrooms
- car park
- shelter with seating
- recreation centre
- drinking fountain
- power
- scout hall
- picnic benches
- native bushland

informed by the City of Stirling's Dianella Regional Open Space Infrastructure Map

Figure 10

Infrastructure - Recreation

- athletics
- playground
- practice nets
- hit-up wall
- cricket
- lacrosse
- tennis
- basketball / netball
- tee ball
- football
- soccer
- native bushland

informed by the City of Stirling's Dianella Regional Open Space Infrastructure Map

Figure 11

Character

- native bushland
- built areas
- wetland
- open active recreation
- parkland
- arterial road
- residential road

informed by site analysis drawings
provided by the City of Stirling

Figure 12

a native bushland

b built areas

c wetland

d open active recreation

e parkland

Figure 13

Assets Management Issues
hit-up wall under utilised and poorly located
poor passive surveillance to playground
lack of suitable spectator viewing areas
tennis courts under utilised
dieback spreading in bushland
site identification
acknowledge and preserve historic cultural sites

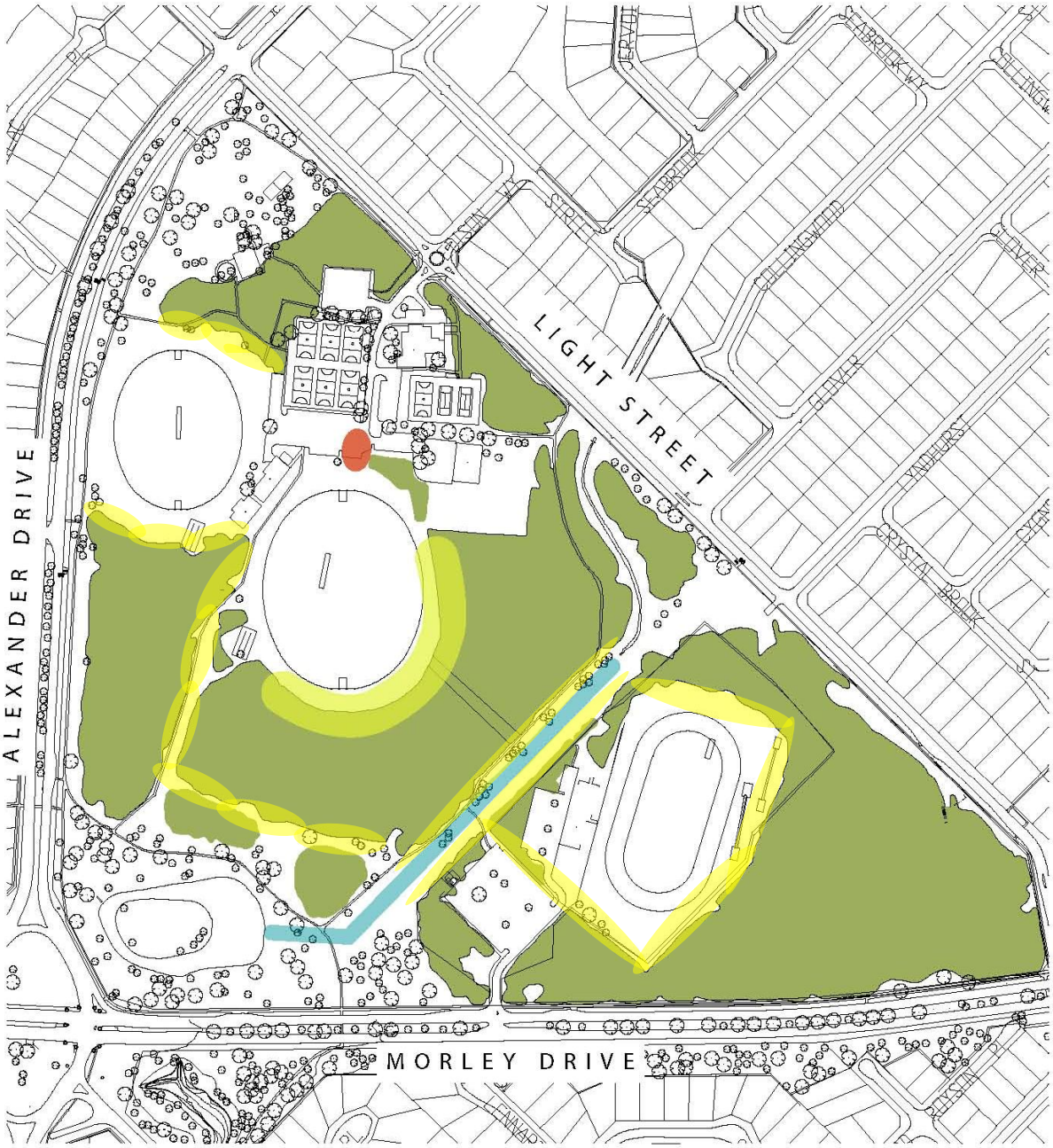
Assets Management Actions
a remove hit-up wall, relocate to b
c remove playground, relocate to d
e new spectator seating to clubrooms
f move and redevelop tennis courts as 3 multi-purpose courts
new fence
new reserve identification signage
new Aboriginal historical site marker

Figure 14

Security and Access Management Issues
anti-social behaviour and fly dumping at night
poor vehicular access and circulation
insufficient parking for multiple sporting events

Security and Access Management Actions
new automated security bollards
new vehicular access road
consolidated parking area

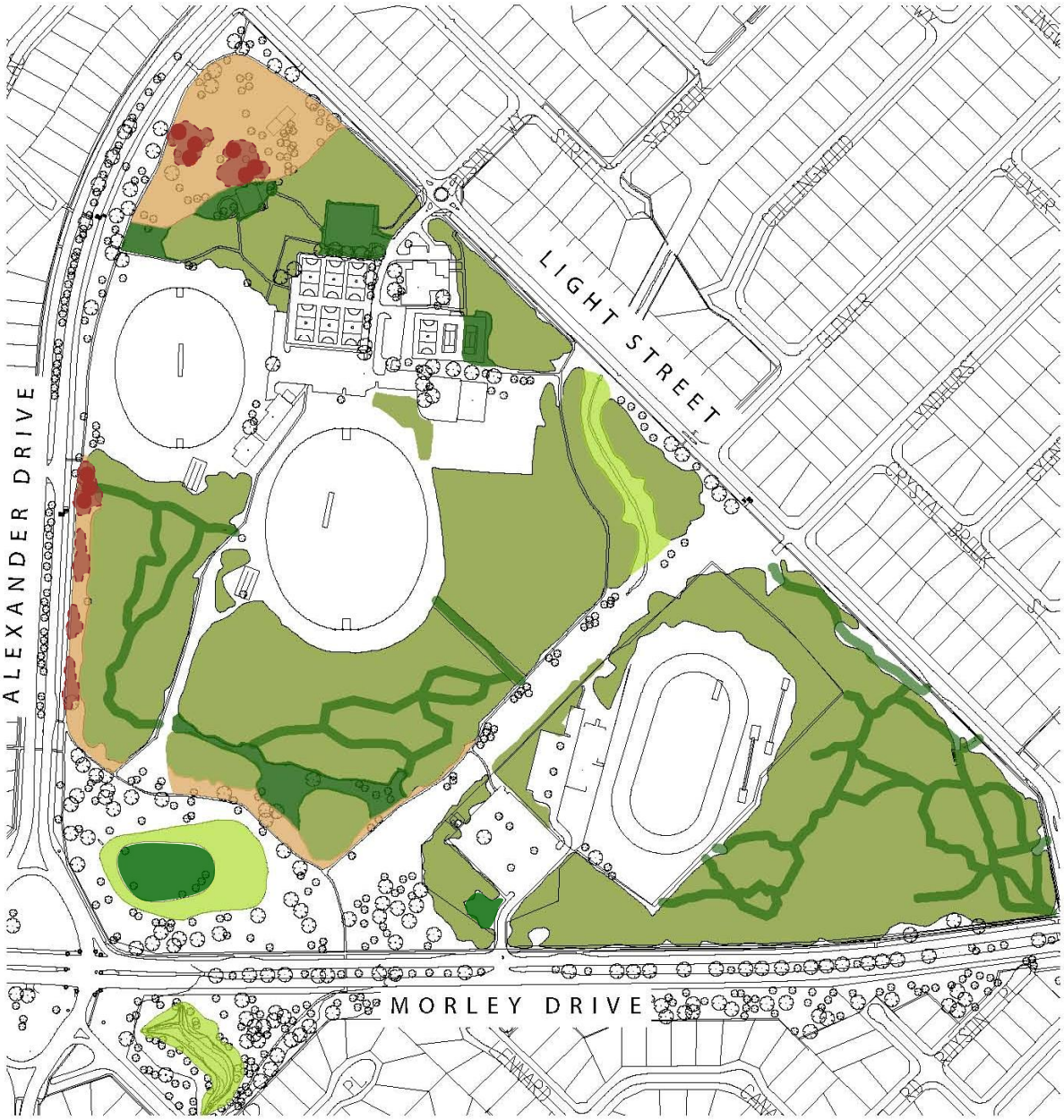
Figure 15



Water Management Issues
flooding to carpark
encroachment of weeds to native bushland
watercourse legibility

Water Management Actions
regrade car park
provide irrigation system with a more suitable spray type to prevent over-spray in to bush
investigate "living stream" and WSUD application to replace buried WC pipe

Figure 16



Vegetation Management Issues
controlling dieback in bushland areas
consolidation of bushland areas
site water quality
lawn management under trees
rationalise interface between bush, turf, path, bollards.

Vegetation Management Actions
revegetated bushland
remove non-native trees and ***progressively*** replace with provenance species
wetland revegetation to improve water quality
consolidate lawn area by using mulching and low native species under trees

APPENDIX I

Dianella Regional Open Space Master Plan

City of Stirling, 2008

REMOVE TENNIS HIT-UP WALL.

REMOVE OCCASIONAL EASTERN STATE EUCALYPTUS TREE SPECIES TO CREATE OPEN LAWN AREAS.

RELOCATION OF PLAY GROUND TO A SAFER MORE ACCESSABLE AREA WITH COMPLEMENTARY RESERVE ACTIVITIES AND PARKING.

REMOVE EXISTING TRACKS AND CONSOLIDATE BUSHLAND.

NEW MAJOR VEHICLE ENTRY / EXIT FROM ALEXANDER DRIVE.

REMOVE CENTRAL TENNIS COURTS & DEVELOP CONSOLIDATED PARKING AREA.

NEW UNIVERSAL ACCESS PUBLIC TOILET.

EXTEND ROOF AND PROVIDE SEATING TO CLUB ROOMS.

UPGRADE OF BUILDING UNDERCROFT ON A SHORT-TERM BASIS TO CREATE ADDITIONAL STORAGE FACILITIES. LONG-TERM USE BASED ON COUNCIL ACCEPTANCE OF CLUB SUPPORTED PROPOSAL.

REMOVAL OF UNDERSTOREY VEGETATION TO IMPROVE VISIBILITY

REMOVE NON-LOCAL TREES FROM BUSHLAND AREAS.

ESD (ENVIRONMENTAL SUSTAINABLE DESIGN) WILL BE INCORPORATED THROUGHOUT FUTURE WORKS. CONSIDERATION AT A DESIGN DETAIL LEVEL WILL ADDRESS CONSERVATION, SUSTAINABLE MATERIALS, WATER QUALITY, SOLAR ENERGY, & FACILITY USE STRATEGIES INCLUDING SHARED USE OF FACILITIES.

INSTALL DRINKING FOUNTAIN WITH DOG BOWL, SEATS AND SHELTER

EARTH WORKS TO EXISTING DETENTION BASIN. PLANTING OF ENDEMIC SP.RUSHES SEDGES AND GRASSES.

RESERVE IDENTIFICATION SIGN.

WIDEN WATERCORP DRAIN TO PROVIDE SOME OPEN WATER HABITAT AND OPPORTUNITIES TO REHABILITATE THE STREAM EDGE WITH SELECTED PLANTINGS OF ENDEMIC RUSHES,SEDGES & GRASSES.

REMOVAL OF THE CAR PARK AND CONSOLIDATION OF BUSHLAND

JIM SATCHEL COMMUNITY RECREATION CENTRE MINOR MODIFICATIONS INCLUDING REDEVELOPMENT OF BUILDING FRONTAGE, CONVERSION OF SMALL NORTHERN CAR PARK INTO A PEDESTRIAN FRIENDLY GRASSED SPACE, INTERNAL AESTHETIC/REFIT IMPROVEMENTS AND REMOVAL OF PLAY EQUIPMENT ITEMS.

RESERVE ENTRY FEATURE STATEMENT

CONSTRUCT NEW MULTIPURPOSE COURTS IN THE CAR PARK AREA WEST OF THE EXISTING COURTS. NEW COURT TO INCLUDE NETBALL AND BASKET BALL COURTS. BUSHLAND REGENERATION OF AREA PREVIOUSLY OCCUPIED BY TENNIS COURT.

EXISTING SCOUT/GUIDE HALL

REHABILITATE OPEN WATER COURSE TO IMPROVE ENVIRONMENTAL VALUES, ENHANCE PEDESTRIAN LANDSCAPE EXPERIENCE . PLANTINGS DESIGNED TO ACCOMMODATE WATERCORP MAINTENANCE REGIMES AND SUIT SEASONAL INUNDATION. BUSHLAND CONSERVATION AND ENRICHMENT WITH TRANSITIONAL PLANTINGS.

FAMILY AND COMMUNITY RECREATIONAL AREA WITH PICNIC & PLAY FACILITIES SHADE SAILS, SHELTERS, & BBQs.

NEW REGIONAL PLAY GROUND WITH SHADE SAIL FACILITY

NEW MULTI PURPOSE HALF COURT AND HIT UP WALL

EXTENDED STREAM ENVIRONMENT WITH IMPROVED WETLAND HABITAT VALUES AND BOARDWALK ACCESS ACROSS.

NEW FLOODLIGHT CONFIGURATION.

INTRODUCE BUSHLAND CONSERVATION FENCING ALONG CONSOLIDATED BUSH TRACKS.

NEW FLOODLIGHT CONFIGURATION

100M SPRINT AND ATHLETICS TRACK

POSSIBLE FUTURE EXPANSION (ADMINISTRATION) TO EXISTING OVAL 3 CLUBROOM FACILITY

UPGRADE OVAL SPECTATOR BOUNDARY FENCE ON EXISTING ALIGNMENT.

RESERVE IDENTIFICATION SIGN.

EDUCATIONAL CULTURAL AND HERITAGE SIGNAGE AT SIGNIFICANT LOCATIONS ALONG BUSH LAND TRAILS AND THROUGHOUT THE PARK.

AUTOMATED SECURITY BOLLARDS TO MANAGE EVENING VEHICLE ACCESS.

RESERVE IDENTIFICATION SIGN.

CONSTRUCT A COMMUTER CYCLIST AND RECREATIONAL CYCLIST/PEDESTRIAN TWO PATH LOOP ON THE OUTSIDE OF THE OPEN SPACE.

SURFACES / VEGETATION

- Bushland vegetation
- Grassed areas
- Active recreation ground
- Wetland areas & rehabilitation
- Natural bushland revegetation areas
- Median dry-land planting

CIRCULATION

- Existing Car Parking
- Footpath
- Recreational Bike/Pedestrian Path
- Street Network Footpath
- Commuter Bike Path
- Shared Path
- Limestone Bush Track
- Bus Stops

LIGHTING

- Practice Lights
- Potential Security Lighting

STRUCTURES

- Bore
- Regional Play Equipment
- Feature Entrance Statement
- Clubrooms

SPORTS FACILITIES

- Cricket Pitch
- Foot Ball Ovals
- Athletics
- Practise Nets
- Hit up Wall
- Soccer
- Lacrosse

PARK FURNISHINGS

- Park Benches
- Picnic Tables
- BBQ's
- Park Shelters
- Drinking Fountain

10 20 50 100 200 metres

The Dianella Regional Open Space Master Plan is being prepared by the City of Stirling to guide the ongoing management and improvement of Dianella Regional Open Space.

City of Stirling
City of Choice

Dianella Regional Open Space Master Plan 2008

Apr 2008

APPENDIX II

Advice from Minister for Aboriginal Affairs
Regarding Location S00691

99000957

**MINISTER FOR HOUSING; ABORIGINAL AFFAIRS;
WATER RESOURCES**

Our Ref: 05363

Ms Liz Du Guesclin
Parks and Reserves Department
City of Stirling
Civic Place
STIRLING WA 6021

Dear Ms Du Guesclin

***ABORIGINAL HERITAGE ACT 1972* - SECTION 18 - CITY OF STIRLING - UPGRADING PLAY EQUIPMENT - REGIONAL OPEN SPACE, DIANELLA**

I refer to the section 18 application dated 10 November 1998 which was received from the City of Stirling seeking permission to use the land containing site S00691 for removing and replacing old play equipment and installing a picnic area at the regional Open Space, Light Street, Dianella.

In accordance with my powers under section 18(3) of the *Aboriginal Heritage Act 1972*, and following consideration of the recommendations from the Aboriginal Cultural Material Committee, I wish to advise you that, as location S00691 is not considered a site, the section 18 is not required and the Committee has no objection to the proposal by the City of Stirling for removing and replacing old play equipment and installing a picnic area at the Regional Open Space, Light Street, Dianella.

Yours sincerely

Dr Kim Hames MLA
MINISTER FOR ABORIGINAL AFFAIRS

15 JAN 1999

CITY OF STIRLING
MAYOR ☐ CNCL REL ☐ GEO / EA ☐
DCEO MR ☐ EMW ☐ EMCO ☐
FM ☐ GA ☐ ☐
18 JAN 1999
ACK ☐ ADVICE ☐ INFO ☐ FILE ☑
RESPOND DIRECT ☐ DRAFT REPLY ☐
ACTION AYS ☐ NO REPLY NEC ☑
FILE No 6.4.0.166

BMW 18.1.98

Search Criteria

Site 3165

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L	Lodged	IR	Insufficient Information (as assessed by Site Assessment Group)
I	Insufficient Information	PR	Permanent register (as assessed by Site Assessment Group)
P	Permanent register	SR	Stored data (as assessed by Site Assessment Group)
S	Stored data		

Site Assessment Group (SAG)

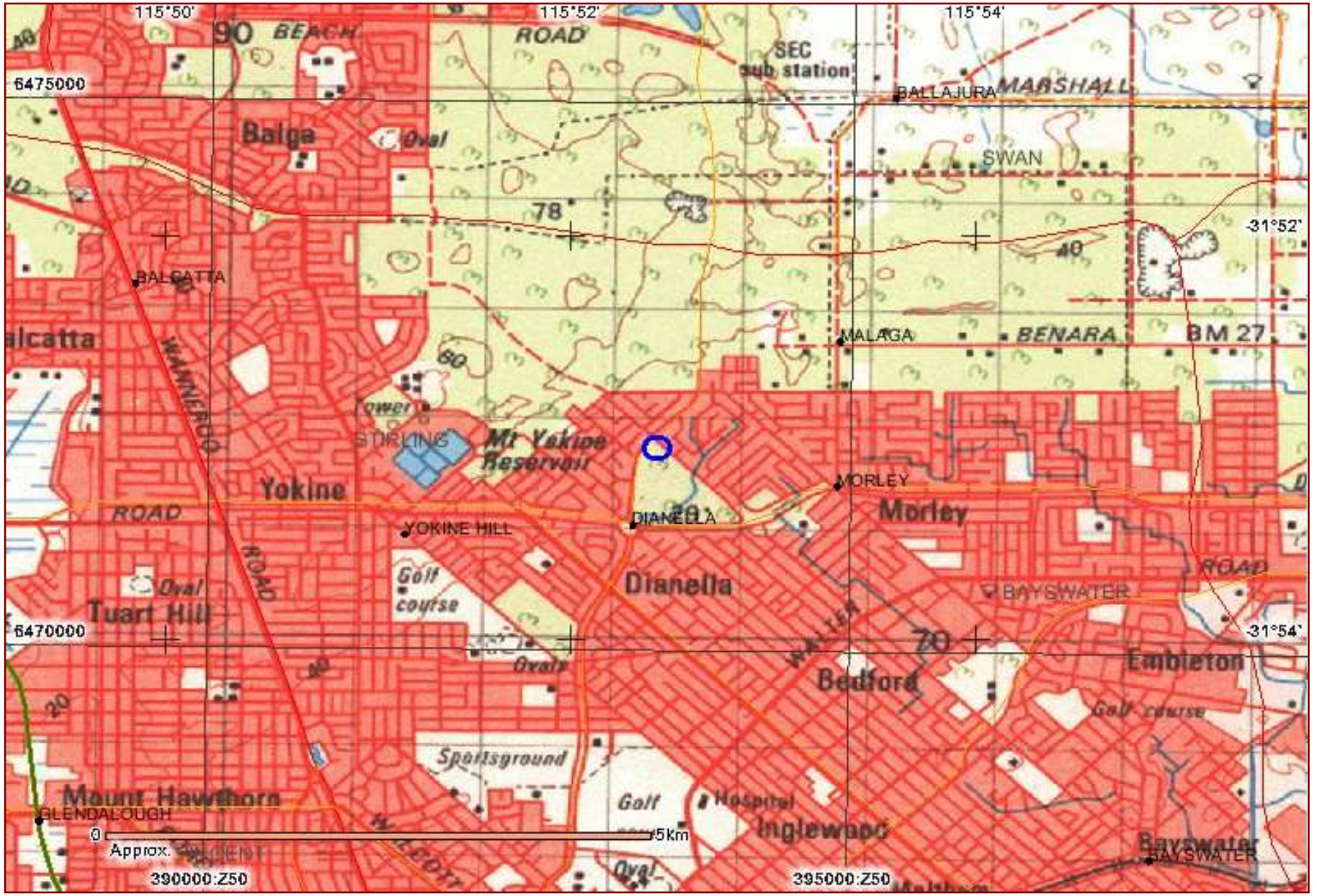
Sites lodged with the Department are assessed under the direction of the Registrar of Aboriginal Sites. These are not to be considered the final assessment.

Final assessment will be determined by the Aboriginal Cultural Material Committee (ACMC).

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
3165	S	O	N	Light Street	Artefacts / Scatter			393489mE 6471849mN Zone 50 [Reliable]	S00691



Legend

- Highlighted Area
- Town
- Map Area
- Search Area

APPENDIX III
Flora & Fauna Survey
Maunsell AECOM, 2009

AECOM

Flora and Fauna Survey

Dianella Regional Open Space (ROS)

City of Stirling

13 August 2009

Flora and Fauna Survey

Prepared for

City of Stirling

Prepared by

AECOM Australia Pty Ltd
3 Forrest Place, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia
T +61 8 6430 2000 F +61 8 6430 2999 www.aecom.com
ABN 20 093 846 925

13 August 2009

60097764

Quality Information

Document Flora and Fauna Survey

Ref 60097764

Date 13 August 2009

Prepared by Gaby Martinez and Alex Sleep

Reviewed by Kellie Honczar

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	21/04/2009	Draft for internal Review	Kellie Gibbs Senior Environmental Scientist	
B	08/05/2009	Draft for Submission	Kellie Gibbs Senior Environmental Scientist	
0	29/04/2009	For Issue	Kellie Gibbs Senior Environmental Scientist	
1	11/05/2009	Revised Issue	Kellie Gibbs Senior Environmental Scientist	
2	15/06/2009	Final Issue	Kellie Gibbs Senior Environmental Scientist - Botanist	
3	13/08/2009	Incorporating Client Comments	Kellie Gibbs Senior Environmental Scientist - Botanist	

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Executive Summary

Recently the City of Stirling issued a Master Plan (MP) and Master Plan Support Strategy (MPSS) document for the Dianella Regional Open Space (ROS) (herein called 'project area') addressing most of the issues, needs and constraints affecting the adoption of long-term future development strategies for the reserve. The MPSS identified the needs the of the community, relevant clubs and user groups; national state and local planning objectives and the underlying natural values of the reserve in order to allow a cohesive vision for the future. The next stage in the strategic planning process is the development and adoption of a Plan of Management for the reserve.

In order to gain an understanding of potential environmental impacts of the proposed works, AECOM was commissioned to conduct a Flora and Vegetation survey of the project area. The results of the survey are presented in this report.

The survey within the project area specifically dealt with the assessment of the following values:

- Flora (native and introduced with a focus on threatened species);
- Vegetation communities;
- Vegetation condition; and
- Weeds (including environmental/pest weeds and Declared Plants).

The timing of the survey was not considered optimal for the identification of the majority of annual and ephemeral species potentially occurring within the project areas. The requirements of a Level 1 survey are considered to have been met, in accordance with Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004). For the purposes of an application to undertake clearing within the project area, the results of the level 1 Assessment are not considered sufficient.

The 'clearing corridor', which refers to the proposed entry/exit from Alexander Drive, was conducted to a Level 2 assessment in accordance with Guidance Statement No. 51 in order to assist the City of Stirling with obtaining approval to undertake proposed clearing activities in this area. However, the entire project area is located within Bush Forever Site No. 280 (Dianella Open Space) as well as within an Environmentally Sensitive Area (ESA) and any vegetation clearing within this area will require active consultation with the DEC. All of the vegetation within the project area is considered to be regionally significant due to its location within an ESA.

No known occurrences of TECs have been recorded within the project area during the March 2009 field assessment. No species of DRF or Priority Flora, or other flora species of conservation significance were recorded during the field assessment.

Nineteen introduced species were recorded during the field survey in 2009, one of which is listed as a Declared Plant by the Department of Agriculture and Food Western Australia, pursuant to the *Agriculture and Related Resources Protection Act, 1976* (DAFWA, 2009). This species is **Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) and its required control measures is presented in Appendix C.

Five vegetation communities were recorded within the project area, consisting of two Woodlands, one Shrubland and two planted and/or cleared areas. None of the vegetation communities recorded have been determined to be equivalent to State TECs or PECs under the listings or Commonwealth TECs under the *EPBC Act 1999.*

The majority of the vegetation within the project area has been subject to a significant amount of disturbance, mainly through clearing for urban based purposes in the surrounding area. Overall, the vegetation condition ranged from 'Very Good – Good' to 'Completely Degraded'. The better quality vegetation within the project area was considered to be in 'Very Good – Good' condition and is represented by communities BmBaLOW and CcEmOW.

There is one Conservation Category wetland (UFI 8142) that occurs within the project area. The majority of vegetation within this wetland was found to be in a Degraded to Completely Degraded condition.

The site assessment of the project area observed only one native fauna species, the Little Wattlebird (*Anthochaera chrysoptera*) and also activity of introduced rabbits. The timing of the survey was not considered optimum for observing native fauna activity. The majority of the project area is far too degraded to provide suitable long-term habitat for significant native fauna, particularly in terms of nesting, breeding and feeding use. However, some areas of intact vegetation exist and are considered to provide good quality habitat for native vertebrate species. Intact remnants patches and predominantly mature trees, both locally native and introduced, are likely to provide habitat for native birds.

Based on the results of DEC database searches and the recorded habitat present at the site, it is considered possible that three threatened fauna species may be supported by the bushland remnants within the ROS. These species are Carnaby's Black Cockatoo, the Graceful Sunmoth and the Native Bee.

For the purposes of assessing any ongoing activities in the area, including an application for vegetation clearing, additional surveys and considerations are recommended and these include:

- a detailed, Level 2 Spring Flora and Vegetation Assessment be conducted in areas of remnant native vegetation to determine whether any of the Priority and DRF from the DEC database search actually occur within the project area;
- a follow-up Level 1 Fauna Survey conducted during spring, when fauna activity will be higher;
- retain existing native flora species where possible, including isolated trees and shrubs, as part of proposed clearing activities;
- retain mature trees that may provide nesting habitat for birds and small mammals;
- dust, noise and vibration is controlled as practicable during any construction activities;
- pathways are rationalised and formalised to minimise disturbance and unnecessary access;
- closed pathways within communities BmBaLOW and CcEmOW should be fenced and compacted ground ripped and rehabilitated with local endemic species;
- Vegetation within communities BmBaLOW and CcEmOW should be 'fenced' and rehabilitated with local endemic species to prevent any weed invasion which could potentially smother native species and compete vigorously for space, water and nutrients, as well as adversely affecting the biological integrity of natural communities by altering vegetation structure; and
- The project area is located within Bush Forever Site No. 280 (Dianella Open Space) and within an ESA. Therefore active consultation with DEC regarding direct impacts on these areas and strategies for minimisation and management of impacts, plus contingencies if appropriate is recommended.

1.0 Introduction

1.1 Project Background

Recently the City of Stirling issued a Master Plan (MP) and Master Plan Support Strategy (MPSS) document for the Dianella Regional Open Space (ROS) (the reserve). These documents addressed most of the issues, needs and constraints affecting the adoption of long-term future development strategies for the reserve. The MPSS identified the needs the of the community, relevant clubs and user groups, national state and local planning objectives and the underlying natural values of the reserve in order to allow a cohesive vision for the future. The next stage in the strategic planning process was the development and adoption of a Plan of Management for the reserve. As a result, the City of Stirling sought to appoint a consultant for the formulation of Dianella Regional Open Space (ROS) Management Plan. This appointment was awarded to EDAW AECOM (now AECOM).

In order to gain an understanding of potential environmental impacts of the proposed works, as well as the most appropriate management of the area, (EDAW) AECOM commissioned Maunsell AECOM (now AECOM) in March 2009 to conduct a Flora and Vegetation survey of the project area. The results of the survey are presented in this report.

1.2 Scope of Work

The survey within the project area specifically dealt with:

- Flora (native and introduced flora, with a focus on threatened species);
- Vegetation communities (with a focus on threatened and significant communities);
- Vegetation condition; and
- Weeds (including environmental/pest weeds and Declared Plants).

1.3 Location

The project area is located in the suburb of Dianella, within the City of Stirling, in the Perth Metropolitan Region. It is bounded by Light Street to the north-east, Morley Drive to the south and Alexander Drive to the west. The reserve contains areas of natural bushland, open parkland used extensively for leisure and recreation, and several large active areas including three major sport ovals. The location and boundary of the survey area is shown in Figure 1.

1.4 Land Use

The project area is a major regional reserve, providing a wide range of neighbourhood facilities, visual interest, recreational spaces and examples of natural environmental diversity for all City of Stirling residents and visitors from the greater Metropolitan region. It is one of the City of Stirling's five larger major regional reserves. It is vested in the City for the purpose of "Recreation" and "Community Recreation" and is designated in the metropolitan Region Scheme as "Parks and Recreation".

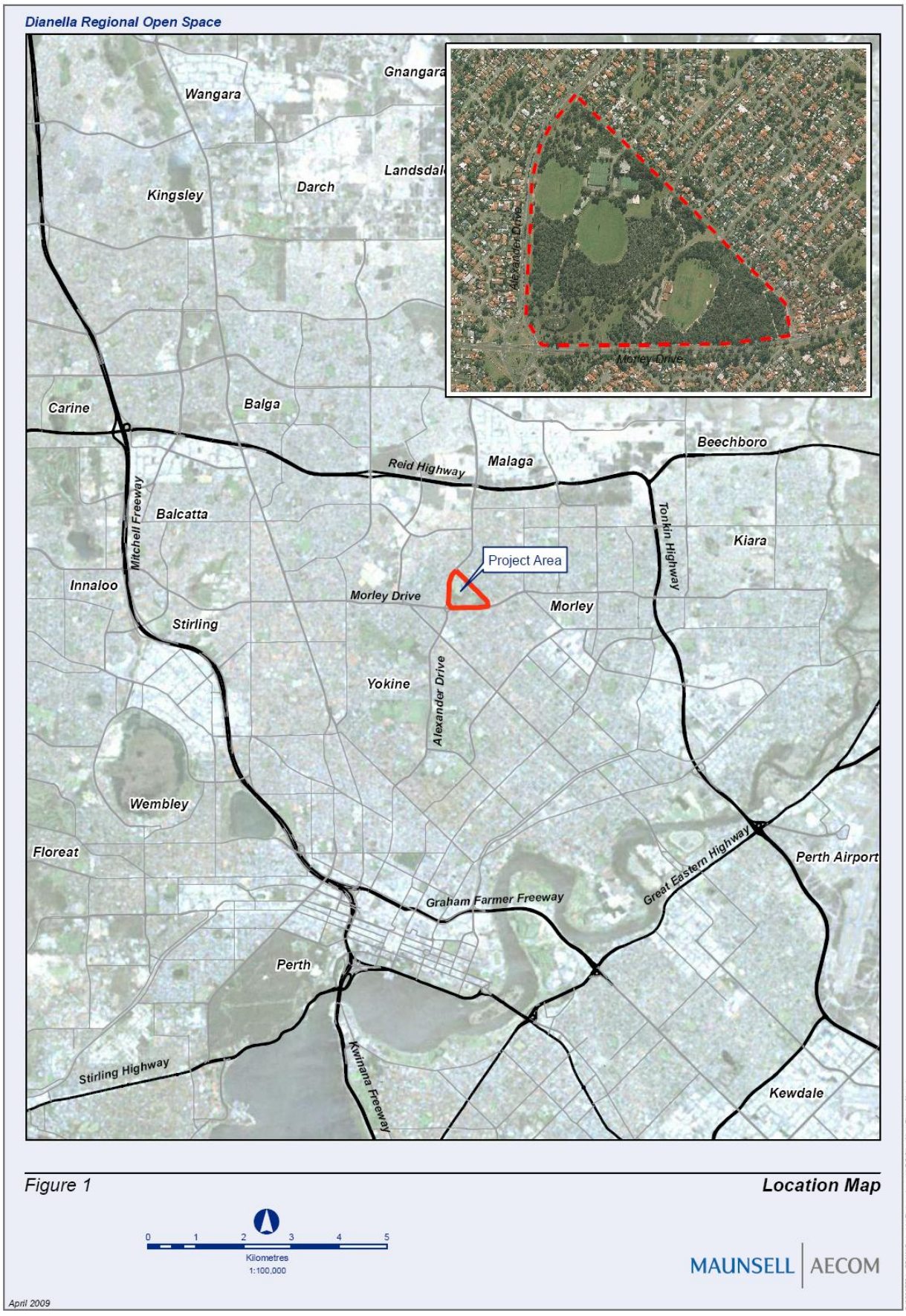

Figure 1: Location Map

1.5 Physical Environment

1.5.1 Climate

The City of Stirling is located within the Perth Metropolitan Region which experiences a humid Mediterranean climate, with cool wet winters and warm dry hot summers. The average annual minimum temperature is 12.6°C and the maximum average annual temperature is 24.5°C. The average annual rainfall for Perth is 756.5mm. 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 (Bureau of Meteorology, 2009).

1.5.2 Geology

A review of the *Environmental Geology Series* maps prepared by the Geological Survey of Western Australia (1986) was undertaken to determine the geology of the project area. The project area is located on Perth Sheet 2034-II (Geological Survey of Western Australia, 1986).

The project area falls within areas shown in published geological mapping (Geological Survey of Western Australia, 1986) and is described as:

- **S8 (Sand)** very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted of eolian origin;
- **S10 (sand) –** as S8 above; and
- **Cps (Peaty Clay) –** dark grey and black with variable sand content of lacustrine origin.

The spatial distribution of geology within the project area is presented in Figure 2.

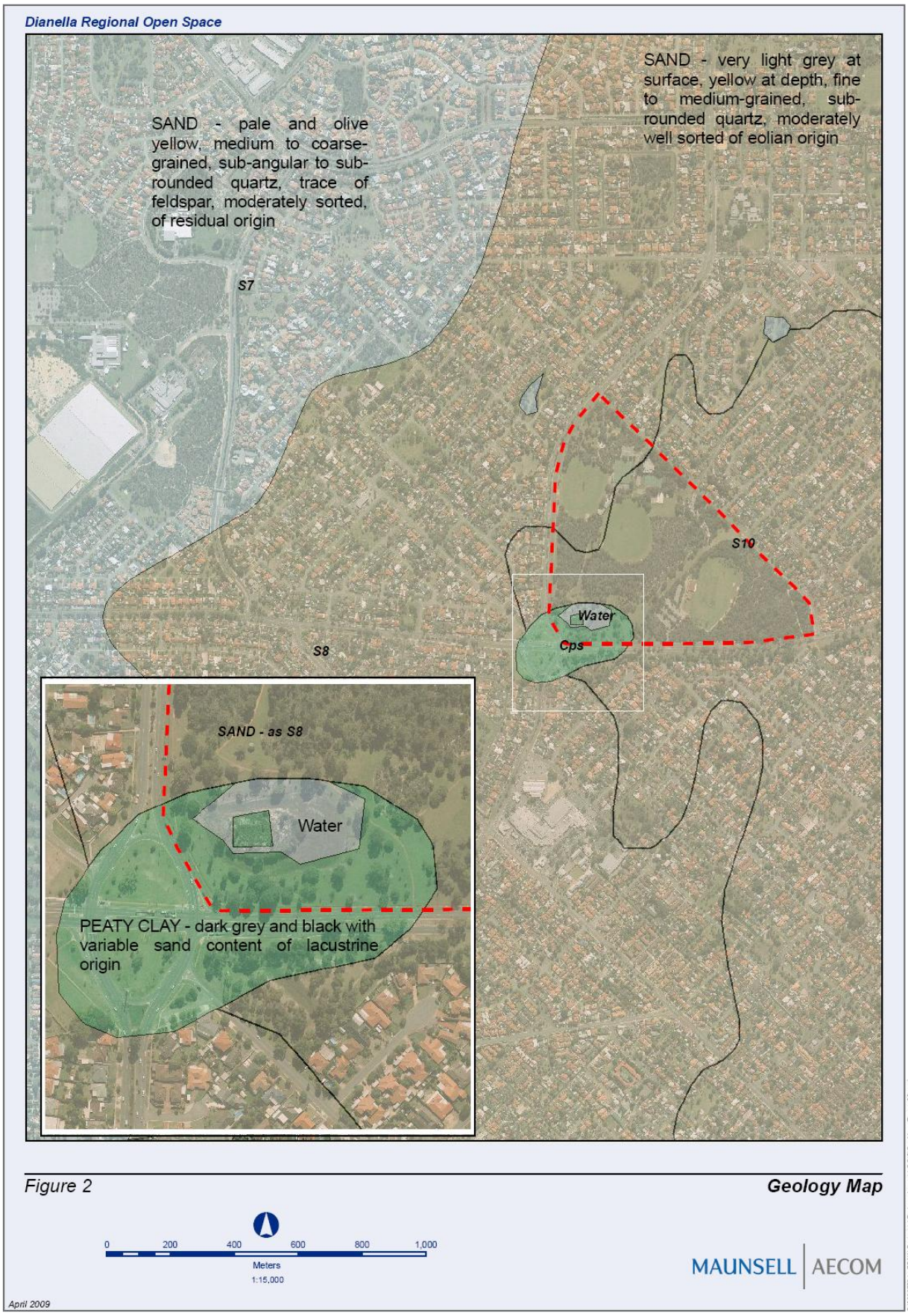

Figure 2: Geology of the Project Area

1.5.3 Wetlands

One Conservation Category (CC) Wetland has been identified in the Department of Conservation's (DECs) *Geomorphic Wetlands Swan Coastal Plain dataset* within the project area. This wetland is summarised as follows:

- Dianella Open Space CC sumpland (seasonally inundated basin) (UFI 8142) occurs on the south-western part of the project area.

The spatial distribution of this wetland within the project area is presented in Figure 3.

1.5.4 Introduced Species

Throughout Western Australia, over 1200 introduced (weed) species have been recognised to date. Specifically within the Swan Coastal Plain Bioregion, a total of 801 weed species are known. Of these, 61% have been classified as Environmental (pest) Weeds (EPA, 2007).

Environmental Weeds establish in natural ecosystems and adversely modify natural processes, resulting in the decline of the invaded community. Weeds threaten the survival of many flora species because of their rapid growth and the ability to out-compete native plants for available nutrients, water, space and sunlight. Proliferation of weeds can also increase the risk of fire at the site.

Under the *Agriculture and Related Resources Protection Act, 1976,* 92 weed species occurring within WA are listed as Declared Plants. Pursuant to the Act, these species are subject to restrictions on movement or sale and landholders are obliged to carry out control measures to prevent their spread. Weeds effectively colonise areas where the soil has been disturbed and where there has been clearing and can then rapidly invade surrounding natural sites.

1.5.5 Reserves and Conservation Areas

The bulk of Dianella ROS is contained in two Crown Reserves:

- Reserve 34538 (vesting order 467); and
- Reserve 46683 (vesting order 705).

Additionally, there is one Bush Forever site (No. 280) that occurs within the project area, namely 'Site No. 280 Dianella Open Space' (Figure 3).

The Bush Forever Strategy is a ten year strategic plan which formally commenced in 2000 to protect around 51,200 ha of regionally significant bushland within around 290 Bush Forever Sites, representing, where achievable, a target of at least 10 per cent of each of the original 26 vegetation complexes of the Swan Coastal Plain portion of the Perth Metropolitan Region (Government of Western Australia, 2000).

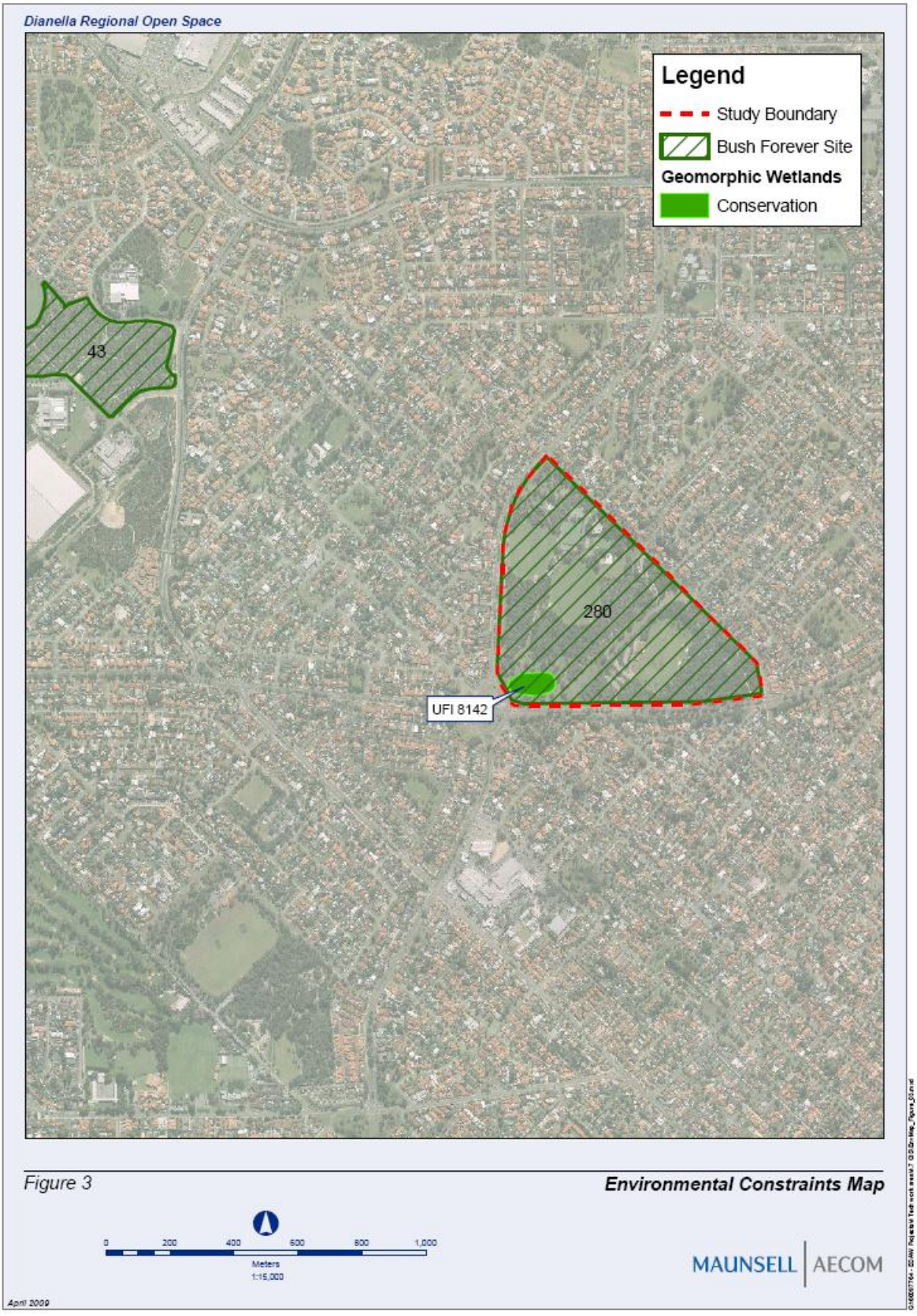

Figure 3: Wetlands and Bush Forever Sites within the Project Area

1.6 Biological Context

1.6.1 IBRA Bioregion

There are 85 recognised IBRA Biogeographic regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (Environment Australia, 2000). Western Australia supports 53 Biogeographical subregions. The project area is located within the Swan Coastal Plain Biogeographic Region of the Interim Biogeographic Regionalisation for Australia (IBRA) (DEWHA, 2009).

The Swan Coastal Plain Biogeographic Region is comprised of two Biogeographical Subregions, namely the Dandaragan Plateau (SWA1) and the Swan Coastal Plain Subregion (SWA2). On a finer scale the project area lies within the Swan Coastal Plain subregion (SWA2).

The Swan Coastal Plain Subregion is a low lying coastal plain, mainly covered with woodlands. Currently, only 10.74% of the sub-region is protected within conservation reserves. The subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone (McKenzie *et al*., 2002).

1.6.2 Vegetation

The Perth Region lies within the Drummond Botanical Sub-District of the South-West Botanical Province which is typically characterised by Low *Banksia* Woodlands with *Melaleuca* swamps and Woodlands of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) (Beard, 1990).

The project area lies within the Bassendean Complex – Central and South. The Bassendean Complex – Central and South consists of Woodland of *Eucalyptus marginata – Casuarina fraseriana – Banksia* spp. to low Woodland of Melaleuca spp. and Sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* to *Eucalyptus todtiana* in the vicinity of Perth (Heddle *et al*., 1990).

1.6.3 Vegetation Clearing, Extent and Status

Where clearing of native vegetation is proposed to occur, purely from a biodiversity perspective and not taking into account any other land degradation issues present, there are now several key criteria being applied with regards to clearing licenses. The criteria, as outlined in the WA EPA Position Statement No. 2, *Environmental Protection of Native Vegetation in Western Australia: Clearing of native vegetation, with particular reference to the agricultural area* (EPA, 2000) are used to help reverse the long-term decline in the quality and extent of Australia's native vegetation cover. The criteria are as follows:

- The "threshold level" below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-clearing extent of the vegetation type;
- A level of 10% of the original extent is regarded as being a level representing "endangered";
- Clearing which would put the threat level into the class below should be avoided; and
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200m wide.

The status of remaining vegetation can be delineated into five different classes:

- *Presumed extinct*: Probably no longer present in the bioregion;
- **Endangered*: <10% of pre-European extent remains;
- **Vulnerable*: 10-30% of pre-European extent exists;
- **Depleted*: >30% and up to 50% of pre-European extent exists; and
- *Least concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status.

1.6.4 Previous Biological Studies

Six discrete sites within the project area were previously surveyed by Mattiske Consulting Pty Ltd during January and November 2006. Inferences from this work defined a total of five vegetation communities within the project area with varying condition ranging from Excellent to Degraded. (Maunsell) AECOM's flora and vegetation survey was conducted to somewhat verify studies undertaken by Mattiske Consulting Pty Ltd but primarily to ascertain the values at the site and to draw conclusions in order to provide information on the project area's biodiversity, suitable for incorporation into the Plan of Management for the reserve, being compiled by (EDAW) AECOM.

1.7 Biological Factors of Environmental Significance

1.7.1 Declared Rare, Priority and Threatened Species

The Department of Environment and Conservation (DEC) assigns conservation status to endemic plant species that are geographically restricted to few known populations or threatened by local processes. Allocating conservation status to plant species assists in protecting populations and conserving species from potential threats (DEC, 2009a and 2009b).

Declared Rare Flora species are gazetted under subsection 2 of section 23F of the *Wildlife Conservation Act, 1950*. It is an offence to "take" or damage Rare Flora without Ministerial approval. Section 23F of the *Wildlife Conservation Act, 1950* defines "to take" as " to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means."

Species designated as Priority Flora are under consideration for declaration as 'Rare Flora' and are in urgent need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the definitions of Declared Rare and the four Priority ratings under the *Wildlife Conservation Act, 1950* as extracted from Department of Environment and Conservation (2009b).

Table 1: Definition of Rare and Priority Flora Species (Department of Environment and Conservation, 2009b)

Conservation Code	Category
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 and have been gazetted as such. "
P1	**Priority One – Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey. "
P2	**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 (not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but urgently need further survey. "
P3	**Priority Three – Poorly Known Taxa** "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but need further survey. "
P4	**Priority Four – Rare Taxa** "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years. "

Any species listed in State and Commonwealth legislation as being of conservation significance is said to be a significant species (EPA QLD, 2002) and incorporates species that are endangered, vulnerable and rare or covered by international conventions. Species at risk of extinction are recognised at a Commonwealth level and are categorised according to the *Environment Protection and Biodiversity Conservation (EPBC) Act*, *1999*, summarised in Table 2. Significance is not limited to species covered by State and Commonwealth Legislation and also includes species of local significance and species showing significant range extensions or at the edge of their known range.

Threats of extinction of species are also recognised at a Commonwealth level and are categorised according to the *EPBC Act, 1999.* Categories of Commonwealth listed threatened species are summarised in Table 2.

Table 2: Categories of Threatened Flora Species (*Environment Protection and Biodiversity Conservation Act, 1999*)

Conservation Code	Category
Ex	**Extinct** Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
ExW	**Extinct in the Wild** Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	**Critically Endangered** Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	**Endangered** Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	**Vulnerable** Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	**Conservation Dependent** Taxa which at a particular time if, at that time, the species is the focus of a specific conservation programme, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

1.7.2 Local and Regional Significance of Vegetation Communities

Vegetation communities are referred to as Locally Significant where they:

- support populations of Priority Flora species;
- extend the geographic range of particular taxa from previously recorded locations;
- are restricted to only one or a few locations;
- occur as small isolated communities; or
- exhibit unusually high structural and species diversity.

Vegetation communities are referred to as Regionally Significant where they:

- are limited to specific landform types;
- are uncommon or restricted plant community types within the regional context; or
- support populations of Declared Rare Flora.

Guidance Statement 51 (EPA, 2004) also states that *"vegetation may be significant for a range of reasons, other than a statutory listing as a Threatened Ecological Community or because the extent is below threshold level".* According to Guidance Statement 51, other significant vegetation may include communities that have:

- scarcity;
- unusual species;
- novel combination of species;
- a role as a refuge;
- a role as a key habitat for threatened species or large populations representing a significant proportion of the local to regional total population of a species;
- being representative of the range of a unit (particularly, a good local and/or regional example of a unit in "prime" habitat, at the extremes of a range, recently discovered range extensions, or isolated outliers of the main range);
- a restricted distribution.

1.7.3 Significant Species

Guidance Statement 51 (EPA, 2004) states that *"species, subspecies, varieties, hybrids and ecotypes may be significant for a range of reasons, other than as Declared Rare Flora or Priority Flora"*. According to Guidance Statement 51 (EPA, 2004), other significant flora may include taxa that:

- have a keystone role in a particular habitat for threatened species, or supporting large populations representing a significant proportion of the local regional population of a species;
- have a relic status;
- have anomalous features that indicate a potential new discovery;
- are representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- show the presence of restricted subspecies, varieties or naturally occurring hybrids;
- have local endemism / a restricted distribution;
- are poorly reserved.

1.7.4 Threatened Ecological Communities and Priority Ecological Communities

The primary tool for classification of TECs on the Swan Coastal Plain is by assigning a Floristic Community Type (FCT), as classified by Gibson *et al.,* (1994). The Floristic Survey of the Swan Coastal Plain (Gibson *et al.,* 1994) identifies suites of dominant and indicator flora species, in combination with the landform complex of the location, as characteristic of a specific FCT. Therefore, results from the field survey are used to compare common species and confirm suitable distributions with regard to landform complexes in respect to Gibson *et al* (1994) to categorically determine FCTs.

Gibson *et al.,*(1994) and outcomes of this are widely recognised in Western Australia as the benchmark study that has defined broad vegetation types (FCT) across the Swan Coastal Plain. The data and information in the Gibson publication forms the basis of all vegetation assessments in the region. Although the publication is now 15 years old, no more recent comprehensive study exists and this publication therefore remains the primary reference.

The Gibson *et al*. (1994) methodology is considered to be rigorous and reproducible if used correctly, and therefore has been accepted as a methodology in defining communities for the purpose of identifying TECs by the DEC. The DEC continues to use the Gibson *et al.,* (1994) methodology for determining floristic communities on the Swan Coastal Plain, and consequently is adding to the dataset originally developed for Gibson *et al.,* (1994).

Reservation and conservation values in Gibson *et al*., (1994) are still considered valid by DEC and although the values may haven changed, it is unlikely that these would have changed significantly in the region given the lack of additional remnant vegetation for reservation (Ken Atkins (2009), *pers. comm*).

Communities are described as 'TECs' if they have been defined by the Western Australian Threatened Ecological Communities Scientific Advisory Committee (DEC) and found to be Presumed Destroyed (PD), Critically Endangered (CR), Endangered (EN) or Vulnerable (VU). Definitions of TEC categories and criteria are described by English and Blyth (1997) and are presented in Table 3. DEC maintains a database of state listed TECs which is available for online searches via their website (www.dec.wa.gov.au).

Table 3: Definition of TECs (as extracted from DEC)

Conservation Code	Category
PD	Presumed Totally Destroyed "An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future."
CR	Critically Endangered "An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. "
EN	Endangered "An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future."
VU	Vulnerable "An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range."

TECs (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat, which are subject to processes that threaten to destroy or significantly modify the assemblage across its range (DEC, 2001). These communities are of conservation significance because they are likely to contain rare organisms or a group of organisms.

There is currently no legislation covering the conservation of TECs in Western Australia; however some are protected under the Commonwealth *EPBC Act, 1999*. The TECs on the Commonwealth register are also listed on the Department of Environment, Water, Heritage and the Arts website (www.environment.gov.au), and reported in the Protected Matters Report. Any proposal having a significant impact on a Commonwealth listed TEC will be considered a controlled action, and will require assessment under the *EPBC Act, 1999*.

For those State TECs not listed on the Commonwealth register, land clearing legislation under the *Environmental Protection Act, 1986* also provides protection for TECs from clearing. The EPA position on TECs states that proposals that result in the direct loss of TECs are likely to be formally assessed.

Additional to TECs, possible TECs that do not meet survey criteria or that are not adequately defined, are rare but not threatened, have been recently removed from the TEC list or require regular monitoring are considered to be Priority Ecological Communities or PECs (DEC, 2009b) and DEC require them to be taken into consideration during environmental impact assessments.

2.0 Objectives

The objectives of the floristic assessment of the project area (Dianella ROS) were to:

- identify and record all observable vascular flora species present;
- determine the presence or absence of DRF, Priority Flora or significant flora species;
- describe the composition and characteristics of the vegetation and map the extent of the varying vegetation communities present;
- determine the conservation status and/or significance of the vegetation communities recorded;
- describe the and determine the vegetation condition at the site and map the extent of the varying classifications present;
- identify any weeds species present and their status as pest/environmental weeds or Declared Plants;
- summarise and present the information for:
    - information and as a reference for the City of Stirling, for ongoing assessment (as a supplement) and management of the site; and
    - for incorporation by (EDAW) AECOM into the Plan for Management for the site.

3.0 Methodology

(Maunsell) AECOM conducted site investigations in accordance with Environmental Protection Authority (EPA) Guidelines for a Level 1 and Level 2 Flora and Vegetation Surveys (EPA, 2004). The field investigations were conducted by Kellie Gibbs, an experienced Botanist, assisted by Alexandra Sleep, a Graduate Environmental Scientist, on 30 March 2009.

Level 1 flora surveys are conducted at a broad scale, recording variable vegetation condition and vegetation communities, their spatial distribution and identification of dominant species within each community. They involve selective, low intensity sampling of the flora and vegetation and encompass:

- desktop studies;
- reconnaissance field survey, encompassing:
  - verification of desktop studies;
  - delineation and characterisation flora and vegetation units; and
  - identification of potential impacts.

Level 2 surveys involve background research and a detailed survey and/or comprehensive surveys involving one or more site visits during the main flowering season and replication of data collection points or quadrats within representative vegetation units.
They encompass:

- Level 1 surveys;
- Detailed surveys, including:
  - one or more visits during the flowering season and visit/s in another season;
  - replication of plots in vegetation units, and greater coverage and displacement of plots over the target area.
- Comprehensive Flora and Vegetation surveys, including:
  - Detailed surveys of both the target (project) area and the wider local area (outside the project area);
  - Multiple visits to enhance the level of knowledge at the locality scale and the local scale.

3.1 Desktop Studies

Prior to the field assessment a search of DECs Declared Rare and Priority Flora database was undertaken to identify significant flora that have been previously recorded within the project area. The database search encompassed the entire project area. During this investigation the following databases were interrogated:

- DEC Threatened Flora Database;
- Western Australian herbarium records; and
- DEC Declared Rare and Priority Flora List.

Similarly, searches of the DEC Threatened Ecological Communities (TEC) and Threatened Fauna databases were also conducted for the entire project area.

3.2 Level 1 Fauna Survey

Maunsell (AECOM) carried out a Level 1 Fauna Survey pursuant to EPA Guidance Statement 56, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004b). The survey involved a desktop assessment (including DEC database search for the site) and making opportunistic field observations of fauna and fauna activity, such as nests, burrows, scats, tracks and diggings, in conjunction with the flora and vegetation survey. Following the completion of field investigations, interpretations were made to determine the likely threatened fauna habitats present at the site, based on the vegetation mapped as part of the flora and vegetation survey.

3.3 Flora and Vegetation Survey

A Level 1 flora survey was conducted for the majority of the project area, with the exception of the 'clearing corridor', where a detailed Level 2 flora survey was conducted (Figure 4). The 'clearing corridor', which refers to the proposed entry/exit from Alexander Drive, was conducted to a detailed Level 2 assessment in order to assist the City of Stirling with obtaining approval to undertake proposed clearing activities in this area. Two non-permanent quadrats, 10m x 10m in dimension were sampled within the 'clearing corridor'.

The Level 1 assessment conducted across the site was considered to exceed EPA Guidance for level 1 Surveys, in that all vascular flora species observed were recorded and collected for identification as necessary, in addition to dominant flora species, as dictated by the guidance. Therefore, all perennial species supported by the site and that were observable have been recorded across the site. Given the time of year, some annuals are likely to have not been recorded.

The bushland within the project area was accessed by foot in order to assess the flora and vegetation values. Floristic communities were identified, described and mapped based on changes in dominant species composition and soil. Where marked changes in species composition and floristic structure occurred, all species within the vegetation community were recorded and identified. Species unidentifiable in the field were systematically collected, pressed, dried and fumigated in accordance with the requirements of the West Australian Herbarium. The plant species were identified and then compared with pressed specimens housed at the West Australian Herbarium (DEC, 2009a).

The plant communities occurring within the site were described in detail. The use of a standard data collection form ensured the data was collected in a systematic and consistent manner. New data collection sheets were used for recordings at the location where surveying began and thereafter until floristic community changes were observed. For the purposes of explaining methodology these locations are referred to as data collection points. At each data collection point, the following records were made:

- GPS Locations (WGS 84);
- species observed;
- height of all species recorded;
- percentage foliage cover (dominance), alive and dead, of all species recorded;
- soil type;
- soil colour;
- outcropping rocks and their type;
- pebble type and size;
- topography;
- slope aspect;
- percentage litter cover;
- percentage of bare ground;
- degree of disturbance;

- nature of disturbance (if any); and
- years since fire (if any noted).

Vegetation condition is determined in relation to the (perceived) ability of the bushland to maintain itself (Keighery, 1994). This is commonly interpreted primarily on the ratio of visible introduced species to native species however disturbance (e.g. grazing, erosion), degree of alteration to community and habitat structure, site ecology and other factors are also considered.

Figure 4: "Clearing Corridor" identifying the extent of the Level 2 Survey (Level 1 Survey conducted elsewhere within the Project Area)

In order to map vegetation condition of the site, the condition was determined at a range of detailed recording sites and in between as necessary, where condition changed. The categories of vegetation condition used were consistent with a combination of methods developed by Keighery (1994) and the Braun-Blanquet Scale (Mueller-Dombois and Ellenberg, 1974), as summarised in Table 4. Given that effective measures of bushland condition are a measure of both the amount of change in community structure and the proportion of weeds present, a quantitative measure is considered to add value to interpretations and results. Accordingly our method incorporates the Keighery (1994) (descriptive and qualitative) and the Braun-Blanquet Scale (Mueller-Dombois and Ellenberg, 1974) (quantitative) methods.

Table 4: Bushland Condition Ratings (adapted from Keighery, 1994 and the Braun-Blanquet Scale of Cover Abundance (from Mueller-Dombois and Ellenberg, 1974))

Descriptor	Explanation
Pristine	Pristine or nearly so, no obvious signs of disturbance. *0% weed cover*
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. *1 – 5% weed cover*
Very Good	Vegetation structure altered obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. *5 – 25% weed cover*
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing. *25 – 50% weed cover*
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance of vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. *50 – 75% weed cover*
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as "parkland cleared" with the flora comprising weed or crop species with isolated native trees or shrubs. *75 – 100% weed cover*

A search of the Department of Agriculture and Food Western Australia (DAFWA) website database for Declared Plants was consulted to determine if any of the recorded species are listed as Declared Plants pursuant to the *Agriculture and Related Resources Protection Act, 1976* (DAFWA, 2009).

3.4 Survey Limitation

The flora and vegetation survey was conducted to verify previous studies undertaken by Mattiske Consulting Pty Ltd as well as to provide information on the project area's floral biodiversity. This involved selective, low intensity sampling of the flora and vegetation for the majority of the project area, with the exception of the 'clearing corridor' which was surveyed to a Level 2 (detailed) assessment (Figure 4).

There are survey limitations and limitations in the methodology as the survey was conducted on 30 March 2009; therefore the timing requirement according to the Guidance for a Level 2 (detailed) assessment was not met. The Guidance requires that flora and vegetation assessments are conducted during "the main flowering season". In the Perth Region, this season is spring, typically from the start of September to the end of November. Surveys conducted outside this period may not record all annual and ephemeral species. Flowering and fruiting also assist in the identification of collected specimens and due to the timing of the survey, some collections were unable to be identified beyond genus level.

In conclusion, this assessment only complies entirely with a Level 1 survey as outlined in the EPA's Guidance Statement No. 51 *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004), for the site as a whole. All Level 2 requirements have been met for the clearing corridor area (Figure 4) besides:

1) Seasonal timing; and
2) Comprehensiveness, relating to:
    a) Multiple visits; and
    b) Assessments in the wider region (conducted to some degree as part of desktop studies).

A Level 2 Flora and Vegetation Survey of the project area would be required to be conducted during the main flowering season in order to meet EPA requirements for such a study.

4.0 Results

4.1 Flora

4.1.1 Desktop Assessment

Prior to the field assessment, a search of the DEC Threatened and Priority Flora database was conducted for the project area. This search identified eight Priority and two Declared Rare Flora species previously recorded within the vicinity of the project area. The results of the DEC database enquiry for Declared Rare and Priority Flora previously recorded within the vicinity of the project area, along with an interpretation of the likelihood of these species occurring in the project area, are presented in Table 5.

Table 5: Declared Rare and Priority Flora known to occur within the vicinity of the Project Area

Species	Conservation Code	Preferred Habitat	Flowering Period	Likelihood in project area
Caladenia huegelii	DRF	Grey or brown sand, clay loam	September – October	*May* occur
Epiblema grandiflorum var. *cyaneum ms*	DRF	Winter-wet swaps	November – December	Unlikely to occur
Amperea protensa	P3	Sandy soils. Seasonally wet flats, depressions, swampy areas	November - January	Unlikely to occur
Aotus cordifolia	P3	Peaty soils. Swamps	August - January	Unlikely to occur
Cyathochaeta teretifolia	P3	Grey sand, sandy clay. Swamps and creek edges		Unlikely to occur
Isopogon drummondii	P3	White, grey or yellow sand, often over laterite	February - June	Unlikely to occur
Stylidium longitubum	P3	Sandy clay, clay. Seasonal wetlands	October – December	Unlikely to occur
Calothamnus rupestris	P4	Gravelly skeletal soils. Granite outcrops and rocks, hillsides	July - December	Unlikely to occur
Drosera occidentalis subsp. *occidentalis*	P4	Sandy and clayey soils. Swamps and wet depressions.	November - December	*May* occur
Jacksonia sericea	P4	Calcareous and sandy soil	December - February	*May* occur

4.1.2 Field Assessment

A total of 110 species from 75 genera and 30 families were recorded within the project area. The total includes 91 (83%) native species and 19 (17%) introduced (weed) or non-endemic species. The full list of vascular flora species recorded and representative communities in which they occur are presented in Appendices A and B, respectively.

Families with the highest representation were Myrtaceae (Myrtle Family – 20 taxa; 19 native, 1 planted (introduced)), Papilionaceae (Pea Family – 11 taxa; 11 natives), Proteaceae (Banksia Family – 10 taxa; 10 natives) and Restionaceae (Sedges and Rushes Family – 9 taxa; 9 natives).

No species of DRF of Priority Flora, listed by DEC under the *Wildlife Conservation Act, 1950* or as Threatened under the *EBPC Act, 1999* were recorded during the March 2009 survey.

Four of the species recorded were found to be occurring outside of their previously recorded range of distribution as documented by the West Australian Herbarium (DEC, 2009a). These species are *Anigozanthos* sp., *Eucalyptus* sp., *Corymbia haematoxylon* and *Melaleuca argentea*.

4.2 Introduced Species

Nineteen introduced species were recorded during the field survey in 2009, one of which is listed as a Declared Plant by the Department of Agriculture and Food Western Australia, pursuant to the *Agriculture and Related Resources Protection Act, 1976* (DAFWA, 2009). This species is **Acacia longifolia* subsp. *longifolia* (Sydney Golden Wattle) and its required control measures is presented in Appendix C.

4.3 Vegetation Communities

Vegetation communities can be described at a finer level than the vegetation complexes. A total of five separate vegetation communities were described and mapped during the field studies in March 2009. The vegetation communities within the project area are presented spatially in Figure 5 and are described as follows:

NB: * denotes introduced or non endemic species (weeds).

Woodlands

BmBaLOW
Low Open Woodland of *Banksia menziesii* and *Banksia attenuata* with occasional *Melaleuca* sp. over an Open Shrubland of *Xanthorrhoea preissii* over a Low Open Shrubland of *Conospermum stoechadis* over a Very Open Herbland dominated by *Alexgeorgea nitens, Thysanotus dichotomus, Phlebocarya ciliata* and *Mesomelaena pseudostygia* with occasional *Melaleuca parviceps* and *Scholtzia* involucrate in grey sands.

CcEmOW
Open Woodland of *Corymbia calophylla* and *Eucalyptus marginata* with occasional *Allocasuarina fraseriana* over a Tall Open Shrubland dominated by *Banksia menziesii, Nuytsia floribunda* and *Xanthorrhoea preissii* over a Low Open Shrubland of *Dasypogon bromeliifolius* over a Very Open Herbland of *Phlebocarya ciliata* with occasional *Lepyrodia drummondii* in grey sands.

Shrublands

MpTOS
Tall Open Shrubland of *Melaleuca preissiana* over a Very Open Sedgeland of **Juncus microcephalus* and **Cyperus polystachyos* over a Very Open Grassland of **Cynodon dactylon* in grey sandy loam.

Planted and Cleared Areas

RT
Remnant trees over parkland areas

P
Cleared 'parkland' areas

Figure 5: Vegetation Communities within the Project Area

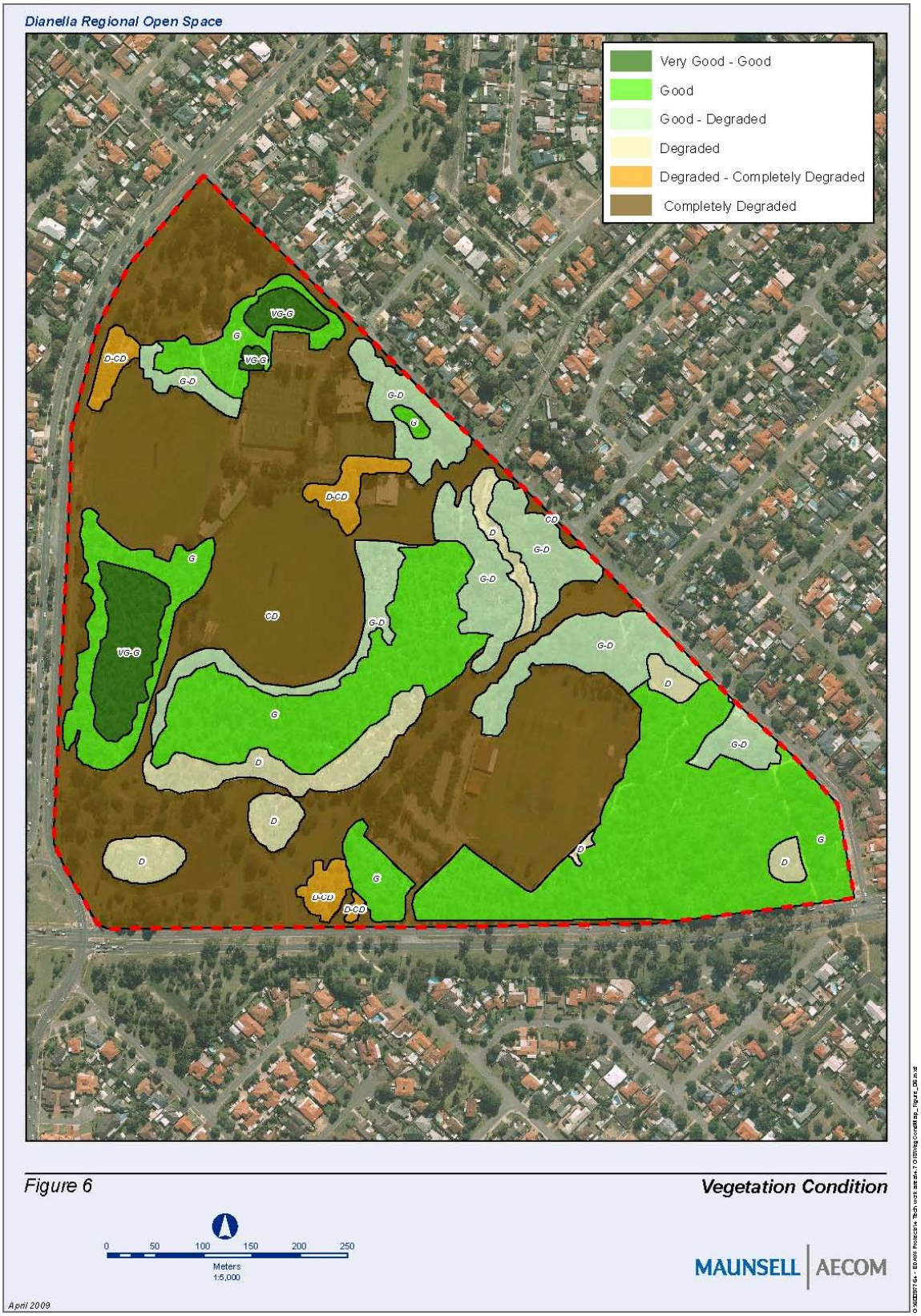

Figure 6: Vegetation Condition within the Project Area

4.4 Vegetation Condition

The condition of the vegetation was assessed according to an adaptation of the condition rating scale devised by Keighery (1994) as described in Table 4. The spatial distribution of vegetation condition recorded within the project area is presented in Figure 6. The condition of the vegetation within the entire project area ranges from 'Very Good to 'Good' – 'Completely Degraded' (Keighery, 1994). The majority of the project area (50.03% or 19.89 hectares) was recorded to be in 'Completely Degraded' (Keighery, 1994) condition.

The best quality vegetation within the study area was considered to be in 'Very Good – Good' (Keighery, 1994) condition and is represented by communities BmBaLOW and CcEmOW. The majority of the project area was found to be 'cleared parkland' which consists of manicured lawn with remnant panted trees and is therefore considered to be 'Completely Degraded' (Keighery, 1994).

A few cleared areas such as car parks and tracks traverse the project area at various locations; however, they have not been individually delineated as part of the vegetation condition mapping. Generally, the tracks and roads are in 'Completely Degraded' (Keighery, 1994) condition; however these have not been individually delineated due to the small area they occupy in comparison to the entire project area.

4.5 Association, Representation and Clearing

At a regional scale, one vegetation type has been described within the project area by the Department of Agriculture report "*Land Use and Vegetation in Western Australia, Technical Report 250*" (Beeston *et al.,* 2002). Table 6 describes this vegetation type and summarises its regional extent.

The vegetation type and extent in Technical Report 250 was identified and assessed using aerial photography and satellite imagery and therefore these figures are indicative only (Beeston *et al*., 2002).

Table 6: Coverage of Regional vegetation Associations in the Project Area

Veg Code	Beard Code	Current extent (ha)	Pre–European extent (ha)	Remaining (%)	Description
1001	e_2Mb cbLi	16, 758	64, 799	25.86	Medium very sparse woodland; jarrah, with low woodland; *Banksia* & *Casuarina*

Additionally the project area lies within the Bassendean Complex – Central and South. This complex is currently represented by 24% of its original extent now remaining on the Swan Coastal Plain, of which approximately 13% is currently protected (Government of Western Australia, 2000).

4.6 Threatened and Priority Ecological Communities

The search of the DECs Threatened Ecological database identified no known occurrences of TECs or PECs within the project area. However, the search did identify the occurrence of one TEC within 1.7 kilometres from the project area. This community is as follows:

The 'Endangered' TEC – Banksia attenuata woodland over species rich dense shrublands (SCP20a).

The species composition of the remnant native vegetation communities recorded within the project area was analysed and compared to the Gibson *et al* (1994) dataset and from this Floristic Community Types (FCTs) have been inferred. Vegetation Communities RT and P do not support sufficient native species and were found to be too degraded for comparison.

Table 7: Summary of Floristic Community Types, Reservation and Conservation and Vegetation Descriptions identified within the project area

AECOM Vegetation Community	Floristic Community Type (FCT)	Floristic Community Description	Reservation Status	Conservation Status
MpTOS	11	Wet forests and woodlands	Well Reserved	Low Risk
CcEmOW	21a	Central Banksia *attenuata* – Eucalyptus *marginata* woodlands	Well Reserved	Low Risk
BmBaLOW	23a	Central Banksia *attenuata* – Banksia *menziesii* woodlands	Well Reserved	Low Risk

None of the inferred FCTs are listed as State TECs under the DEC listings or Commonwealth TECs under the *EPBC Act 1999*.

The inferred FCT 11 represents a degraded variant of the original intact woodland, which has lost most of the remnant native vegetation and has been replaced by weeds such as **Juncus microcephalus* and **Cyperus polystachyos*.

The results for the FCT analysis are presented in Appendix D.

4.7 Fauna

4.7.1 Desktop Assessment

Prior to the field assessment, interrogation of the DEC database of Threatened and Priority Fauna was undertaken. The results of the DEC database enquiry for Threatened and Priority Fauna previously recorded within the vicinity of the project area are presented in Table 8.

Table 8: Significant Fauna recorded in the vicinity of the Project Area, DEC (2009)

Species	Status *under Wildlife Conservation Act 1950*	Status under *EPBC Act 1999*	Potential to occur in the project area
Carnaby's Black Cockatoo *Calyptorhynchus latirostris*	Schedule 1	Endangered	***May*** occur within the project area
Graceful Sunmoth *Synemon gratiosa*	Schedule 1	Endangered	***May*** occur within the project area
Black-Striped Snake *Neelaps calonotos*	Priority 3	N/A	Species ***unlikely*** to occur within the project area
Native Bee *Hylaeus globuliferus*	Priority 3	N/A	***May*** occur within the project area
Western Brush Wallaby *Macropus irma*	Priority Four	N/A	Species ***unlikely*** to occur within the project area
Quenda *Isoodon obesulus fusciventer*	Priority 5	N/A	Species ***unlikely*** to occur within the project area

DEC records do not include and specific records of significant fauna sightings, activity or observations within the project area.

Priority Fauna species are not regarded to be of specific conservation significance, under legislative requirements, however they are considered by DEC to be in need of further monitoring and protection where possible.

The Schedule 1 species, *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo) was sighted once in 2003 in Koondoola. This species was not observed during the field assessment.

The Schedule 1 species, *Synemon gratiosa* (Graceful Sunmoth) has been sighted in the region 25 times in recent years and all of these records are certain. This species has previously been recorded in Koondoola and Warwick.

The Priority 3 species, *Neelaps calonotos* (Black striped snake) has been caught and/or trapped in the region 15 times and all of these records are certain. The DEC records however appear to be historical, dating back to 1952.

The Priority 3 species, *Hylaeus globuliferus* (Bee) has been recorded once only in Yokine and this record is certain.

Previous studies conducted by Mattiske Consulting Pty Ltd have recorded evidence of foxes, dogs, rabbits, *Streptopelia senegalensis* (Lauging Turtle Dove) and *Columbia livia* (Feral Pigeon) within the project area.

4.7.2 Field Assessment

The field assessment included only two fauna observations. One bird species, *Anthochaera chrysoptera* (Little Wattlebird) was observed within the project area. Additionally Rabbit (*Oryctolagus cuniculis*) droppings were also observed within the project area (Table 9).

Table 9: Fauna Recorded during the 2009 Assessment by Maunsell (AECOM) within the Project Area

Species	Common Name	Frequency	Observation
Anthochaera chrysoptera	Little Wattlebird	Uncommon	Sighted
Oryctolagus cuniculis	Rabbit	Common	Scats

A large proportion of the project area is considered far too degraded to provide suitable long-term habitat for native fauna, particularly in terms of nesting, breeding and feeding use. However, some areas of intact vegetation exist and are considered to provide good quality habitat for native vertebrate species is available.

Intact remnants patches and predominantly mature trees, both locally native and introduced, are likely to provide habitat for native birds. This includes migratory birds, protected under JAMBA/CAMBA, that may occur within the artificial wetland feature at the site. This wetland feature is in relatively poor condition and may not provide a sustainable habitat for waterbirds, especially due to the close proximity to main roads.

4.8 Environmentally Sensitive Area

The entire project area is located within an Environmentally Sensitive Area (ESA).

Environmentally Sensitive Areas (ESAs) are protected under the *Environmental Protection (Clearing of Native Vegetation) Regulation 2004* and are selected for their environmental values at State or National Levels. They include:

- Defined wetlands and riparian vegetation within 50m;
- Areas covered by Threatened Ecological Communities;
- Area of vegetation within 50m of Declared Rare Flora;
- Bush Forever Sites; and
- Declared World Heritage property sites.

5.0 Discussion

5.1 Flora

A total of 110 species from 75 genera and 30 families were recorded within the project area. No species of DRF, listed by DEC under the *Wildlife Conservation Act, 1950* or as Threatened under the *EBPC Act, 1999* were recorded within the project area.

Although the DEC database search for flora of conservation significance in the project area resulted in a number of Priority Flora species, no species of conservation significance were recorded during the field assessment.

Seven of the species resulting from the DEC database search are perennial species which would have been observed if present, regardless of the seasonal timing of the field assessment. These species are as follows:

- *Epiblema grandiflorum* var. *cyaneum ms;*
- *Aotus cordifolia;*
- *Cyathochaeta teretifolia;*
- *Isopogon drummondii;*
- *Calothamnus rupestris;*
- *Drosera occidentalis subsp. occidentalis;* and
- *Jacksonia sericea*

The majority of the Priority Flora resulting from the database search is documented to occur in locations, habitats and soil types not supported within the project area. However, some of the Priority Flora species (i.e. *Caladenia huegelii, Drosera occidentalis* subsp. *occidentalis* and *Jacksonia sericea*) have the potential to occur within habitats supported by the project area based on soil type suitability and other habitat factors. The primary reason that such species may have not been recorded is likely to be due to the timing of the survey as well as the degraded nature of the project area.

Caladenia huegelii preferred habitat is deep sandy soil in mixed *Banksia*/Jarrah/*Allocasuarina* woodland (Hoffman & Brown, 1992). It has an underground tuber which sprouts in autumn. The plant grows through winter, flowers in spring and then dies back to become dormant over summer. Tubers are replaced annually during the growth period autumn to late spring.

Although no *Caladenia huegelii* species were recorded within the project area, it can not be ruled out that any individuals may appear in subsequent years, either arising from tuberoids that were dormant at the time of the survey or through seed dispersal from nearby populations.

Due to the timing of the survey a number of species were only able to be identified to Family or Genus level, due to the absence of flowers, fruit or other identifiable material. It is not anticipated that any of the collected species are of conservation significance when compared to known Declared Rare or Priority Flora species from the area.

Most of the species diversity within the project area is represented in areas of better quality vegetation along pockets of remnant native vegetation which are represented by communities BmBaLOW and CcEmOW. These areas are considered valuable for preservation.

Four of the species recorded were found to be occurring outside of their previously recorded range of distribution as documented by the West Australian Herbarium (DEC, 2009a). These species are *#Anigozanthos* sp., *#Eucalyptus* sp., *Corymbia haematoxylon* and *Melaleuca argentea*. These four species, although not native to local area, are not considered weeds as they are endemic to other regions in Western Australia. The aforementioned species were observed to have been planted and

occurring within vegetation communities CcEmOW and MpTOS . *Corymbia haematoxylon* and *Melaleuca argentea* are both commonly planted species in the Perth region and surrounds.

One species listed as a Declared Plant under the *Agriculture and Related Resources Act, 1976* was recorded during the survey. This species is Sydney Golden Wattle which was recorded in vegetation community RT. Under the Act, landholders are obliged to carry out specific control measures to prevent the spread of these pest weeds (Declared Plants). The recommendations for Sydney Golden Wattle are provided on the DAFWA website as well as in Appendix C.

Weed invasion is relatively low throughout the project area which can mainly be attributed to the majority of the project area only being surveyed to a Level 1 assessment. Level 1 flora surveys are conducted at a broad scale and involve selective, low intensity sampling of the flora and vegetation. Additionally, the March 2009 survey was conducted at a time of year that was not suitable for detecting the majority of annual and ephemeral species, including weeds and threatened flora potentially occurring in the area. Most annual ephemeral species germinate after sustained rains and may not have been identifiable or present at the time the reconnaissance field assessment was conducted.

Although weed invasion is relatively low, it is considered likely to be a significant issue within the project area in areas adjacent to cleared areas (i.e. parklands, car parks etc), however, with annual weeds not being present at the time of survey, this was difficult to assess. It is likely that weeds, predominantly annual grasses may exist within the project area and would be observable during Spring (September – November), after the sustained rains.

5.2 Vegetation Communities

A total of 5 individual vegetation communities were recorded within the project area, consisting of two Woodlands, one Shrubland and two planted and/or cleared areas. The “cleared areas” are void of any remnant native vegetation.

Two vegetation communities recorded a species composition of 11 species. This low species diversity within these two vegetation communities is an indication of the highly degraded nature of much of the project area and therefore the communities. However, vegetation communities BmBaLOW and CcEmOW recorded a species composition of 72 and 46 species respectively. This can be attributed to these areas been represented by better quality vegetation and therefore condition.

Data collected in the field can be compared to the dataset used to categorise the FCTs for the Gibson *et al.,* publication. Assignment of FCTs is achieved by determining common species and confirming suitable distributions.

The species composition of the intact remnant native vegetation communities recorded within the project area has been analysed and compared to the Gibson *et al* (1994) dataset. None of the vegetation communities recorded have been determined to be equivalent to State TECs or PECs under the DEC listings or Commonwealth TECs under the *EPBC Act 1999*. The known TEC (*Banksia attenuata* woodland over species rich dense shrublands) from the surrounding area occurs approximately 1.7 kilometres from the project area.

There were three inferred FCT identified within the project area, namely FCT11 (Wet forest and woodlands), FCT21a (Central *Banksia attenuata – Eucalyptus marginata* woodlands) and FCT23a (Central *Banksia attenuata – Banksia menziesii* woodlands). The Gibson publication classifies FCT11, FCT21a and FCT 23a as “Well Reserved” and at “Low Risk” to the threats of extinction.

Vegetation communities can be considered significant due to other factors that are not necessarily related to TEC or PEC status. All of the vegetation within the project area is located within an ESA therefore it is considered to be regionally significant. The ESA status is due to the Bush Forever status of the project area. Consultation with DEC as part of a clearing permit application will need to address this.

5.3 Vegetation Condition

The vegetation within the project area has been subject to a significant amount of disturbance, mainly through clearing for urban based purposes which is evident from the assessment of vegetation condition. Overall, the vegetation condition ranged from 'Very Good – Good' to 'Completely Degraded' with a high proportion of the project area classified as 'Completely Degraded' (Keighery, 1994). The better quality vegetation within the project area was considered to be in 'Good – Very Good' condition (Keighery, 1994) and is represented by communities BmBaLOW and CcEmOW.

The majority of vegetation within the project area is in 'Completely Degraded' (Keighery, 1994) condition with 19.89 hectares or 50.03% of the total area in this condition.

5.4 Associations, Representation and Clearing

A range of factors, including isolation, supporting significant flora or fauna and landform types determine the significance of native vegetation communities. However, the most important factor in consideration of community significance is the degree of representation in the local and regional area. That is, vegetation communities are considered significant if they are poorly represented elsewhere.

The EPA's Position Statement No. 2 lays out a series of constraints which relate to biodiversity. One of them is to protect at least 30% of the original extent of vegetation complexes in unconstrained areas and 10% in constrained areas (i.e. urban zoned regions). The project area is considered a constrained area due to its urban zoning. Vegetation type 1001 identified Technical Report 250 within the project area meets the 10% target, with 25.86% of its original extent remaining. Additionally the Bassendean Complex – Central and South has 24% of its original extent remaining on the Swan Coastal Plain, of which approximately 13% is currently protected (Government of Western Australia, 2000).

All of the vegetation within the project area is located within an ESA therefore it is considered to be regionally significant.

5.5 Wetlands

Due to the 'Degraded' to 'Completely Degraded' condition of CC wetland (UFI 8142), its relatively small area as well as surrounding land uses such as 'urban', the number of native species is low. There were only 11 species identified from vegetation community MpTOS which corresponds to CCW (UFI 8142).

None of the species identified within this wetland are Declared Rare or Priority listed species (Appendix B). It is considered that one of the species identified from the DEC database search, namely *Drosera occidentalis* subsp. *occidentalis* has the potential to occur within the project area based on habitat and soil types (Table 5).

5.6 Bushland Management

There are a number of unofficial pathways through the larger vegetation remnants and this is likely to facilitate the spread of weeds in the future due to continual disturbance. It is recommended that the pathways are rationalised and formalised to minimise disturbance and unnecessary pathways. The majority of better quality native vegetation (BmBaLOW and CcEmOW) should be 'fenced' and rehabilitated with local endemic species to prevent any weed invasion which could potentially smother native species and compete vigorously for space, water and nutrients, as well as adversely affecting the biological integrity of natural communities by altering vegetation structure.

Recent fires in the study site are likely to have resulted by accidental means from human disturbance (e.g. a cigarette butt) or by arson. It is considered likely that the network of unofficial pathways has increased the likelihood of fire ignitions by either potential means. A limitation of access to the bushland is likely to reduce the incidence of such disturbances. Fire results in direct impacts to

vegetation via death and damage to flora and indirectly, later impacts include weed proliferation and the increased potential for the spread of dieback. In this regard, fire management in very important. In a suburban setting, fire management is imperative for the preservation of human life and property.

5.7 Fauna

Interrogation of the DEC Threatened Fauna Database prior to field assessment identified the presence or potential presence for 6 species to occur within the region (Table 8). This consisted of two Schedule 1, two Priority 3, one Priority 4 and one Priority 5 species. None of these species were observed during the opportunistic field assessment. Based on the habitat present at the site, there is the potential for three of these species to be supported by the bushland remnants within the ROS. These species are Carnaby's Black Cockatoo, the Graceful Sunmoth and the Native Bee.

During the field assessment, only a single native fauna observation was made, a Little Wattlebird (*Anthochaera chrysoptera*) (Table 9). Rabbit scats were also observed. Rabbits are likely to be attracted to the large expanses of horticultural grasses to feed on, along ovals and other recreational areas, accompanied my nearby bushland refuge into which they can quickly hide from predators.

Evidence of the activity of rabbits was also observed in the project area by Mattiske Consulting. Rabbits compete directly with many native animals for food; their grazing can prevent the regeneration of native vegetation, with increased grazing pressure often resulting in complete loss of vegetation and resultant soil erosion (Vertebrate Pest Research Section, 2001).

It is considered unlikely that the Western Brush Wallaby occurs within the project area. This species occurs in areas of forest and woodlands supporting a dense shrub layer, elements which are not present within the project area. Additionally, the Western Brush wallaby is vulnerable to predators that are likely to occur in the project area.

Similarly, the Quenda is also unlikely to occur within the project area. This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses which provide ample protection from predators. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. On the Swan Coastal Plain Quenda are often associated with wetlands (DEC, 2009c). The Quenda is a Priority 5 species, which means that it is not considered threatened but is subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years. Quenda populations on the Swan Coastal Plain are threatened by development in this region, which has resulted in loss of habitat. This species is relatively common in the southern suburbs of Perth, particularly in the Jandakot – Murdoch region. This species is also vulnerable to predators that are likely to occur in the project area.

The preferred habitat and know distribution of the Black-striped snake dictates that this species does not occur within the project area. The Black-striped Snake is a small, moderately slender snake that inhabits dunal areas supporting heathlands and Banksia /Eucalypt woodlands. The range of this species is particularly restricted and is found only on the Swan Coastal Plain between Mandurah and Lancelin (Bush *et al.,* 1995). This species was not recorded during the opportunistic fauna survey.

Based on the preferred habitat and known distribution of Carnaby's Black Cockatoo, this species may occur within the project area. This species was sighted once in 2003 in Koondoola, which are several kilometres from the project area. The habitat type preferred by Carnaby's Black Cockatoo is Proteaceous scrubs and heaths and Eucalypt woodlands as well as pine plantations. The project area supports Eucalyptus woodlands and is considered suitable habitat for the species.

The Graceful Sunmoth may occur within the project area. This species has been sighted in the region 25 times in recent years and all of these records are certain. The Graceful Sunmoth has been found in the last decade in eight reserves on the Swan Coastal Plain including Koondoola Regional Bushland and the Warwick Conservation Reserve, which are in close proximity to the project area (DEWHA, 2009b). This species is thought to breed exclusively on *Lomandra* species, probably *Lomandra hermaphrodita* which is present within the project area.

Based on the preferred habitat and know distribution of the Native Bee (*Hylaeus globuliferus*), this species may occur within the project area. This species of native bee is known to feed on the flowers of *Adenanthos cygnorum* in particular, but also has been collected from the flowers of *Grevillea cagiana*, *Banksia grossa* and *Banksia attenuata*. The project area supports individuals of *Adenanthos cygnorum* and *Banksia attenuata*.

Despite no Threatened or Priority Fauna being observed within the project areas, utilisation of the project area can not be discarded since the results of the database search do not account for the occurrence of the species within their entire range. In some instances the range of individual species can be quite extensive, particularly bird species that have the ability to travel large distances, in particular between water bodies.

The majority of the project area is considered far too degraded to provide suitable long-term habitat for significant native fauna, particularly in terms of nesting, breeding and feeding use. However, some areas of intact vegetation exist and are considered to provide good quality habitat for native vertebrate species. Intact remnants patches and predominantly mature trees, both locally native and introduced, are likely to provide habitat for native birds.

The upgrade or construction of roads may lead to increases in traffic volumes and can affect fauna populations by introducing a new source of mortality (Jackson and Griffin, 2000). Increased vehicle movements, particularly during construction phases of development projects have the potential to impact on local fauna by introducing factors such as increased noise, vibration and dust, all of which may affect normal behaviour and home ranges. Any upgrade of existing roads to facilitate access should take into account this potential interaction.

With a temporary increase in construction related traffic and transportation of machinery, and a permanent increase in traffic via use of the new access road, potential impacts on fauna from construction and traffic related activities include:

- increased edge effect from weed invasion; and
- dust and noise produced during construction.

6.0 Conclusions and Recommendations

The significance of an impact is dependent on the conservation and reservation status of the vegetation communities and individual flora species that would be affected. It is also dependent on the intensity and duration of the impact.

Overall, the majority of the vegetation within the project area is in 'Completely Degraded' (Keighery, 1994) condition with 19.89 hectares or 50.03% of the total area in this condition. All of the vegetation within the project area is located within an Environmentally Sensitive Area therefore it is considered to be regionally significant.

The timing of the survey was not considered optimal for the identification of the majority of annual and ephemeral species potentially occurring within the project areas. The requirements of a Level 1 survey are considered to have been met, in accordance with EPA Guidance 51. For the purposes of an application to undertake clearing within the project area, the results of the level 1 assessment may not be considered sufficient. However, the 'clearing corridor', which refers to the proposed entry/exit from Alexander Drive was conducted to a Level 2 assessment in order to assist the City of Stirling with obtaining approval to undertake proposed clearing activities in this area. However, the project area is located within Bush Forever Site No. 280 (Dianella Open Space) and any vegetation clearing within this area will require consultation with the DEC. The degraded nature of the vegetation, in combination with the relatively small footprint proposed for the development suggests that the survey conducted may be sufficient for impact assessment and acquisition of appropriate Clearing Permits. This matter requires negotiation with DEC.

The project area is located within Bush Forever Site No. 280 (Dianella Open Space) and within an ESA. Therefore active consultation with DEC regarding direct impacts on these areas and strategies for minimisation and management of impacts, plus contingencies if appropriate is recommended.

For the purposes of assessing any ongoing activities in the area, including an application for vegetation clearing, additional surveys and management considerations are recommended, and these include:

- a detailed, Level 2 Spring Flora and Vegetation Assessment be conducted in areas of remnant native vegetation to determine whether any of the Priority and DRF from the DEC database search actually occur within the project area;
- a follow-up Level 1 Fauna Survey conducted during spring, when fauna activity will be higher;
- retain existing native flora species where possible, including isolated trees and shrubs, as part of proposed clearing activities;
- retain mature trees that may provide nesting habitat for birds and small mammals;
- dust, noise and vibration is controlled as practicable during any construction activities;
- pathways are rationalised and formalised to minimise disturbance and unnecessary access;
- closed pathways within communities BmBaLOW and CcEmOW should be fenced and compacted ground ripped and rehabilitated with local endemic species;
- Vegetation within communities BmBaLOW and CcEmOW should be 'fenced' and rehabilitated with local endemic species to prevent any weed invasion which could potentially smother native species and compete vigorously for space, water and nutrients, as well as adversely affecting the biological integrity of natural communities by altering vegetation structure; and
- The project area is located within Bush Forever Site No. 280 (Dianella Open Space) and within an ESA. Therefore active consultation with DEC regarding direct impacts on these areas and strategies for minimisation and management of impacts, plus contingencies if appropriate is recommended.

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Appendix A Vascular Flora List of Species Recorded at Dianella ROS

APPENDIX A: VASCULAR FLORA LIST OF SPECIES RECORDED AT DIANELLA ROS

* Denotes Introduced (weed) or non-endemic species
\# Denotes Planted species

		# Sites Recorded
	016A Zamiaceae	
	Macrozamia riedlei	2
	031 Poaceae	
*	*Briza maxima*	2
*	*Cynodon dactylon*	2
*	*Ehrharta calycina*	2
*	*Ehrharta longiflora*	1
*	*Eragrostis curvula*	1
	032 Cyperaceae	
*	*Cyperus polystachyos*	1
	Lepidosperma squamatum (narrow form)	2
	Lepidosperma tenue	1
	Mesomelaena pseudostygia	3
	Tetraria capillaris	1
	039 Restionaceae	
	Alexgeorgea nitens	3
	Desmocladus fasciculatus	1
	Desmocladus flexuosus	2
	Hypolaena exsulca	2
	Lepyrodia drummondiana	1
	Loxocarya cinerea	1
	Loxocarya striata	1
	Lyginia barbata	2
	Lyginia imberbis	1
	052 Juncaceae	
*	*Juncus microcephalus*	1
	Juncus pallidus	1
	054C Dasypogonaceae	
	Dasypogon bromeliifolius	2
	Lomandra hermaphrodita	1
	Lomandra preissii	1
	054D Xanthorrhoeaceae	
	Xanthorrhoea preissii	4
	054F Anthericaceae	
	Thysanotus dichotomus	3
	Tricoryne elatior	1
	054J Colchicaceae	
	Burchardia sp.	4

APPENDIX A: VASCULAR FLORA LIST OF SPECIES RECORDED AT DIANELLA ROS

	055 Haemodoraceae	**# Sites Recorded**
#	*Anigozanthos* sp.	1
	Conostylis aculeata subsp. *aculeata*	2
	Conostylis setigera	1
	Haemodorum sp.	2
	Phlebocarya ciliata	3
	060 Iridaceae	
*	*Gladiolus caryophyllaceus*	2
	Patersonia occidentalis	3
*	*Romulea rosea*	1
	066 Orchidaceae	
	Prasophyllum sp.	2
	070 Casuarinaceae	
	Allocasuarina fraseriana	2
	Allocasuarina huegeliana	3
	Allocasuarina humilis	1
	090 Proteaceae	
	Adenanthos cygnorum	1
	Banksia attenuata	2
	Banksia grandis	2
	Banksia ilicifolia	2
	Banksia menziesii	5
	Conospermum stoechadis	2
	Persoonia comata	1
	Petrophile linearis	2
	Stirlingia latifolia	1
	Synaphea spinulosa	1
	097 Loranthaceae	
	Nuytsia floribunda	3
	138 Brassicaceae	
*	*Heliophila pusilla*	1
	163 Mimosaceae	
	Acacia alata	1
*	*Acacia longifolia* subsp. *longifolia*	1
	Acacia pulchella	3
	Acacia stenoptera	1

APPENDIX A: VASCULAR FLORA LIST OF SPECIES RECORDED AT DIANELLA ROS

165 Papilionaceae	**# Sites Recorded**
Bossiaea eriocarpa	1
Daviesia physodes	1
Daviesia triflora	2
Gastrolobium capitatum	1
Gompholobium confertum	1
Gompholobium tomentosum	4
Hardenbergia comptoniana	1
Jacksonia floribunda	2
Jacksonia furcellata	1
Jacksonia sternbergiana	2
Kennedia prostrata	1
226 Dilleniaceae	
Hibbertia huegelii	1
Hibbertia hypericoides	1
Hibbertia subvaginata	1
263 Thymelaeaceae	
Pimelea leucantha	1
Pimelea sp.	1
273 Myrtaceae	
# *Eucalyptus* spp.	1
Agonis flexuosa	1
Astartea leptophylla	1
Calothamnus quadrifidus	1
Calytrix flavescens	2
Calytrix fraseri	2
Calytrix leschenaultii	1
Corymbia calophylla	3
Corymbia haematoxylon	1
Eucalyptus marginata	3
Eucalyptus todtiana	1
Hypocalymma robustum	1
Melaleuca argentea	1
Melaleuca parviceps	2
Melaleuca preissiana	3
Melaleuca rhaphiophylla	1
Melaleuca sp.	2
Scholtzia involucrata	2
Verticordia drummondii	1
Myrtaceae sp.	1
281 Apiaceae	
Platysace compressa	1

APPENDIX A: VASCULAR FLORA LIST OF SPECIES RECORDED AT DIANELLA ROS

	# Sites Recorded
288 Epacridaceae	
Conostephium pendulum	1
Leucopogon nutans	1
303A Menyanthaceae	
Villarsia albiflora	1
307 Convolvulaceae	
* *Ipomoea indica*	1
313 Lamiaceae	
Hemiandra linearis	2
315 Solanaceae	
* *Solanum nigrum*	1
341 Goodeniaceae	
Dampiera linearis	2
Scaevola canescens	1
343 Stylidiaceae	
Stylidium brunonianum	1
Stylidium repens	1
345 Asteraceae	
* *Conyza bonariensis*	1
Helichrysum luteoalbum	1
* *Hypochaeris glabra*	2
Lagenophora huegelii	1
* *Sonchus oleraceus*	1
* *Ursinia anthemoides*	2

Appendix B Summary of Vascular Flora Species Recorded Within Dianella Region Open Space, March 2009

APPENDIX B: SUMMARY OF VASCULAR FLORA SPECIES RECORDED WITHIN DIANELLA REGIONAL OPEN SPACE, MARCH 2009

NB: * Denotes introduced (weed) or non-endemic species

# Denotes planted species

Family		Species	BmBaLOW	CcEmOW	RT	MpTOS
ZAMIACEAE		*Macrozamia riedlei*	+	+		
POACEAE	*	*Briza maxima*	+	+		
	*	*Cynodon dactylon*			+	+
	*	*Ehrharta calycina*	+			
	*	*Ehrharta longiflora*		+		
	*	*Eragrostis curvula*		+		
CYPERACEAE	*	*Cyperus polystachyos*				+
		Lepidosperma squamatum (narrow form	+	+		
		Lepidosperma tenue	+			
		Mesomelaena pseudostygia	+			
		Tetraria capillaris		+		
RESTIONACEAE		*Alexgeorgea nitens*	+			
		Desmocladus fasciculatus	+			
		Desmocladus flexuosus	+	+		
		Hypolaena exsulca	+			
		Lepyrodia drummondiana		+		
		Loxocarya cinerea	+			
		Loxocarya striata	+			
		Lyginia barbata	+			
		Lyginia imberbis	+			
JUNCACEAE	*	*Juncus microcephalus*				+
		Juncus pallidus		+		
DASYPOGONACEAE		*Dasypogon bromeliifolius*	+	+		
		Lomandra hermaphrodita	+			
		Lomandra preissii	+			
XANTHORRHOEACEAE		*Xanthorrhoea preissii*	+	+	+	
ANTHERICACEAE		*Thysanotus dichotomus*	+			
		Tricoryne elatior		+		
COLCHICACEAE		*Burchardia* sp.	+	+		
HAEMODORACEAE	#	*Anigozanthos* sp.		+		
		Conostylis aculeata subsp. *aculeata*	+			
		Conostylis setigera	+			
		Haemodorum sp.	+			
		Phlebocarya ciliata	+	+		
IRIDACEAE	*	*Gladiolus caryophyllaceus*	+			
		Patersonia occidentalis	+			
	*	*Romulea rosea*	+			
ORCHIDACEAE		*Prasophyllum* sp.	+			

APPENDIX B: SUMMARY OF VASCULAR FLORA SPECIES RECORDED WITHIN DIANELLA REGIONAL OPEN SPACE, MARCH 2009

NB: * Denotes introduced (weed) or non-endemic species

# Denotes planted species

Family		Species	BmBaLOW	CcEmOW	RT	MpTOS
CASUARINACEAE		*Allocasuarina fraseriana*		+	+	
		Allocasuarina huegeliana	+		+	+
		Allocasuarina humilis	+			
PROTEACEAE		*Adenanthos cygnorum*		+		
		Banksia attenuata	+			
		Banksia grandis	+	+		
		Banksia ilicifolia		+	+	
		Banksia menziesii	+	+	+	
		Conospermum stoechadis	+			
		Persoonia comata		+		
PROTEACEAE (Cont)		*Petrophile linearis*	+	+		
		Stirlingia latifolia	+			
		Synaphea spinulosa	+			
LORANTHACEAE		*Nuytsia floribunda*	+	+		
BRASSICACEAE	*	*Heliophila pusilla*	+			
MIMOSACEAE		*Acacia alata*	+			
	*	*Acacia longifolia* subsp. *longifolia*			+	
		Acacia pulchella	+	+		
		Acacia stenoptera		+		
PAPILIONACEAE		*Bossiaea eriocarpa*	+			
		Daviesia physodes		+		
		Daviesia triflora	+			
		Gastrolobium capitatum	+			
		Gompholobium confertum	+			
		Gompholobium tomentosum	+	+		
		Hardenbergia comptoniana		+		
		Jacksonia floribunda	+			
		Jacksonia furcellata		+		
		Jacksonia sternbergiana	+			
		Kennedia prostrata		+		
DILLENIACEAE		*Hibbertia huegelii*	+			
		Hibbertia hypericoides		+		
		Hibbertia subvaginata		+		
THYMELAEACEAE		*Pimelea leucantha*	+			
		Pimelea sp.	+			

APPENDIX B: SUMMARY OF VASCULAR FLORA SPECIES RECORDED WITHIN DIANELLA REGIONAL OPEN SPACE, MARCH 2009

NB: * Denotes introduced (weed) or non-endemic species

# Denotes planted species

Family	Species	BmBaLOW	CcEmOW	RT	MpTOS
MYRTACEAE	*Agonis flexuosa*			+	
	Astartea leptophylla		+		
	Calothamnus quadrifidus	+			
	Calytrix flavescens	+			
	Calytrix fraseri	+	+		
	Calytrix leschenaultii	+			
	Corymbia calophylla	+	+	+	
	Corymbia haematoxylon				+
	Eucalyptus marginata	+	+	+	
	Eucalyptus todtiana	+			
	# *Eucalyptus* spp.				+
	Hypocalymma robustum	+			
	Melaleuca argentea				+
	Melaleuca parviceps	+			
	Melaleuca preissiana		+	+	+
	Melaleuca rhaphiophylla		+		
	Melaleuca sp.	+			
	Scholtzia involucrata	+			
	Verticordia drummondii		+		
	Myrtaceae sp.	+			
APIACEAE	*Platysace compressa*		+		
EPACRIDACEAE	*Conostephium pendulum*	+			
	Leucopogon nutans	+			
MENYANTHACEAE	*Villarsia albiflora*				+
CONVOLVULACEAE	* *Ipomoea indica*		+		
LAMIACEAE	*Hemiandra linearis*	+			
SOLANACEAE	* *Solanum nigrum*		+		
GOODENIACEAE	*Dampiera linearis*		+		+
	Scaevola canescens	+			
STYLIDIACEAE	*Stylidium brunonianum*	+			
	Stylidium repens		+		
ASTERACEAE	* *Conyza bonariensis*	+			
	Helichrysum luteoalbum				+
	* *Hypochaeris glabra*	+	+		
	Lagenophora huegelii		+		
	* *Sonchus oleraceus*	+			
	* *Ursinia anthemoides*	+			

Appendix C Declared Plant in Project Area

Acacias (*Acacia spp*., all species not native to Australia except *Acacia farnesiana*)

Declaration

(Code: C= City; S=Shire; T=Town)

Category : P1, P2
Location : For the whole of the State. All species not native to Australia (except *Acacia farnesiana*)

Standard Control Codes (these may vary for individual plants)	
P1 REQUIREMENTS Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 REQUIREMENTS Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.

Control Method

Recommended herbicides	**:**	**Clopyralid** **Triclopyr + Picloram**

Herbicide	**:**	**Lontrel 750 SG, Clopyralid 750, Granosan**
Active ingredient and Group	**:**	750 g clopyralid as potassium salt or 300 g/L triisopropanolamine salt **(Group I herbicide)**
Rate of product	**:**	200 g in 2.5 L water
Wetting agent		N/A
Remarks	**:**	Single stem plants less than 25 cm diameter 1mL/cut made waist high at 10-13 cm intervals. Multiple stems or greater than 25 cm diameter, 2mL/cut at same spacing.

Herbicide	**:**	**Grazon DS, Tri-pick, Grass-up, Picker.**
Active ingredient and Group	**:**	100 g/L picloram + 300 g/L triclopyr **(Group I herbicide)**
Rate of product	**:**	35 mL/10 L water
Wetting agent		Add at recommended rate as per label
Remarks	**:**	Apply to trees 1-3 m tall and thoroughly wet foliage.

Herbicide	**:**	**Access (Group I herbicide)**
Active ingredient	**:**	120 g/L picloram (isooctyl ester)+ 240 g/L triclopyr (butoxyethyl ester)
Rate of product	**:**	1:60 in distillate
Remarks	**:**	Treat plants up to 5 cm diameter Treat all stems on multiple stemmed plants. Root suckering may occur and will require treating

Herbicide	**:**	**Garlon and various other trade names (Group I herbicide)**
Active ingredient and Group	**:**	600 g/L triclopyr
Rate of product	**:**	16 mL/10 L water for trees 1-2 m tall 32 mL /10 L water for trees 2-3 m tall

Weed Description

Family : Mimosaceae
Form : Tree/Shrub - Perennial
Status : Present in WA

Trees and shrubs sometimes spiny. One species, Prickly acacia (*Acacia nilotica*) is a Weed of National Significance.

Leaves : Leaves are bipinnate, that is they are divided twice and give a feathery appearance.

Flowers : Flowers are grouped into dense globular or cylindrical spikes, either in the axils of the leaves or at the end of branches.

Other relevant information related to this topic:

- Quarantine WA
- Permitted and quarantine species list
- Weed of National Significance
- Weeds CRC
- Permit for minor off-label-use of a registered agvet chemical product (Permit number – per9655)
- Off-label permit (olp) for use of a registered agvet chemical product (Permit number - per4590)

Appendix D Floristic Community Type (FCTS) Analysis for the Study Area, Dianella 2009

APPENDIX D - FLORISTIC COMMUNITY TYPE (FCTS) ANALYSIS FOR THE STUDY AREA, DIANELLA 2009.

Community		Floristic Community Types (FCTs)																																								Determined FCT
	FCT Score	1a	1b	2	3a	3b	3c	4	5	6	7	8	9	10	10a	10b	11	12	13	14	15	16	17	18	19	20a	20b	20c	21a	21b	21c	22	23a	23b	24	25	26a	26b	27	28	29a	29b	30a	30b	30c	
BmBaLOW		26	27	16	24	26	21	25	21	24	8	13	10	9	11	17	17	3	5	3	0	3	2	4	3	38	33	38	46	34	40	27	45	40	39	24	13	31	7	49	9	9	3	6	10	**23a**
CcEmOW		21	23	11	16	26	12	25	19	15	6	12	8	4	5	12	18	4	5	7	3	2	4	3	4	20	23	16	32	25	29	22	28	19	20	17	10	17	10	29	7	6	4	7	6	**21a**
MpTOS		2	2	2	2	1	1	2	2	2	1	1	2	0	0	2	4	1	3	1	2	1	2	0	0	1	1	0	2	2	2	2	2	1	1	1	1	0	1	1	0	0	0	0	0	**11**

NB: Table shows results of FCT analysis (selectd FCT score in yellow) - comapring species recorded during flora survey and species as recorded by Gibson *et al.*, (1994)

APPENDIX IV
Dieback Survey
Glevan, 2009

City of Stirling

Project: *Phytophthora cinnamomi* occurrence mapping

Location: Dianella regional open space & Walter Hamer bushland reserve

GLEVAN CONSULTING

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Executive Summary

Glevan Consulting conducted assessments for the presence of the disease caused by *Phytophthora cinnamomi* (Rands) within the vegetation of the Dianella Regional Open Space and Walter Hamer bushland reserve, City of Stirling..

Phytophthora cinnamomi (Dieback) occurrence mapping was done according to standards defined by the Department of Environment and Conservation.
The method involved interpretation of disease symptoms. Areas of disturbance can be given an Unmappable category and consequently may not be mapped for *Phytophthora* Dieback occurrence. The interpretation of any mappable area may result in three separate categories of disease occurrence; infested, uninfested and uninterpretable. Delineated categories can include infested areas and uninterpretable areas. Locations of boundaries were recorded using non-differential GPS.

The assessment found that Dianella Regional Open Space is a mosaic of Unmappable, Infested and Uninfested, with changes made to the disease boundaries from the previous assessment.

Walter Hamer bushland reserve is infested with no significant uninfested areas.

Study Team

Jake Cortis from Glevan Consulting managed and completed the project in April 2009.

Introduction

Glevan Consulting was commissioned by the City of Stirling to conduct an assessment of the remnant vegetation within Dianella Regional Open Space and Walter Hamer bushland reserve for the presence of *P. cinnamomi*. This assessment determined any changes to the existing disease boundaries that were demarcated in December 2006 and provided new information for the previously unmapped Walter Hamer bushland reserve.

The study areas (Map 1 & 2) are shown attached.

A *P. cinnamomi* occurrence assessment is the first step in developing an effective management plan for the pathogen. This assessment assigns four possible categories to all assessable areas within Dianella Regional open space and Walter Hamer bushland reserve. These categories are; Unmappable, Infested, Uninfested and Uninterpretable.

The following table describes *P. cinnamomi* occurrence categories as defined by the Department of Environment and Conservation in the manual "*Phytophthora cinnamomi* and disease caused by it, volume 1, Management Guidelines, 2003". The superior categories "Mappable" and "Unmappable" definitions are not yet published by the department, but are in general use at this time.

Unmappable Areas that are sufficiently disturbed so that *P. cinnamomi* occurrence mapping is not possible at the time of inspection	Further categorisation may be possible after variable regeneration periods for different types of disturbance	
Mappable Natural undisturbed vegetation. *P. cinnamomi* occurrence mapping is possible. Three categories may result.	**Infested**	Areas that a qualified person has determined to have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.
	Uninfested	Areas that a qualified person has determined to be free of plant disease symptoms that indicate the presence of the pathogen *P. cinnamomi*
	Uninterpretable	Areas where indicator plants are absent or too few to determine the presence or absence of disease caused by *P. cinnamomi*

Table 1. Category Definitions

Once *P. cinnamomi* occurrence information has been assessed, protectable and unprotectable management categories can be overlayed on occurrence information to further simplify the management of the area. All infested area is unprotectable. Unmappable, Uninterpretable and Uninfested may be given protectable or unprotectable status depending on local variations and influences.

This report will give results of the *Phytophthora* Dieback occurrence assessment, stating infested, uninfested and unmappable area. Recommendations of protectable area will also be made. Glevan Consulting

can do final rationalisation of protectable area categories in consultation with the land managers.

P. cinnamomi is an introduced soil-borne pathogen (water mould) that causes the death of a vast and diverse range of plant species in South West Western Australia through a disease known as ‘Dieback’. The disease enters through the plant roots, gradually breaking down the structure of the roots, ultimately causing roots to ‘rot’. As a result of this ‘root rot’, the vascular system (xylem and phloem) in the root region of the plant is destroyed and the ability to transport water and nutrients is lost along with it. Additional information on the Disease is provided in Appendix 2.

Method

Disease Interpretation

The project study area consisted of all vegetated areas within the Dianella Regional Open Space and Walter Hamer bushland reserve.

Qualified dieback interpreter Jake Cortis of Glevan Consulting traversed the study area.

Glevan Consulting use the presence of susceptible plant deaths as an initial point of reference. This methodology is consistent with that prescribed in "*Phytophthora cinnamomi* and the disease caused by it, Volume II Interpreter Guidelines for detection, diagnosis and mapping, DEC 2001"

Indicator species deaths and chronological patterns of indicator species deaths were observed. Plant death chronology is used to help confirm the presence of *P. cinnamomi*. Distinct patterns will often form, in which older deaths are closer to the original point of infestation, and the most recent deaths will be located nearer the disease edge.

All disease boundaries have been flagged using day-glo orange flagging tape tied as close as practicable to the active disease edge. The knot in the tape faces the vegetation that is already infested with the disease.

Results

Dianella

Twelve infested areas have been identified and demarcated. These areas are existing infestations and/or infestations that have had demarcations modified from previous assessments. The modifications were made to incorporate merging infestations and natural spread of disease boundaries.

Phytophthora occurrence categories	**Area**	**Percentage of total %**
Infested	4.1	19.0
Uninfested	14.6	67.6
Unmappable	7.4	13.4
Total	**26.1**	

4.1 ha of infested areas exist within the park. The infested areas are the naturally occurring Banksia woodlands. Dead and dying indicator species such as *Banksia menziesii, Banksia attenuata, and Xanthorrhea preissii* were found throughout infested areas. Infested areas also typically showed a significant biomass reduction.

14.6 ha of uninfested area consisted of naturally occurring vegetation. These areas displayed high biomass densities and a high level of species diversity typical of uninfested sites. Some small burnt areas are within the uninfested areas, however this did not impede upon identification of Phytophthora Dieback.

7.4 ha of unmappable areas included grassed or modified vegetated areas and swamps due to a lack of *Phytophthora* dieback indicators.

Sample Results

Sample number	***Species***	***Result***	***MGA Reference***
Sample 1	*Xanthorrhea preissii*	*negative*	*393930e* *6471402n*
Sample 2	*Xanthorrhea preissii*	*negative*	*393738e* *6471165n*
Sample 3	*Xanthorrhea preissii*	*negative*	*393548e* 6471274n
Sample 4	*Xanthorrhea preissii*	*negative*	*393657e* 6471404n

Management of *Phytophthora* within Dianella Regional Open space.

There are significant areas of uninfested natural vegetation within Dianella regional open space. Day-glo orange demarcation visibly displays all boundaries between uninfested and infested areas.

All uninfested areas are protectable and a comprehensive management plan should be compiled if any infrastructure works are to be carried out within these areas. The data provided for this assessment and any demarcations within Dianella regional open space are valid for 12months.

Unmappable areas are unprotectable as no clear boundaries for the presence of the pathogen can be defined. Unmappable areas cannot be defined as uninfested and should be treated or regarded as being unprotectable in this instance. No hygiene management strategies are recommended for unmappable areas.

Walter Hamer bushland reserve

2.3 ha of infested vegetation exist with in Walter Hamer bushland Reserve. Dead and dying *Xanthorrhea preissii* and *Banksia menziesii* were found within or around areas of reduced biomass. This evidence suggests the presence of *Phytophthora cinnamomi* throughout the reserve. An intensive soil and tissue sampling regime was employed at the reserve to ascertain the presence of the pathogen. Out of 10 samples taken one positive was achieved. The low percentage of positives samples could be attributed to the extremely dry soils in the area at the time of sampling.

No uninfested areas of significant size could be demarcated due to the small size of the reserve and positioning of infested sites.

Phytophthora occurrence categories	**Area ha**	**Percentage of total**
Infested	2.3	100

Sample number	***Species***	***Result***	***MGA Reference***
Sample 1	Xanthorrhea *preissii*	Negative	393908e 6468087n
Sample 2	Xanthorrhea *preissii*	Negative	393877e 6468109n
Sample 3	Xanthorrhea *preissii*	Negative	393929e 6468120n
Sample 4	unknown	Negative	393925e 6468184n
Sample 5	Xanthorrhea *preissii*	Negative	393871e 6468127n
Sample 6	Banksia *menziesii*	*P. cinnamomi*	393915e

			6468205n
Sample 7	Xanthorrhea *preissii*	Negative	393863e 6468218n
Sample 8	Stirlingia *latifolia*	Negative	393856e 6468259n
Sample 9	Xanthorrhea *preissii*	Negative	393937e 6468100n
Sample 10	Xanthorrhea *preissii*	Negative	393669e 6468159n

Management of *Phytophthora* within Walter Hamer bushland reserve.

No *phytophthora* hygiene management strategies are recommended for Walter Hamer bushland reserve. A mosaic of infested areas scattered throughout the reserve render the area unprotectable. A positive sample result for P. *cinnamomi* was recovered. Given the small size of the reserve and all of the factors above no uninfested areas were demarcated.

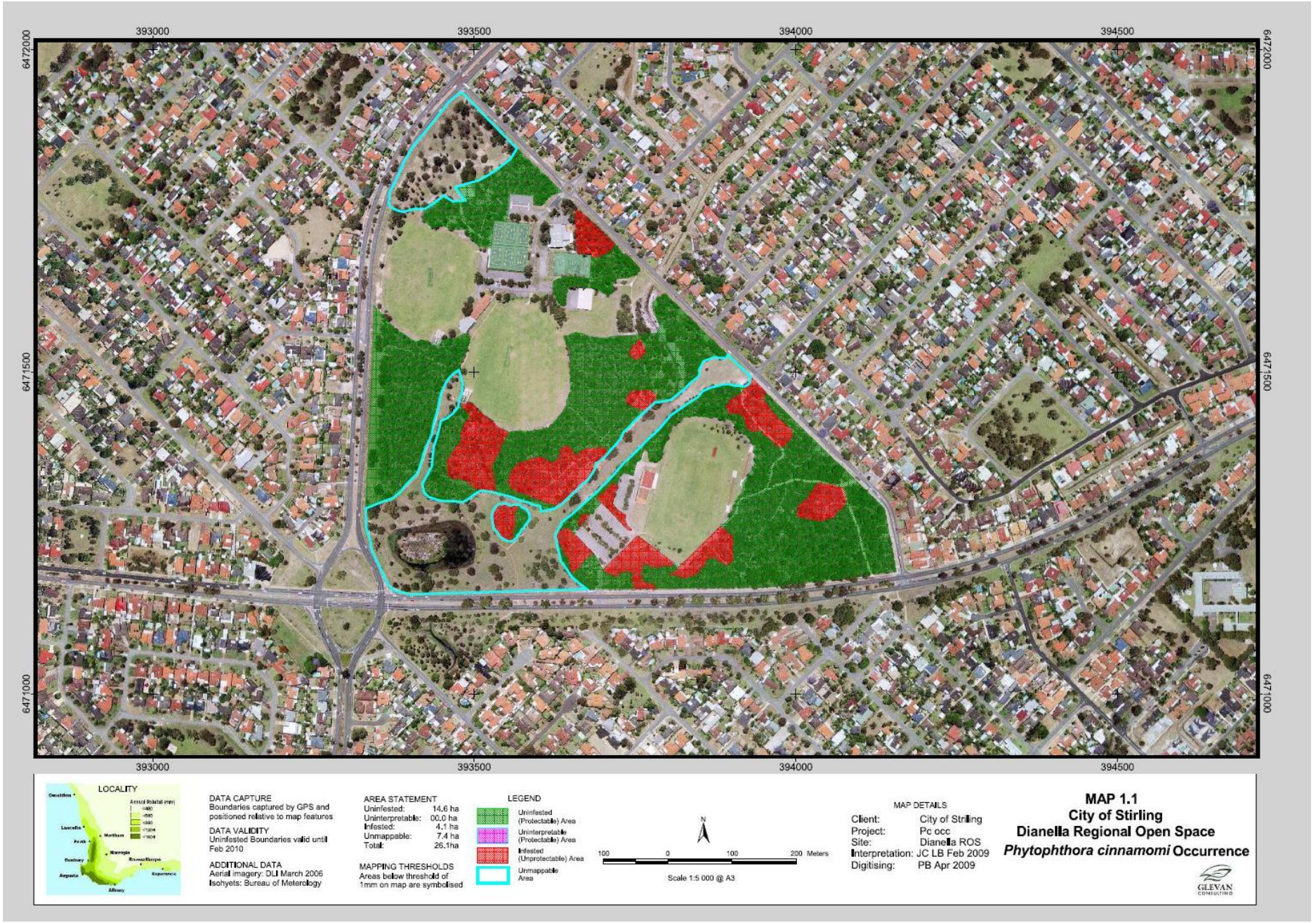
Infested areas may be managed by treatment with phosphite chemical. The chemical is applied on a regular basis (approximately every 3 years) as a foliar spray to medium size shrubs and plants. The area may also be replanted using resistant plant species. Both these tactics would need further investigation to determine a prescription for this particular reserve

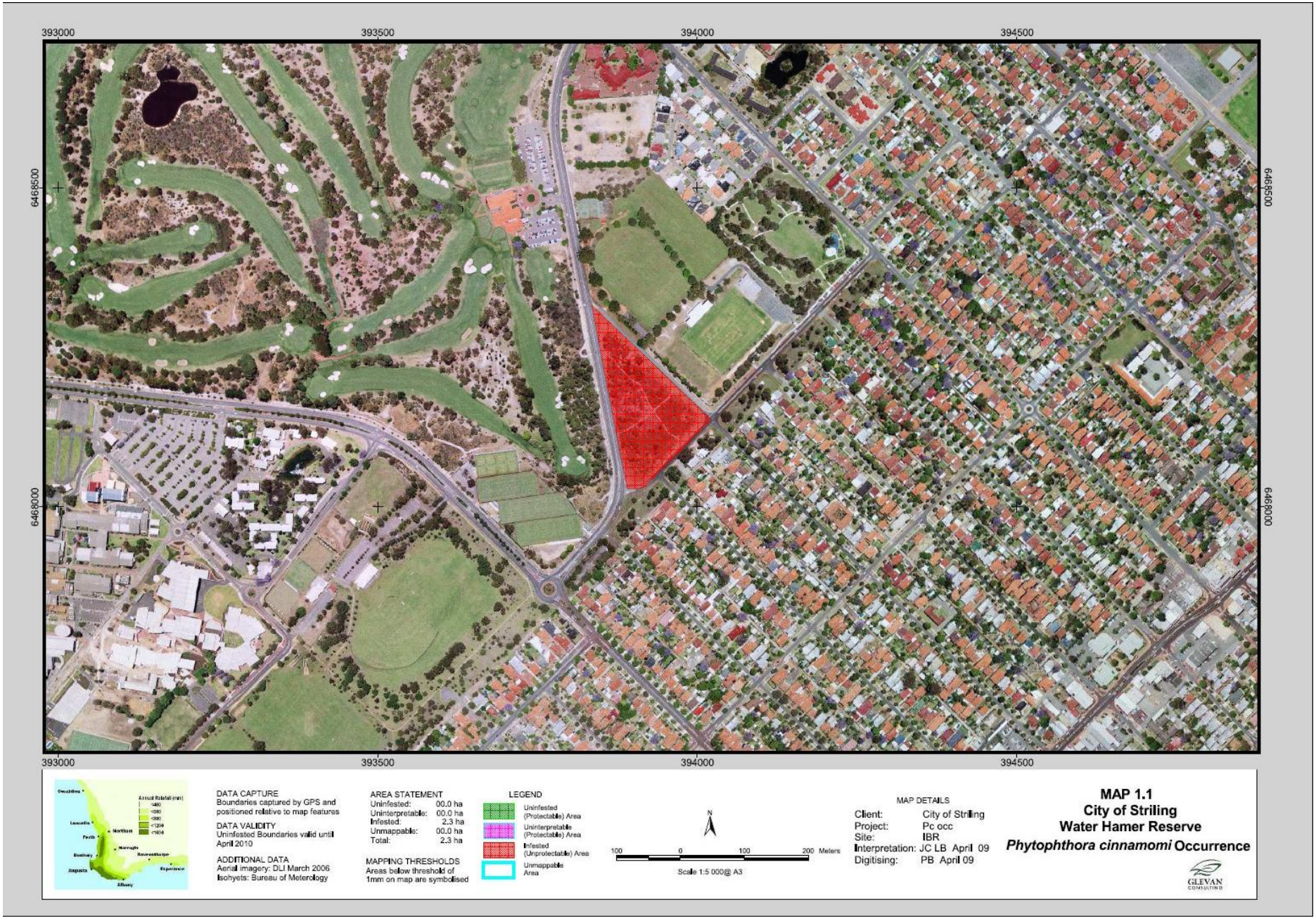
References

DEC (2003) *Phytophthora cinnamomi and the disease caused by it. Volume I – Management guidelines*. Department of Environment and Conservation.

DEC (2001) *Phytophthora cinnamomi and the disease caused by it. Volume II - Interpreter Guidelines for Detection, Diagnosis and Mapping*. Department of Environment and Conservation.

Appendix 1 – Phytophthora occurrence maps




393000
393500
394000
394500
6468500
6468000
DATA CAPTURE
Boundaries captured by GPS and positioned relative to map features
DATA VALIDITY
Uninfested Boundaries valid until April 2010
ADDITIONAL DATA
Aerial imagery: DLI March 2006
Isohyets: Bureau of Meterology
AREA STATEMENT
Uninfested: 00.0 ha
Uninterpretable: 00.0 ha
Infested: 2.3 ha
Unmappable: 00.0 ha
Total: 2.3 ha
MAPPING THRESHOLDS
Areas below threshold of 1mm on map are symbolised
LEGEND
Uninfested (Protectable) Area
Uninterpretable (Protectable) Area
Infested (Unprotectable) Area
Unmappable Area
N
100 0 100 200 Meters
Scale 1:5 000@ A3
MAP DETAILS
Client: City of Stirling
Project: Pc occ
Site: IBR
Interpretation: JC LB April 09
Digitising: PB April 09
MAP 1.1
City of Striling
Water Hamer Reserve
Phytophthora cinnamomi Occurrence
GLEVAN CONSULTING

Appendix 2 – *Phytophthora cinnamomi* (Dieback)

Phytophthora cinnamomi is an introduced soil-borne pathogen (water mould) that kills a diverse range of plant species in South West Western Australia. Jarrah Dieback, the name given to the disease associated with *P. cinnamomi* is actually something of a misnomer. The Jarrah *(Eucalyptus marginata*) *is susceptible to P. cinnamomi*, but it also demonstrates a degree of resistance to the pathogen (that most susceptible species appear to lack), and hence it is often observed to gradually 'die back'. Most susceptible species however, do not gradually dieback, but rather experience a 'sudden death' in which the entire plant dies at once.

P. cinnamomi is thought to have been introduced to Western Australia shortly after European colonization and has since produced a complex mosaic of infected and uninfected areas throughout the southwest of the State. The spread of the pathogen accelerated after World War II with the use of heavy machinery being used for road building and logging activities and unknowingly spreading infected soil.

The life cycle of *P. cinnamomi* depends on moist conditions that favour the survival, sporulation and dispersal of the spores. The pathogen is not capable of photosynthesis and must extract food from living plant tissue. It does this via a mass of microscopic threadlike mycelium that forms the body of the organism that grows through host tissue. The mycelia continue to grow within the host tissue when the ambient moisture content is above 80%. The mycelia may be transported in soil and host tissue and then deposited where it may infect new hosts. During favourable (warm, moist) conditions, the mycelium, are capable of producing the millions of tiny spores that reproduce the pathogen. Two spore types are produced;

Zoospores

Zoospores are very small spores that can actively swim very short distances towards new hosts and initiate new infections. They are short-lived and fragile but produced in large numbers, and are the mode for the spread of the disease from one plant to the next. Zoospores can also be carried along in moving water over large distances. As they move through the soil zoospores lodge on plant roots, infect them, and in susceptible plants produce mycelia. The mycelium grows, feeding on the host, rotting the roots and cutting off the plant's water supply. The mycelium may grow from plant to plant via root-to-root contact points and/or root grafts.

Chlamydospore

Chlamydospores are larger spores that are tough and long-lived (within dead plants and the soil). They are produced under unfavourable conditions and are the resistant resting phase of the pathogen. They may be transported in soil or roots and then germinate to cause a new infection when they encounter favourable conditions. The chlamydospores produce mycelium and zoospores.

When conditions are warm and moist, microscopic spore sacks called sporangia and thick walled chlamydospores are produced vegetatively from mycelia strands that form the body of the pathogen in the soil or host tissue. The sporangia release motile zoospores in free water to infect host roots. Following infection, the pathogen invades root bark and forms lesions that may extend in to the plants stem collar. In susceptible species, the infection of roots and collar will result in the death of the host.

Mycelia of different mating types may grow together inducing the production of thick walled sexual spores called oospores. The two recognised mating types are known as either A1 or A2, and only one of these mating types (A1) is known to occur in WA. As a result, the pathogen cannot reproduce sexually in WA and relies on vegetative reproduction for survival and dispersal.

P. cinnamomi has a very wide host range, with at least 1000 species from taxonomically diverse families reported as hosts, almost half of which have been recorded from research in Australia. Indigenous species most affected belong to four families:

- Proteaceae
- Epacridaceae
- Papilionaceae/Fabaceae
- Myrtaceae

It has been estimated that approximately 1500 to 2000 species of the estimated 8000 species of vascular plants in the South West of WA may be susceptible to the degree that successful infections result in the death of the host. It is important to note however that not all genera within a family or all species within a genus are necessarily susceptible. Some species of *Eucalyptus,* for example*,* are highly resistant (including Karri, Marri, Wandoo and Tuart) while others, such as Jarrah, are affected but have the ability to resist the invasion of the pathogen under certain conditions (Tissue moisture content < 80%).

The survival of any *Phytophthora* species is dependant upon the presence of a combination of the pathogen, host and suitable environmental conditions. The optimum temperature for the growth of the organism is between 15°C and 30°C while the optimum temperature for sporulation is 25°C to 30°C. Temperatures less than 0°C and greater than 35°C are unfavourable to the survival of the spores and mycelium of *P. cinnamomi*.

Infertile soils are more compatible to *P. cinnamomi* where there is a good movement of water and little biomass with few antagonistic microflora. The soil texture allows for the easy lateral movement of the motile zoospores and the easy development of mycelium. Native vegetation that has adapted to the infertile soils through a large surface area of root matter is at greater risk of infestation.

Clay and laterite are significant components of some soil types of the southwest and may act as impeding layers and cause subsurface ponding, which can facilitate the production of spores. These soils tend to drain laterally, further spreading the zoospores. The moisture content of the soil must be at a level that provides for aerobic environmental conditions. Saturated soils may become anaerobic and will not contain the oxygen levels required for the production of sporangia.

In some areas that are environmentally suited to the establishment, survival and reproduction of the pathogen, the spread of *Phytophthora* infections has reached epidemic proportions. These areas are generally in areas receiving more than 800mm of rainfall annually. In areas receiving between 600-800mm, the occurrence of *P. cinnamomi* is less extensive and confined to water-gaining sites in the landscape.