Appendix 3 – Bioscience Wetland Management Plan

WETLAND MANAGEMENT PLAN

Lots 13, 14, 21 and 22 Southern River Road
&
Lots 18, 19 and 20 Matison Street
Southern River

Precinct 3
City of Gosnells

Dec 2011

Prepared By: Mia Harris BSc
Bioscience Pty Ltd

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1. INTRODUCTION

Wetlands are valuable environments as they support a diversity of flora and fauna as well as provide many different hydrological and ecological functions. Due to our arid climate wetlands in Australia are uniquely diverse, many of which have international recognition. Wetlands on the Swan Coastal Plain have been extensively altered and destroyed since European settlement with only 20 percent remaining relatively undisturbed (DEC, 2011). Conservation of our wetlands is vital for a sustainable environment for future generations to enjoy, which is achieved through community integrated management practices. The greatest threats to wetlands include; alteration to water regimes, loss of vegetation, salinisation, introduced species and water pollution. The following management plan will outline the existing wetland attributes, then outline targets and strategies to improve the physical, biological and cultural factors necessary to achieve environmental sustainability.

1.1. Background

The Department of Housing (DoH) in collaboration with 2 private land owners have commissioned Bioscience to undertake a desktop and field study of Lots 13, 14, 21, 22 Southern River Road and Lots 18, 19, and 20 Matison Road in Southern River. The purpose of which is to produce a management plan for a Resource Enhancement Wetland (REW) to protect its functions, values and attributes. The Wetland Management Plan has been prepared under DEC guidelines (December 2008) and the area is being incorporated into the Southern River Precinct 3E structure plan.

1.2. Site Location

The subject land is located within the City of Gosnells and approximately 20 km south, south-east of Perth CBD and around 20 km east of the coast (Figure 1). Historical aerial photography reveals all the land has been cleared at some stage over the last 60 years, however there has been regrowth in many areas and the majority is currently vegetated.

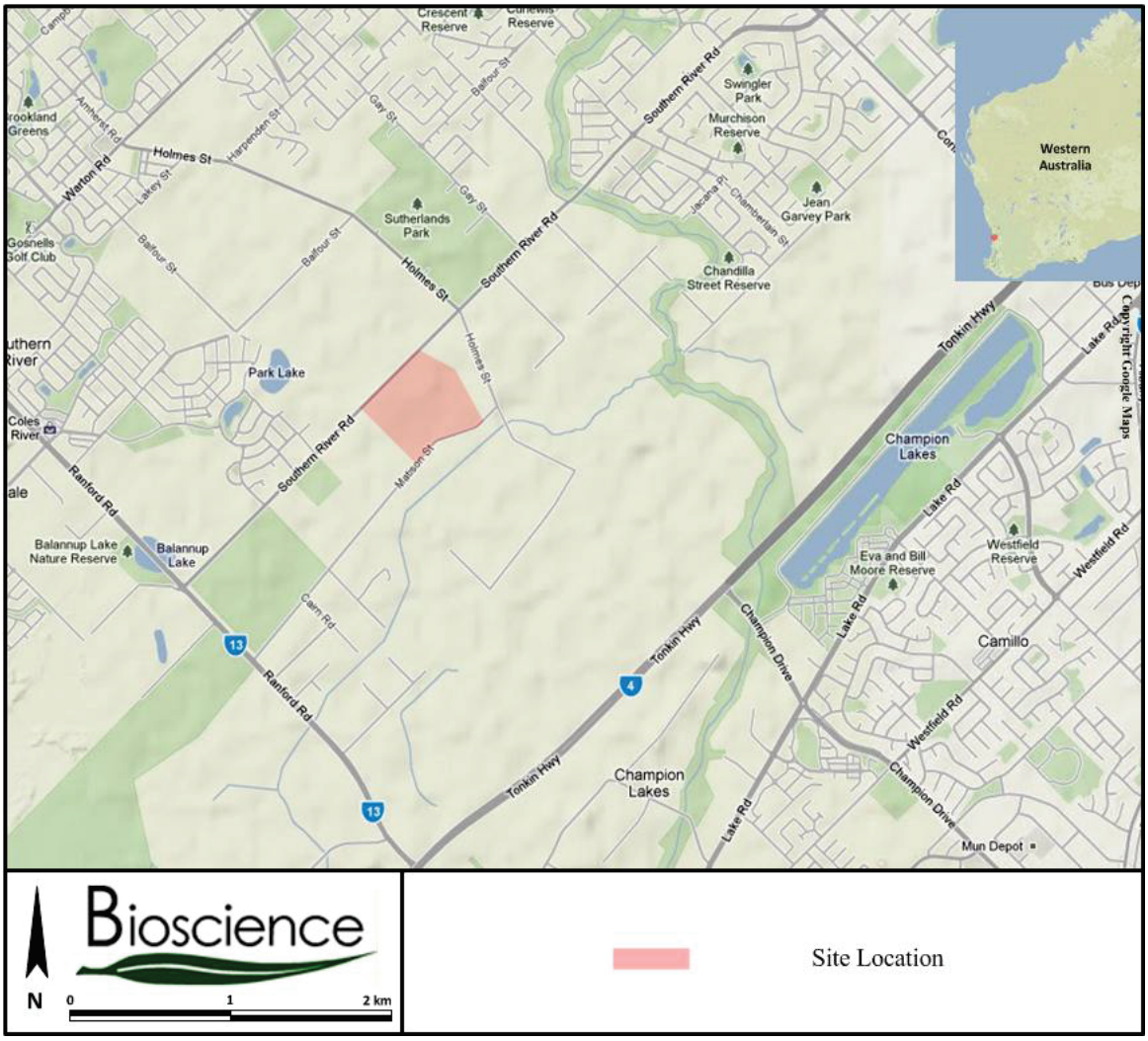


Figure 1: Location of study site

1.3. Planing and Policy

The subject area is zoned "Urban" as per the Metropolitan Region Scheme (MRS) updated 1st February 2011 and "Residential Development" as per Gosnells Town Planning Scheme No. 6 updated 4th January 2011.

1.4. Proposed Development

Lots 13-14, 18-22 combine to make the Southern River Precinct 3E, a subsection of the Southern River Precinct 3 structure plan for redevelopment. The subject area consists of 25.8 hectares of land bound by Southern River Road to the north-west, Lander Street to

the south-west, Matison Street to the south-east, and a local drain connecting to Forrestdale main drain to the east and north-east (Figure 2).

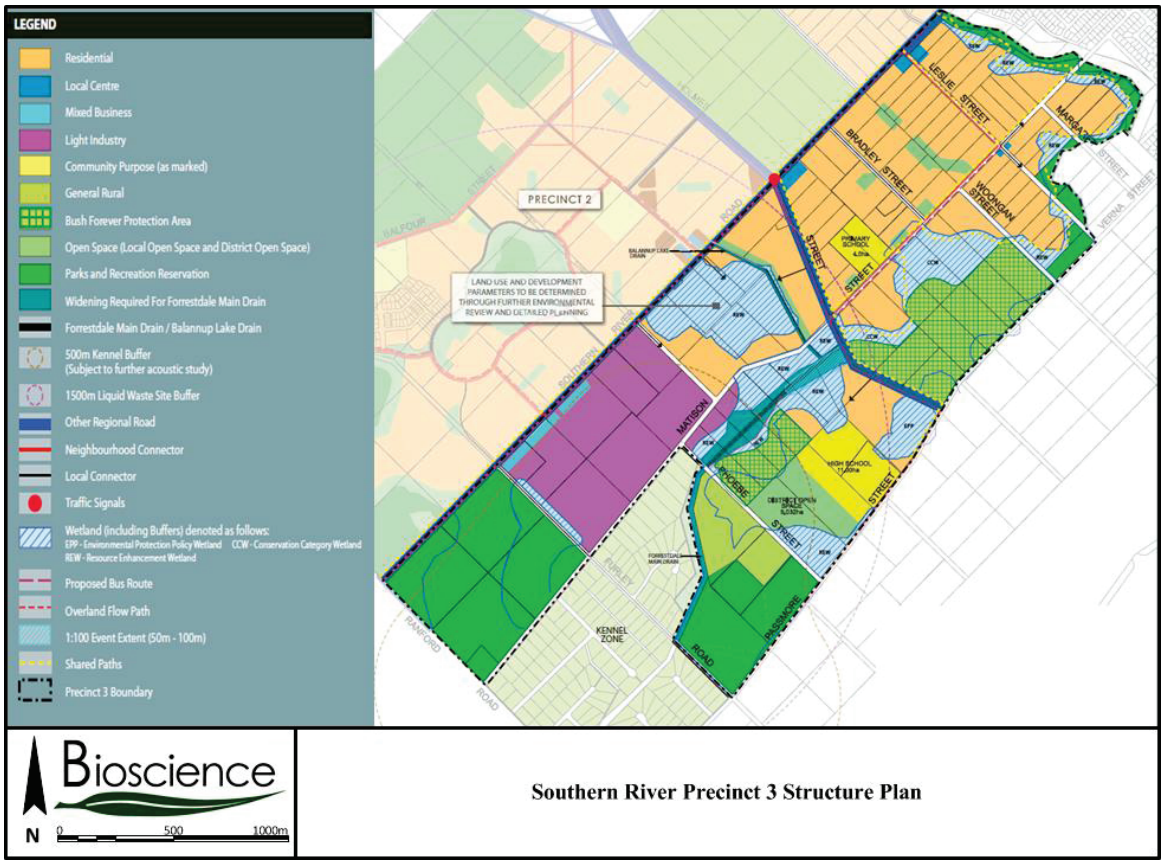


Figure 2: Southern River precinct 3 structure plan

1.5. Tenure

The subject area is currently owned by The Department of Housing and two private land owners as outlined in table 1 below.

Table 1: Summary of land owners

Lot	Street Frontage	Area (ha)	Landowner
13	Southern River Road	4.0494	State Housing Commission
14	Southern River Road	4.0469	State Housing Commission
18	Matison Road	4.5072	Carmelo & Rosina Radici
19	Matison Road	4.5881	State Housing Commission
20	Matison Road	4.3655	Landflow Holdings Pty Ltd
21	Southern River Road	2.0011	State Housing Commission
22	Southern River Road	2.2199	State Housing Commission

1.6. Geomorphic Wetland Dataset

The Geomorphic Wetlands Dataset displays the location, boundary, geomorphic classification and management category of wetlands on the Swan Coastal Plain. The information contained within the dataset was originally digitised from the *Wetlands of the Swan Coastal Plain Volume 2B Wetland Mapping, Classification and Evaluation: Wetland Atlas*, which was captured at a scale of 1:25,000 (Hill et al. 1996). According to the dataset two wetlands exist within the subject area, one Multiple Use Wetland (MUW) (15792) covering the perimeter along the north west, west and south eastern boundaries with a Resource Enhancement Wetland (REW) (15728) along the central south east and north eastern sides. An area in the center of the subject area is classified as a dryland (15727) and a small area in the southern corner not classified as a wetland (Figure 3).

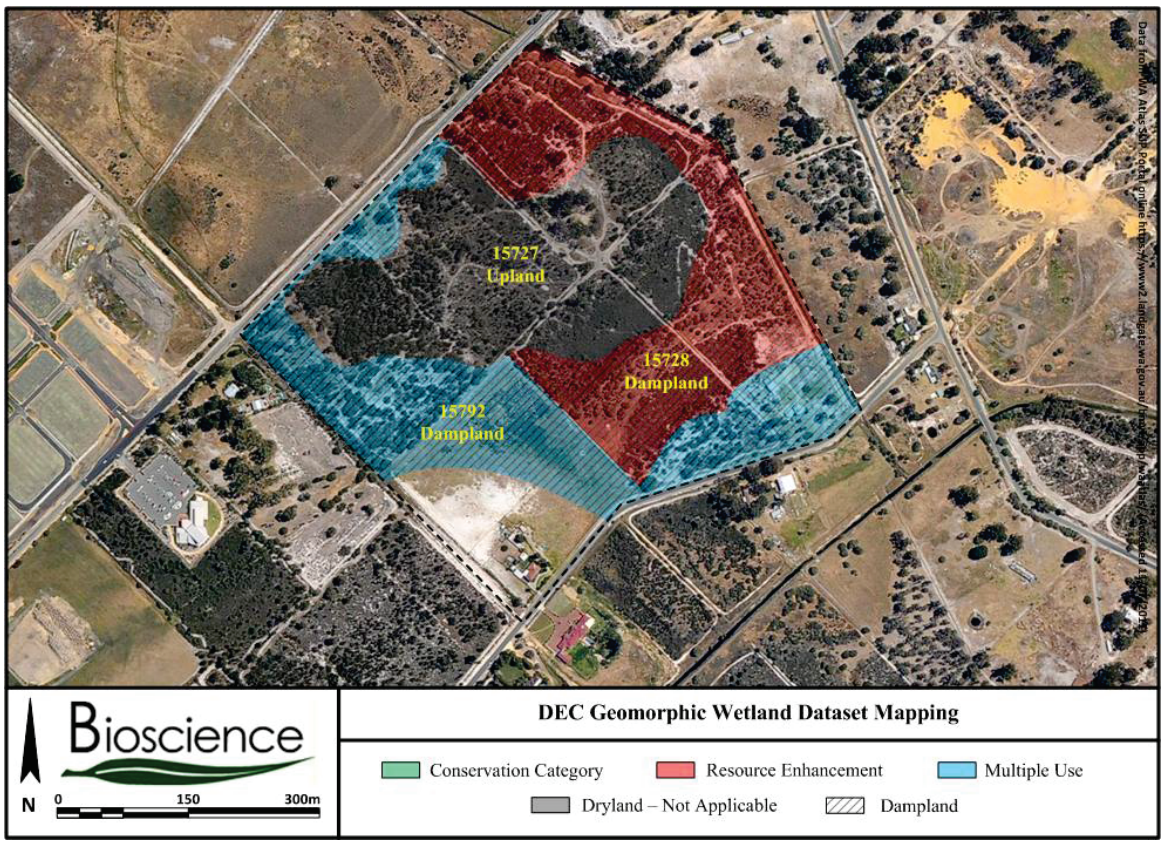


Figure 3: Geomorphic Wetland Dataset

2. EXISTING NATURAL ENVIRONMENT

2.1. Climate

The south west of Western Australia is characterised by a Mediterranean climate comprising hot dry summers and cool wet winters. According to the Bureau of Meteorology the average annual rainfall within the vicinity of the proposed development is 824.3 mm (Gosnells City No. 009106). The monthly distribution of rainfall indicates approximately 79% of the rainfall occurs during the months of May to September (Figure 4).

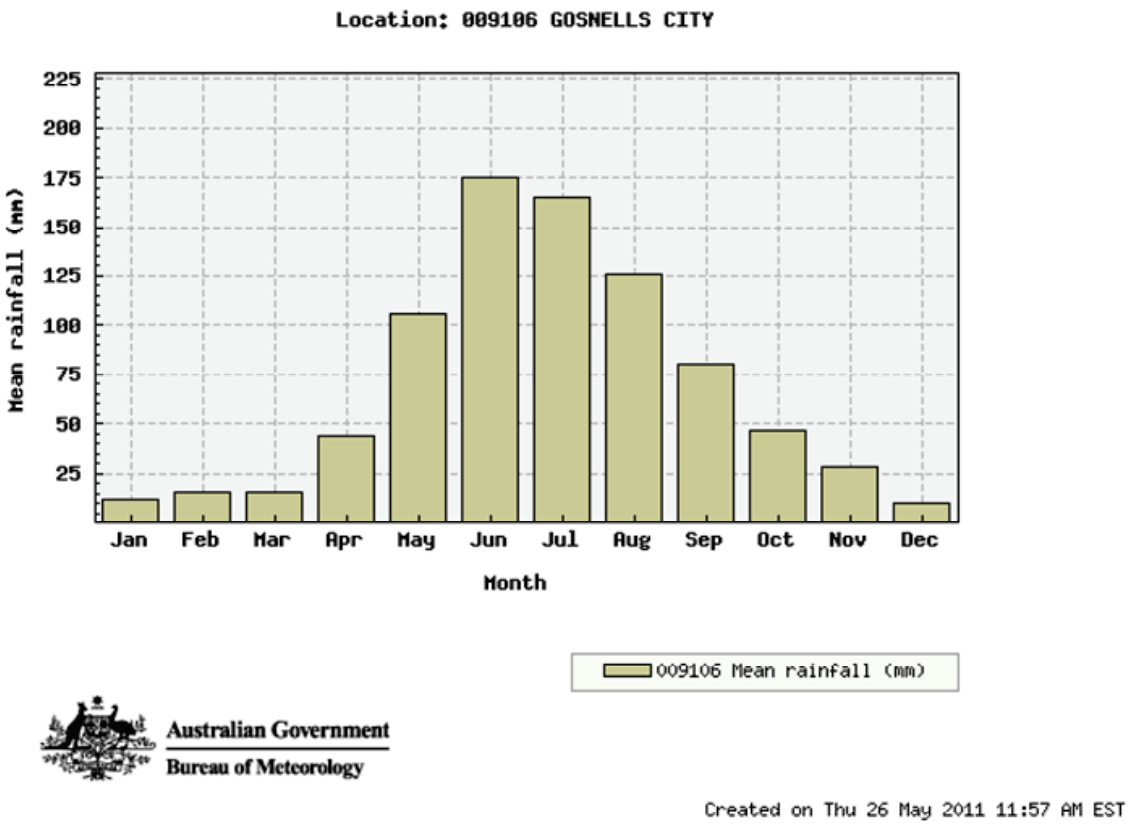


Figure 4: Average annual rainfall

2.1.1. Climate Change

Australia is one of the driest continents in the world and the affects of climate change are no more obvious than in south-western Australia. Time series charts such as figure 5 illustrate an excessive decrease in annual rainfall over the past 100 years. Decreasing rainfall and increasing temperatures over south-western Australia has had grim consequences for the Swan Coastal Plain's unique and diverse wetlands. These factors have left many wetlands dry due to decreased groundwater recharge and increased evaporation.

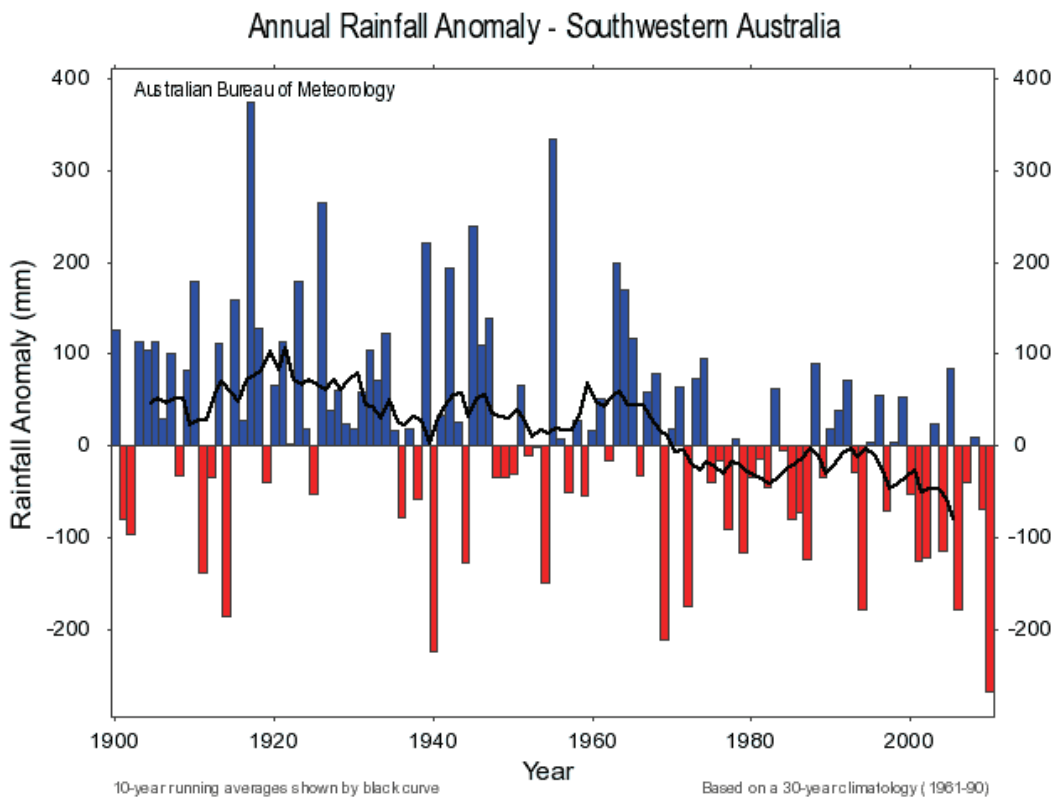


Figure 52: Annual rainfall anomaly for south-western Australia

2.2. Regional Context

Australia's climate has greatly influenced the development of the landscape and uniqueness of the biota; as a result Australia has a large number of internationally recognised wetlands. The subject wetlands are situated in the central part of the Western Australian Swan Coastal Plain which contains a large chain of wetlands running approximately 3 to 5 km inland parallel to the coast as well as within the Bassendean sand dune system that runs parallel to the scarp. Approximately 70 percent of wetlands on the Swan Coastal Plain have been disturbed since European settlement with only about 20 percent remaining relatively undisturbed with high ecological values (DEC, 2011).

2.3. Topography

The subject area has low relief with some minor variations in topography. The area ranges from 21m AHD in the wetland areas to 23m AHD (Figure 6).

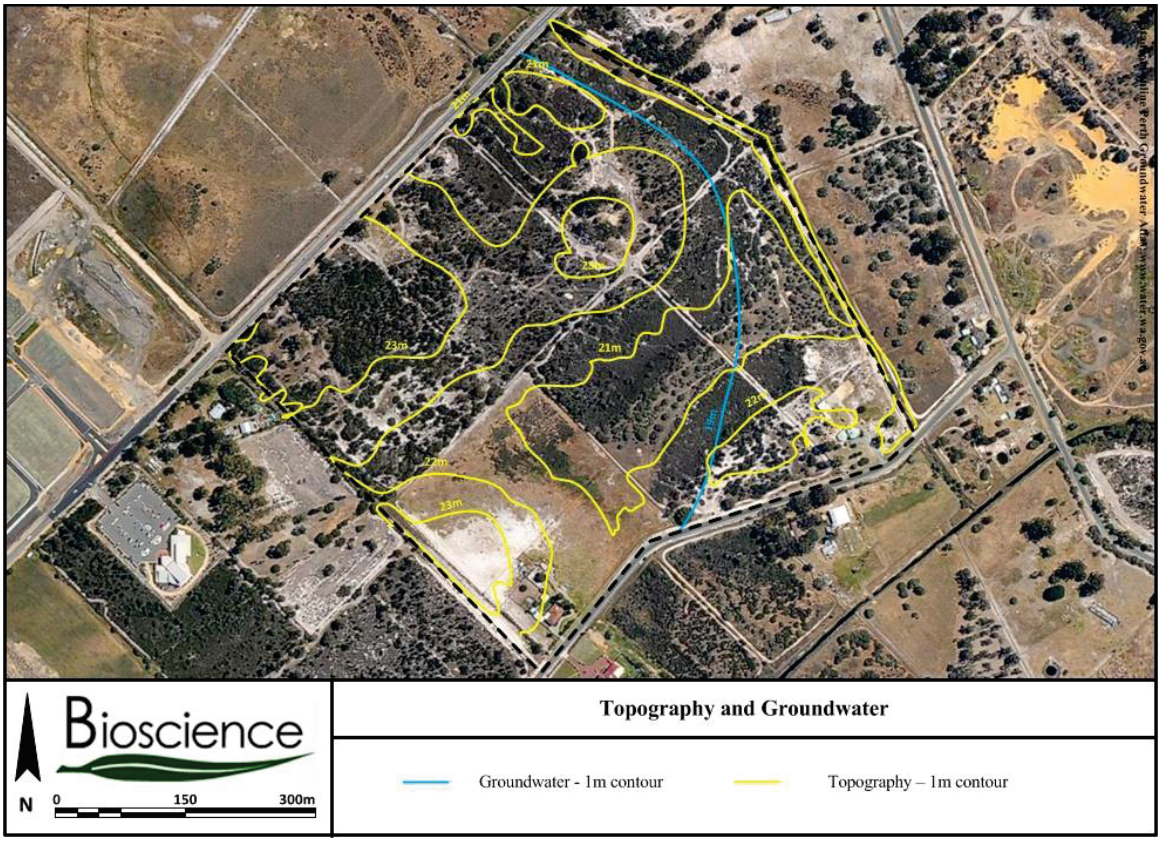


Figure 63: Topography and Groundwater

2.4. Geology, Geomorphology, and Soils

The subject site is located on the Swan Coastal Plain within the Bassendean dune system, an area characterised by low dunes of siliceous sand interspersed with poorly drained areas or wetlands. Soils tend to be a deep bleached grey colour sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m.

Underlying the Bassendean formation is the Guildford formation. The soils of the Guildford formation are complex, and comprise a successive layering of soils formed from erosion of material from the scarp to the east. Rivers and streams have mostly carried the eroded material, which is deposited from the water as fans of alluvium. The Guildford formation is characterised by poor drainage due to the low permeability of sub-soil clays which prevent the downward infiltration of rainfall, consequently during the winter month's water logging and surface inundation can occur. In addition, the clay fraction of the Guildford formation is known to have highly variable Plasticity Indices (Hillman *et al*., 2003).

The geology at the site as per the Geological Survey of Western Australia 1:50000 Environmental Geological Series Armadale Map Sheets 2033 I and part of sheet 2033 IV are either (Figure 7):

S8 – SAND : White to pale grey at surface, yellow at depth, fine to medium grained, moderately sorted, subangular to subrounded, minor heavy minerals, or eolian origin

S10 – SAND: As S8 over sandy clay to clayey sand of the Guilford formation, of eolian origin

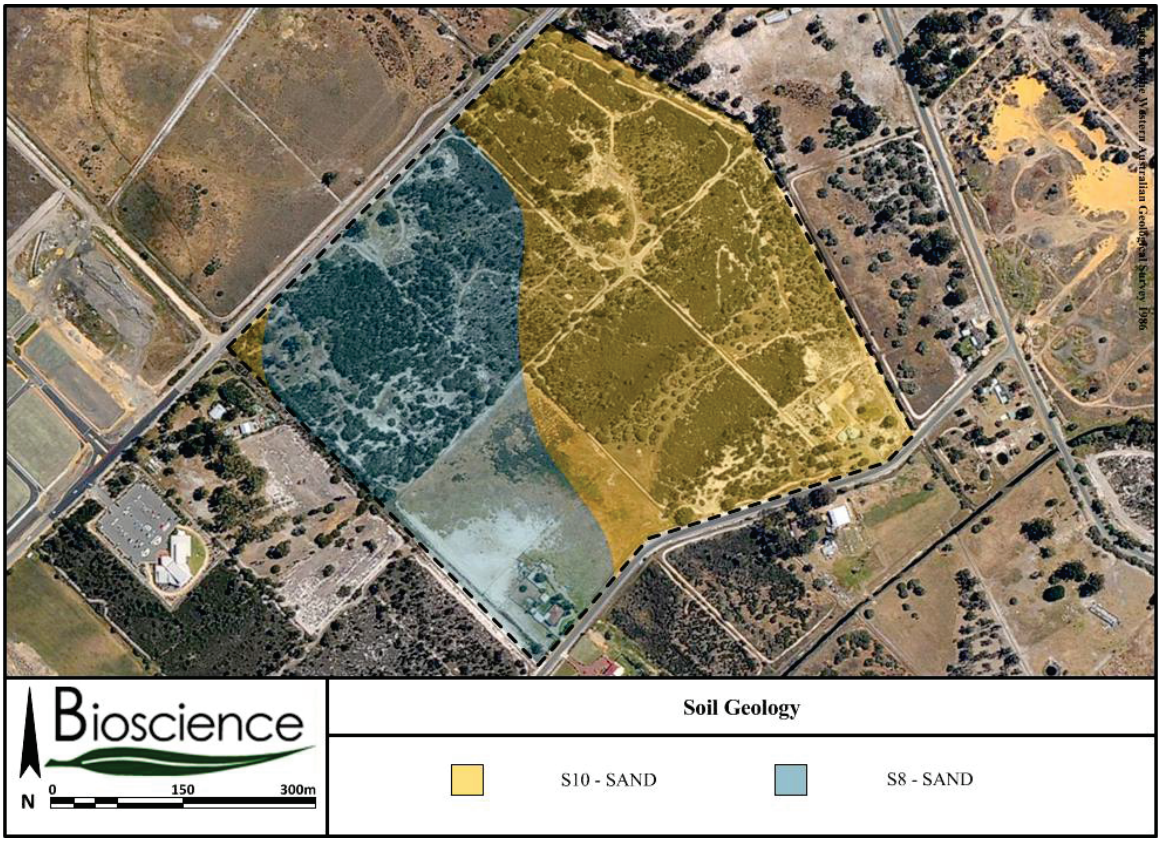


Figure 7: Soil geology

Bioscience undertook a geotechnical investigation (2010) of the site to determine the nature of soils for Precinct 3E. A hand auger was used to dig 25 holes for installation of piezometers as well as recovery of soil samples. A 14 tonne mechanical excavator was also used to dig 15 investigation pits in order to log the soil profile and to recover soil samples for laboratory investigations.

Test pit locations were determined based on earlier desk top investigations, from piezometer experience and from field observation of surface soils. The fifteen test pits were excavated to investigate the sub-surface soil and groundwater conditions. The site has three distinct geological areas. The first covers most of the area and is uniform in regards to the geological layers and is summarised as possessing a light grey to grey organic sandy topsoil, overlying a grey to white medium texture, poorly sorted Bassendean sandy soil.

The second is mainly found within the wetland areas and is relatively uniform in regards to the geological layers and is summarised as possessing a dark grey to grey organic sandy topsoil, overlying a light grey to white medium texture, poorly sorted Bassendean sandy soil, overlying a mottled cream to orange loamy sand to sandy loam to a sandy clay loam with increasing depth, overlying a mottled green to grey sandy loam to sandy clay loam with increasing depth.

The third appears to be a transition zone between the first and second areas, however is more similar to the second geological areas in that it possess a dark grey to grey organic sandy topsoil, overlying a light grey to white medium texture, poorly sorted Bassendean sandy soil, overlying a dark brown to black, rocky ferrunginous induration or "coffee rock" layer, overlying a mottled green to grey sandy loam to sandy clay loam with increasing depth.

Particle size distribution (PSD) was determined on soil samples collected during the geotechnical investigation (2010). Of the 54 soils tested, the vast majority (72%) were classified as sandy soils, 11% were classified as loamy sands and 11% were classified as sandy loams. Three soil samples (6%) were consolidated rock like material and did not undergo PSD.

2.5. Acid Sulfate Soils

Acid sulfate soils (ASS) are naturally occurring soils which contain iron sulfides, most commonly pyrite (DEC, 2009b). These soils can produce a variety of iron compounds and sulfuric acid conditions when exposed to air. The resulting low pH can release other substances such as heavy metals into the surrounding environment which potentially

threatens the health of receiving ecological systems (DEC, 2009b). Minimising the disturbance of acid sulfate soils is recommended so as to prevent any detrimental impacts on the environment and its surroundings.

Disturbance risk is assessed on the basis of depth from natural ground-surface on the precept that most land development activities including drainage, excavations and dewatering generally do not extend to greater than 3m below natural ground-level. The map includes areas where ASS risk has been predicted using available desk-top information and limited ground-truthing with areas where intensive on-ground mapping and soil analysis work has been carried out.

DEC has compiled maps of ASS risk areas for several coastal regions of Western Australia. These maps are not an accurate representation of the risk areas but rather give a general indication and encourage site-specific investigations to determine management strategies. The land holds a moderate-low risk of acid sulfate soils within 3m of natural soil surface and a high-moderate risk beyond 3m (Figure 8).

The extent and severity of these soils with regards to acid sulfate potential is unknown and will require further testing and investigation. Proposed development activities such as major earth works, infrastructure earth works such as the installation of sewers, and lowering of the ground water can disturb and accentuate ASS areas (DEC, 2009a). Serious environmental, economic, engineering and health impacts may occur if proper management of the area is not undertaken. Acid sulfate soils can be remediated by applying an adequate amount of limestone to neutralize the soil and reduce its acid sulfate potential (DEC, 2009a).

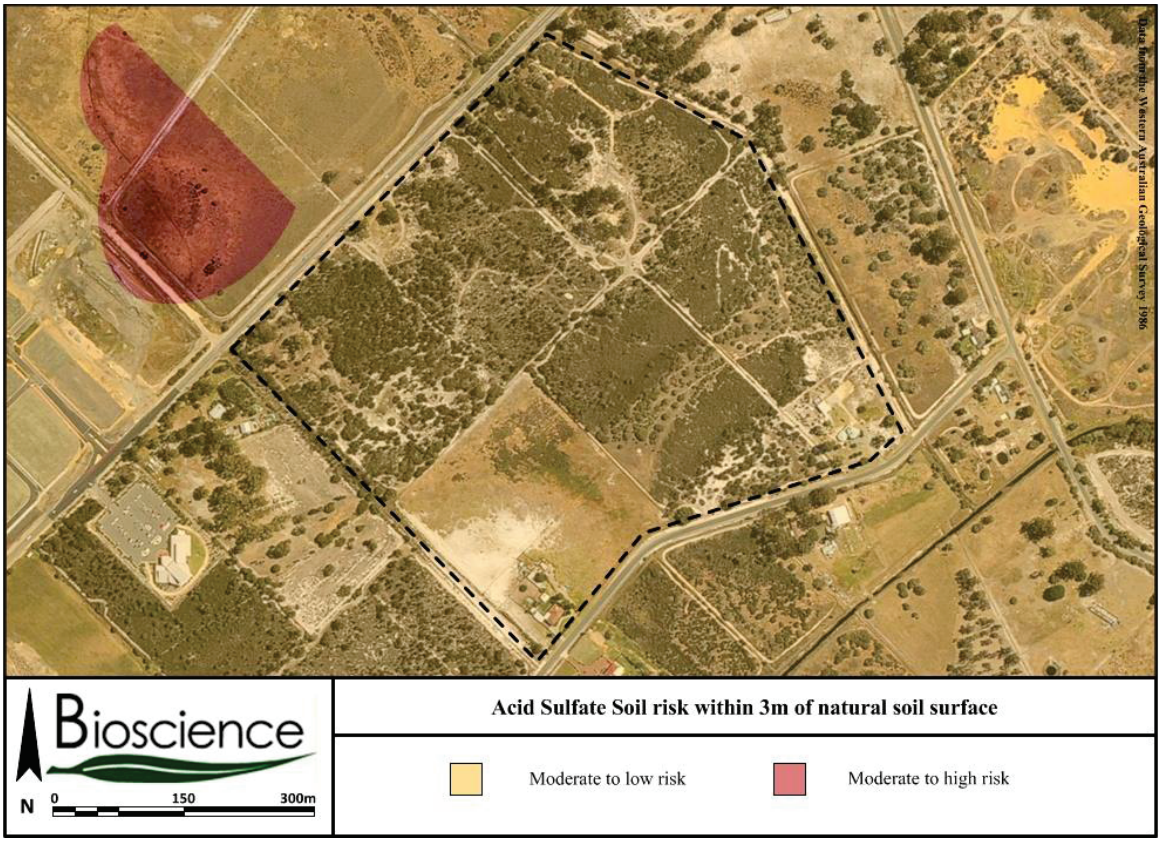


Figure 8: Acid Sulfate Soil risk map

Bioscience conducted Acid Sulfate Soil (ASS) testing during the geotechnical investigation (2010). Eleven soil samples were tested in accordance with DEC guidance criteria as well as Leco total sulphur analysis (Ahern *et al,* 2004). Results indicate that none of the 11 samples tested exceeds the action criteria for both Titratable Peroxide Acidity (TPA) and total Sulfur (Note, S_{POS} gives a measure of the maximum "oxidisable" sulphur present in a soil sample, where as total sulphur S_{TOTAL} (as measured in the geotechnical report) gives a measure of total sulphur present with a soil sample, consequently S_{TOTAL} will always be equal to or greater than S_{POS}). Three of the 11 samples do exceed the TPA, however as they all possess S_{TOTAL} less than the action criteria (i.e. 0.03%) and are considered to have an inconsequential ASS risk.

2.6. Hydrology

The subject area is located in the north eastern part of the Forrestdale mian drain subcatchment within the Swan-Avon - Canning River catchment in the South West Division. The Forestdale main drain subcatchment covers an area of approximately 95

km^2 extending from Roe Highway to the north-west, Tonkin Highway to the east, around 3km south of Armadale road to the south, and past the Kwinana freeway to the west (Figure 9).

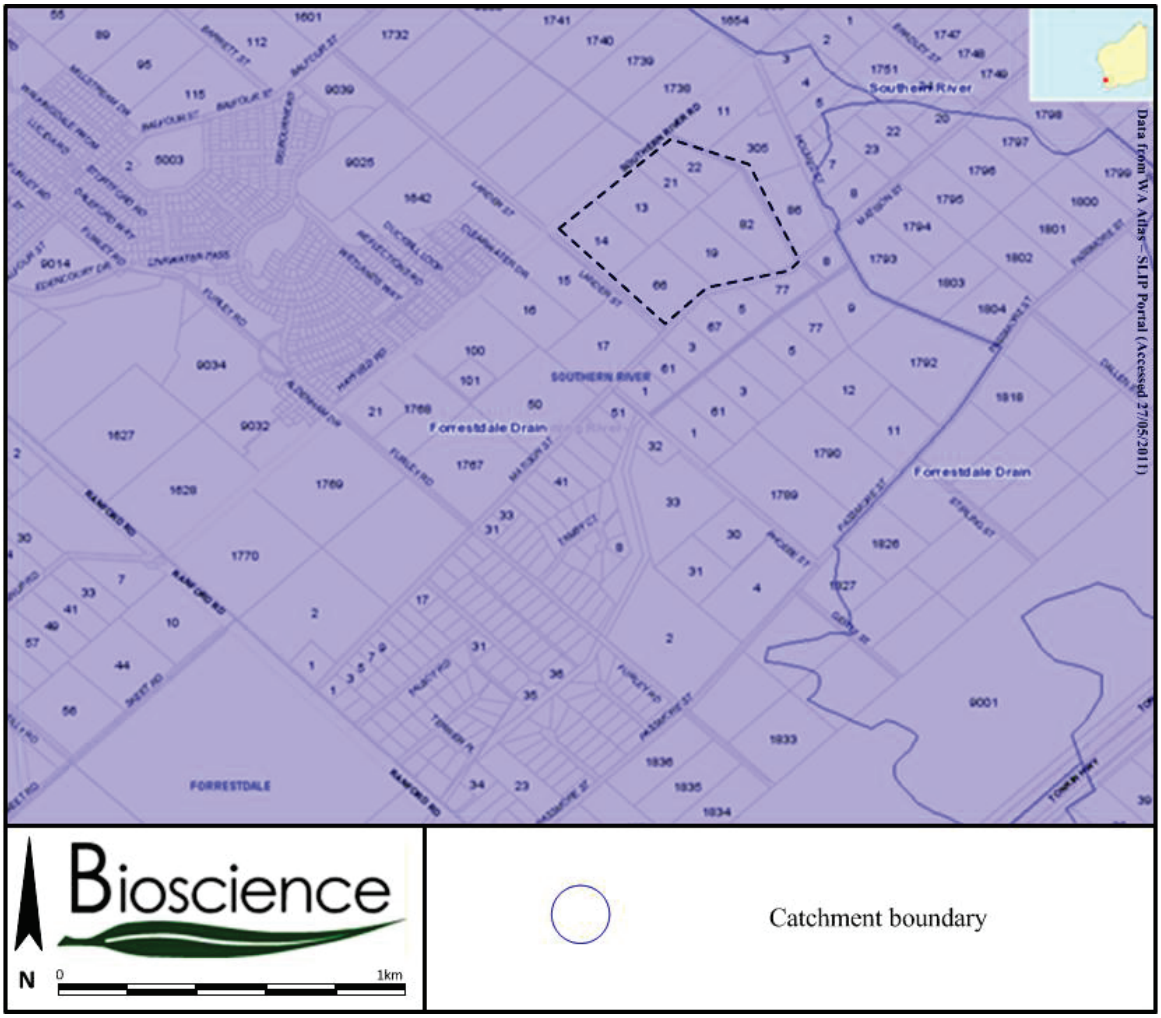


Figure 9: Catchments

Bioscience undertook a hydrological assessment of the wetland areas during the Geotechnical Report (2010). Groundwater levels were determined from an initial 5 piezometers installed October 2008 and a further 20 piezometers installed April- July 2009. All piezometers were installed using a hand auger and were made from 50 mm PVC pipe with 1m of slotted interval buried to at least 0.5 m below the water table in March, when the water table was expected to be at or near the minimum level.

Results showed that groundwater levels varied significantly throughout the site from a maximum of 21.348m AHD (DHW6 on the 9th October 2009) to a minimum of 18.34m

AHD (DHW1 on the 12th June 2009). In relation to depth below ground level a maximum depth of 3.65m BGL (DHW 8 on the 12th June 2009) and a minimum of -0.04 m BGL or 0.04m above the natural ground level were recorded (DHW 19 on the 4th October 2009). (Image 1 and 2, Appendix 2).

The ongoing hydrological investigations informed both a request to modify the boundaries and management classification of wetlands (2009) and a Local Water management Strategy (2011). This work concluded that groundwater levels have declined substantially over the last 20 years, due to the combination of drainage and declining rainfall. The Ballinup Lake Drain, a Water Corp managed drain is against the north east boundary of the site and acts as a groundwater discharge, directing water into the Forrestdale main Drain and ultimately into the Southern River. The winter of 2011 was wetter than average, with good rains throughout winter and spring. The inundation of the wetland area however was not greater than in 2009, attesting to the influence of the drain in lowering groundwater levels.

2.7. Vegetation and Flora

2.7.1. Regional Setting

The south west Western Australia is one of the top 25 biodiversity hotspots in the world, covering an area of over 300 000 square kilometres (CABS, 2007). Hotspots are defined by an area containing at least 1500 endemic plant species. All of the 25 hotspots identified throughout the world have lost over 70% of their original habitat.

The study area is within the Swan Coastal Plain Biogeographic Region of the South-west Botanical Province (Thackway and Cresswell, 1995, Paczkowska and Chapman, 2000), an area that extends from Jurien Bay to the north to Dunsborough to the south, and west to the Darling Scarp. Historically this biogeographic region has been extensively cleared for both urban and agricultural purposes. Four vegetation groups have been cleared to less than 20 percent.

2.7.2. Wetland Vegetation

The subject site has historically been completely cleared in various stages and as such contains a large number of introduced flora. Vegetation condition ranges from very good to completely degraded according to the Bush Forever vegetation condition rating with varying floor cover of introduced grasses such as Kikuyu, Chooch and annul weeds *Briza maxima* and *Ehrharta longiflora*.

Bioscience undertook a level one vegetation survey in accordance with EPA Guidance 51. The vegetation broadly fits within the community types described in Gibson et al 1994 as type 23a, Central *Banksia attenuata – B. menziesii* woodlands, type 4 damplands and type 5 mixed shrub damplands. There is evidence that much of the land has been previously cleared for grazing, and more recently it has been disturbed through the dumping of domestic and building rubbish. The central part of the wetland which is the subject of this management plan is dominated by *Melaleuca raphiophilla,* albeit somewhat small and stressed, and an understory of kikuyu and very few native plants. The outer fringe contains *Melaleuca preissiana, , Astartea, Kunzia* and to the north west a gradual transition towards upland vegetation.

2.8. Fauna

According to NatureMap (DEC, 2009) there is 72 fauna species known to inhabit the region with a radius of 2km from the centre of the site (402164mE, 6447517mN 50H). Of the 72 species 2 are listed as rare or priority fauna; Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as Rare or likely to become extinct, and Southern Brown Bandicoot or Quenda (*Isoodon obesulus* ssp. *Fusciventer*) is listed as a Priority 5 species.

Site visits concluded that the area is inhabited by many bird species, Magpie (*Cracticus tibicen*), Magpie Lark (*Grallina cyanoleuca*), Port Lincoln Ringneck (*Barnardius zonarius semitorquatus*), and Australian Raven (*Corvus coronoides*) were spotted during the visit. The site is also likely to be inhabited by many reptile, mammal, and marsupial species, some kangaroo scats were identified during the site visit. The site also had evidence of feral inhabitants such as rabbits (*Oryctolagus cuniculus*), foxes (*Vulpes vulpes*), and cats (*Felis catus*).

2.9. Ecological Linkages

Habitat loss and fragmentation are the two biggest contributors of declining biodiversity in Australia. Wildlife corridors provide a link between fragmented bushland in human environments; this enables continual movement of biotic factors. The proposed wetland and conservation area is within approximately 1km of five DEC bush forever sites and the structure plan (Figure 2) indicates that the wetland will be part of an ecological link to Southern River (Figure 10). The ecological link will consist of Parks and recreation reservation, Public open space, General rural, other REWs, Forrestdale main drain, Bush Forever sites, and Southern River.

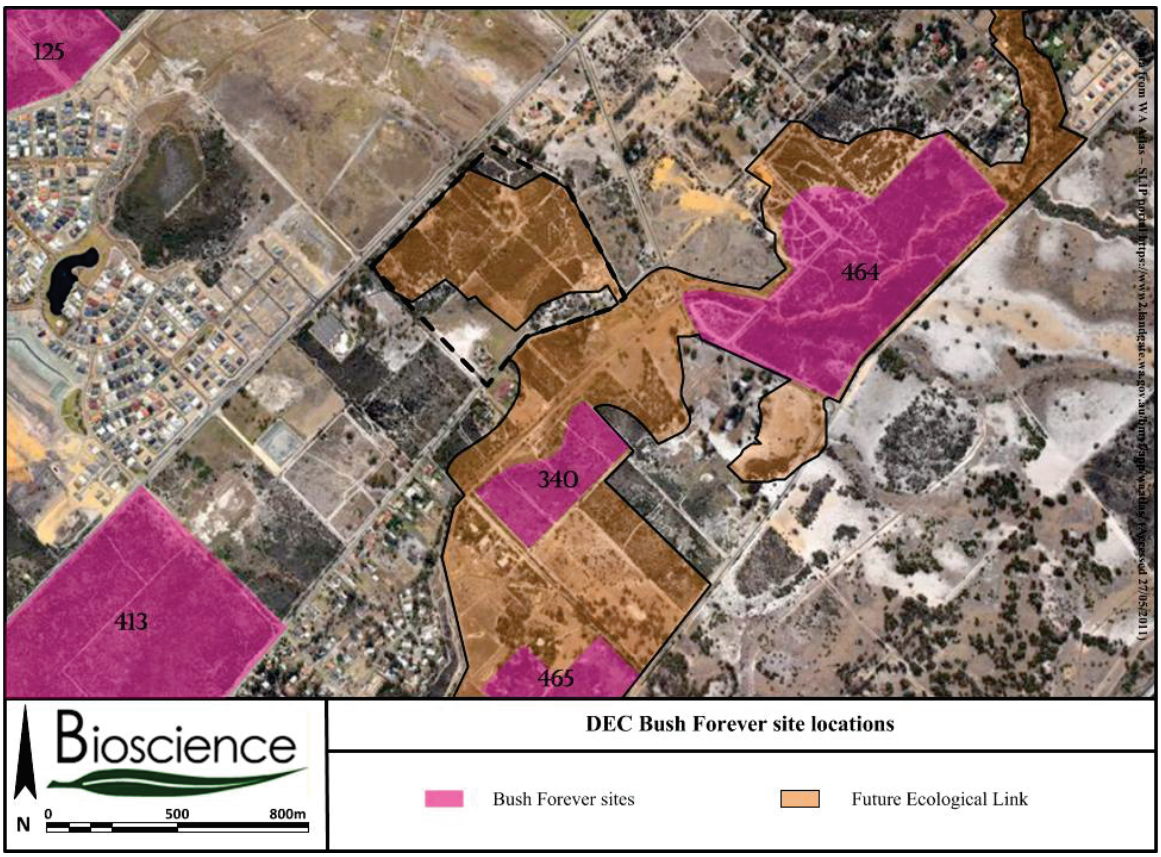


Figure 4: DEC Bush Forever Site Locations

2.10. Disease

The wetland vegetation does not have any obvious signs of disease however surrounding bushland contains some dead *Banksias* that may be due to presence of dieback (*Phytopthora cinnamomi*).

2.11. Fire

Fire age is greater than 20 years. Fire breaks surround the perimeter fence line of each lot.

3. EXISTING CULTURAL AND SOCIAL VALUE AND COMMUNITY USE

3.1. Cultural Heritage

A search of the Department of Indigenous Affairs Aboriginal Heritage Inquiry Database reveals that no Aboriginal sites exist within the subject area. However, Aboriginal site 3511 is approximately 300m east but has no effect on the subject area (Figure 11). Site 3511 is a Mythological area once used for camping and hunting and is a closed access non-restricted site.

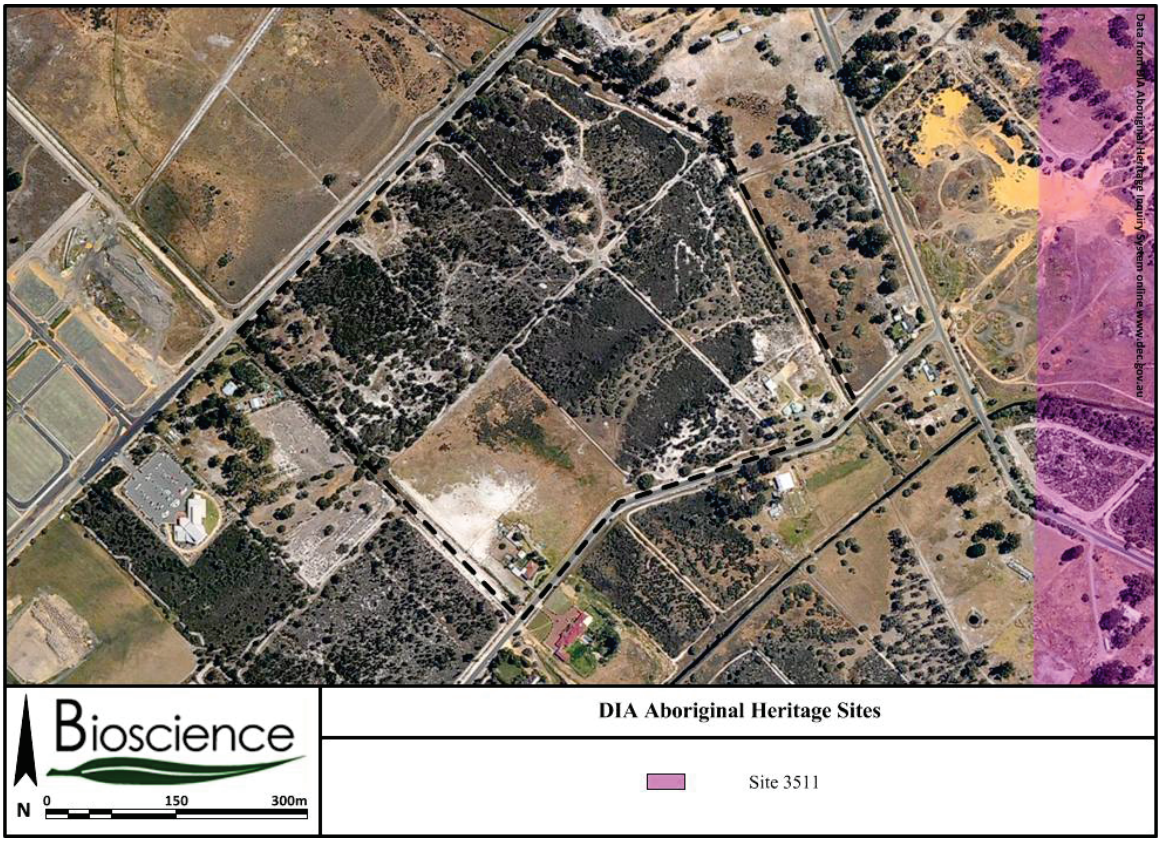


Figure 5: Aboriginal heritage sites

3.2. Community Use and Appreciation

The 7 lots included within the development area is private property owned by the Department of Housing and private owners and has historically been used for pastureland and bushland making community use and appreciation quite limited. A perimeter fence surrounds the area except for along Southern River Road. The land is heavily used for

dumping rubbish, demonstrating poor community appreciation and a substantial threat to natural values.

4. POTENTIAL IMPACTS AND THREATS

Many of the threats affecting the management area are not easily solved or prevented and as such may create opportunities for new practices and innovative thinking. Threats such as decreasing groundwater and introduced species have degraded the wetland's functions, values and attributes. The environmental threats are ongoing problems that are likely to become more challenging in the future. Table 3 outlines the threats and impacts associated with the management area.

Due to the extent of hydrological change and degraded vegetation the wetland cannot be easily restored to pre European conditions. However the deprivation of wetland functions and values has provided a great opportunity for modern thinking and innovative urban design and management. Integration of stormwater management into wetland management could effectively restore some of the wetlands pre European functions and values that would not otherwise ever be restored.

Wetland buffer guidelines have been established by the WAPC and are determined on an individual basis. Steps involved in determining a wetland buffer include; identify wetlands attributes, wetland management category, establish management objectives, define wetland function area, identify threatening processes, and establish separation requirement. After consideration of the buffer protection zone criteria in respect of wetlands within the subject area, a notional sized buffer zone is not considered an appropriate or effective way to protect the wetland from major threats to attributes and functions.

4.1 Urban Drainage

Restoration of groundwater to above existing levels, even if only temporary will be essential if wetland attributes are to be maintained. This becomes possible where the wetland itself become the receiver of urban stormwater, prior to it being discharged in the longer term by infiltration or overflow into the existing drain. Urban development increases the proportion of hard surfaces, thus reduces the total infiltration area. Urban

drainage design seeks to take higher rainfall events and convey them towards holding areas, typically adjacent to Public Open Space, and after bioretention to remove any nutrients, water is infiltrated into groundwater.

Policy to date has been to avoid infiltration near wetlands, for fear that sediments, nutrients or toxins in the stormwater could potentially damage or otherwise contaminate wetlands. Better Urban Water Management involves the installation of systems which capture and treat stormwater to remove silt, sediment and nutrients, using both engineered and natural treatment systems. Post-development monitoring has progressively built a database which demonstrates such systems are effective.

Bioscience acknowledges that even with attenuation, there is a risk in directing stormwater into wetlands. In this particular instance, we argue that in the alternative, the risk to wetlands of lowering groundwater is far greater and more immediate.

Groundwater modelling suggests that directing treated stormwater into the wetland will create an elevated water mound in the vicinity of outlets, but this water mound will progressively relax due to horizontal flow towards the discharge face created by the Ballinup Lake Drain. Any elevation of groundwater is likely to assist the growth of *Melaleuca preissiana.*

Table 2: Threats affecting the management area

	Threat	Cause	Impact	Response
Hydrological	•Decreasing groundwater level	•Climate Change •Historical deforestation •Altered water regimes and surface water flow •Local drain along the east and north eastern boundary	•Wetland becoming dry causing ecological changes	•Use treated stormwater use for wetland management •Revegetate with indigenous flora
Vegetation	•Invasive weeds	•Historical land use •Surrounding residential gardens, passive transport by fauna and visitors	•Decreased biodiversity, decreased food and habitat for native fauna, increased fuel load and fire risk	•Implement weed control measures on regular bases •Revegetate with native indigenous flora
Fauna	•Vehicle collision with increased traffic •Conflict with humans and pets •Habitat disturbance and fragmentation	•Increased traffic on boundary roads •cat inhabiting residential homes and gardens straying into bushland •Noise, light, vibration, surrounding deforestation	•Fauna deaths and human injury or death due to car accidents •harm caused by venomous/dangerous animals •reduction in fauna diversity	•Wildlife crossing road signs •community education about dangerous wildlife such as snakes •Wetland buffer of 50m to reduce impacts such as light, noise, vibration.
Disease	•Spread of disease such as Dieback (*Phytophthora cinnamomi*)	•Passive transport of disease from visitors and fauna	•Flora/fauna deaths •Loss of habitat •Reduction in biodiversity •Local extinction	•Quick response test and treat any signs of disease •Revegetation and captive breeding programs
Fire	•Damage to wetland ecosystem •Damage to surrounding residences	•High fuel loads •Human activity such as campfires, dumping	•Flora/fauna deaths •Loss of habitat •Reduction in biodiversity •Local extinction •Human death/injury •Loss of homes	•Maintain firebreaks •Reduce fuel loads •Educate community about dangers •Remove any rubbish such as metal cans and glass bottles

5. MANAGEMENT AND MONITORING COMMITMENTS

Successful wetland management requires a commitment from stakeholders, the community, monitoring groups and other parties involved in the execution and operation of the management plan. Integration and Management of the wetlands within Precinct 3E is an important step towards human and environmental cohesion and environmental sustainability. It is initially the responsibility of the Department of Housing and their development team, with the City of Gosnells thereafter to oversee the operation of the management plan. The Department of Housing and the City of Gosnells are also responsible for task delegation and performance review.

Monitoring is a vital component of the management plan. Monitoring allows the collection of both physical and biological information that can be used to determine the success of a management action**.** It can also be used to adjust the performance criteria in response to environmental changes. Ongoing monitoring will be conducted or delegated by the Department of Housing and the City of Gosnells. Management and monitoring criteria is outlined in table 4.

Table 3: Management objectives, strategies, monitoring and performance

	Management objectives	Strategies	Monitoring	Contingency Measures	Performance Criteria
Hydrology	•Reduce surface water runoff carrying nutrients and other pollutants	•Implement a Urban Water Management Plan •Investigate options to utilise stormwater for wetland management	•Extract samples for water quality testing every 3 months through existing piezometers during and after construction •Analyse samples against ANZECC guidelines and baseline data	-	•Reduce nutrient and contaminant input to wetland by 90% after construction and implementation of stormwater management system.
Vegetation	•Rehabilitate the vegetation so as to increase biodiversity, fauna habitat, and aesthetic	•Implement weed control measures to eliminate invasive grasses •Revegetate with indigenous species that will provide food and habitat for local wildlife	•Monitor and record survival rate of rehabilitation plantings •Monitor and record abundance of wildlife inhabiting the area •Monitor and record the resilience and distribution of weeds •Remove weeds every 3-6 months or when required	•Examine cause for loss of rehabilitation plantings as well as established vegetation	•70% reduction in the distribution of weeds throughout the wetlands and wetland buffers within 5 years
Fauna	•Reduce introduced predators and competition •Reduce fauna conflict with vehicles	•Feral animal control measures •Erect wildlife crossing signs on bordering roads •Educate community to reduce their pets' effect on the management area such as keeping cats indoors after dark	•Monitor number of vehicle collisions and road kill •Monitor number of feral animals and destructive pets within the management area •Undergo feral animal control every 3-6 months through destruction of housing, and physical removal (trapping and humane euthanasia)	•Captive breeding programs for rare and threatened species	•Reduce abundance of introduced species by 50% for rabbits (*Oryctolagus cuniculus*), and foxes (*Vulpes vulpes*) within 2 years

Ecological Linkages	•Keep sufficient ecological link between subject land and surrounding native bushland	•Rehabilitate vegetation by planting similar flora in connecting areas (vegetation to the north and south) for a gradual succession of vegetation communities •Get local landowners involved in conservation of native bushland	•Monitor and record health and survival of vegetation throughout the whole corridor	-	-
Disease	•Reduce disease risk	•Test all flora or fauna suspected of infection	•Monitor health and abundance of native flora and fauna and record all deaths	•Isolate and treat infected areas	•No significant outbreaks throughout management period
Fire	•Reduce fire risk	•Keep fuel loads low by removal of dense weed cover, dead trees and branches (without impacting on fauna habitat), and removal of litter •Ensure clear firebreaks in accordance to FESA and local council guidelines	-	•Revegetate lost flora	•No major fires within 10 years
Community	•Increase community education and involvement •Increase recreational use	•Create walkways that circulate the wetland with plaques set out every 20m educating the community of local vegetation, local fauna, overall wetland importance and rare species •Circulate wetland management plan with key stakeholders and organise meetings (if/when required) •Encourage field trips from local schools and get involved with monitoring and improvement •Create 'friends of' groups and get them involved with monitoring and improvement programs	•Remove debris and rubbish from pathways every 3 months •Keep plaques clean and legible remove any graffiti •Maintain a good relationship with local schools and respond to feedback •Maintain good relationship with conservation group	-	•Hold at least 2 meetings with community and friends within first year of management •Survey local community and gather data on community needs and appreciation

6. SUMMARY OF WETLAND MANAGEMENT PLAN

6.1. Vision

The intention of this Wetland Management Plan is to enhance the natural quality of the REW and conservation bushland with its integration into the Southern River Development Plan to protect their functions, values and attributes, whilst also creating ecological association to surrounding native bushland reducing the affects of urban fragmentation. It is also the intention to create community appreciation through valued recreation and environmental education.

6.2. Objectives

1.) Monitor and examine water quality and impacts. Investigate ways to maintain good water quality and prevent contamination
2.) Restore and rehabilitate vegetation communities and create wildlife corridors to ensure the long term viability of native flora and fauna
3.) Create habitat for native fauna with a focus on species in decline
4.) Amalgamate recreational needs with conservation values
5.) Promote conservation to local schools and residents through education and community involvement
6.) Keep stakeholders informed and involved in all management processes

6.3. Strategies

The key strategies include:
1.) Eliminate invasive weeds and rehabilitate native flora
2.) Establish and enhance ecological links with surrounding native bushland
3.) Implement stormwater management and investigate options to incorporate into wetland management
4.) Control introduced fauna such as rabbits and foxes
5.) Minimise roadkill
6.) Enhance recreational value and community education involvement

6.4. Plan

The overall plan to increase the functions, values and attributes of the wetlands is by using natural control methods to reduce the threats outlined previously. Natural methods include strategic use of different flora to reduce biological and hydrological impacts incurred since European settlement. The restoration and rehabilitation of the wetland is to use a gradual successive approach so that the restoration starts around the perimeter and progresses towards the center. The main threat that affects the wetland is invasive weeds and must be considered first before other strategies can be implemented.

Weed control

The first step towards increasing the wetlands values is weed control. The control of weeds requires an ongoing program to eliminate the current infestation as well as future incursions. The weed community needs to be eradicated and replaced with a native sedge community. This is achieved by repeated treatment of a non-accumulative, systemic herbicide such as Glyphosate to eliminate the current infestation as well as reduce the soil seed bank which is likely to sprout after rain. Major focus should be herbicide applications in late autumn before winter rains, then again in mid spring

Once the weeds are under control, restoration and rehabilitation of native species can be effectively achieved. Rehabilitation with rushes and sedges will out-compete most re-establishing weeds due to the dense tuft-like growth habits. Sedges and rushes also provide great habitat for breeding birds. A list of some rehabilitation species is included in Appendix 1.

Introduced species control

Introduced species such as rabbits (*Oryctolagus cuniculus*) and foxes (*Vulpes vulpes*) may best be controlled by destruction of dens and burrows. The control of invasive weeds is likely to contribute to the control of rabbits due to the reduction in food available.

Roadkill

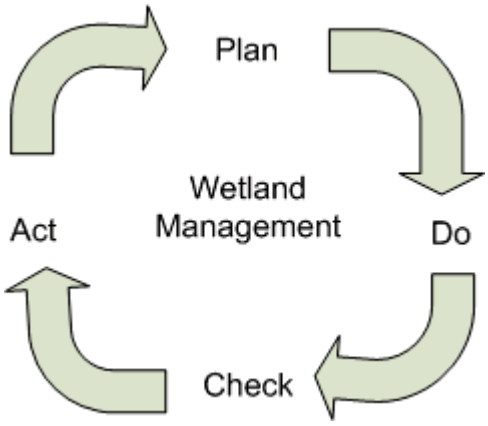
Erect road signs informing oncoming traffic of animal crossing. Also investigate ways of creating alternative routes for wildlife to safely cross roads to surrounding wetland and bushland areas.

Recreation

Create a footpath that circumnavigates around the wetland with park benches every 50m.

6.5. Performance

To ensure that the vision of the management plan is being achieved targets must be set within a dedicated time period as a way of measuring performance. Constant review of the management plan is required for continual improvement and can be achieved by adopting the Plan – Do – Check – Act management principle.



Plan: Establish objectives and create a plan to achieve the targets

Do: Implement the plan

Check: Measure the results

Act: Correct and improve the plan

Performance criteria are outlined in Table 3 above.

7. IMPLEMENTATION AND REVIEW

Implementation of the management plan is the responsibility of the Department of Housing and UrbanPlan Pty Ltd until responsibilities are relinquished to the City of Gosnells. Evaluation and review of the objectives and actions is required throughout the period of the wetland management plan. Review of the objectives set out by the management plan is an essential tool for evaluation of the overall affect on the wetlands

physical and biological characteristics. Using an adaptive management approach the feedback accumulated from the monitoring programs can provide evidence to achieve better management objectives for continual improvement.

8. REFERENCES AND FURTHUR READING

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APPENDIX 1

Species that may be used for revegetation

Type	Species	Family
Tree	*Eucalyptus rudis*	Myrtaceae
Tree	*Melaleuca preissiana*	Myrtaceae
Tree	*Melaleuca rhaphiophylla*	Myrtaceae
Shrub	*Hypocalymma angustifolium*	Myrtaceae
Shrub	*Pericalymma ellipticum*	Myrtaceae
Shrub	*Xanthorrhoea preissii*	Xanthorrhoeaceae
Sedge	*Lepidosperma longitudinale*	Cyperaceae
Rush	*Chaetanthus aristatus*	Restionaceae
Rush	*Baumea juncea*	Cyperaceae
Herb	*Centella asiatica*	Apiaceae
Herb	*Dampiera linearis*	Goodeniaceae
Herb	*Dasypogon bromeliifolius*	Dasypogonaceae
Herb	*Hypolaena exsulca*	Restionaceae
Herb	*Stylidium repens*	Stylidiaceae

APPENDIX 2

Image 1: Surface water on lots 18 and 19 (taken on the 4th September 2009).

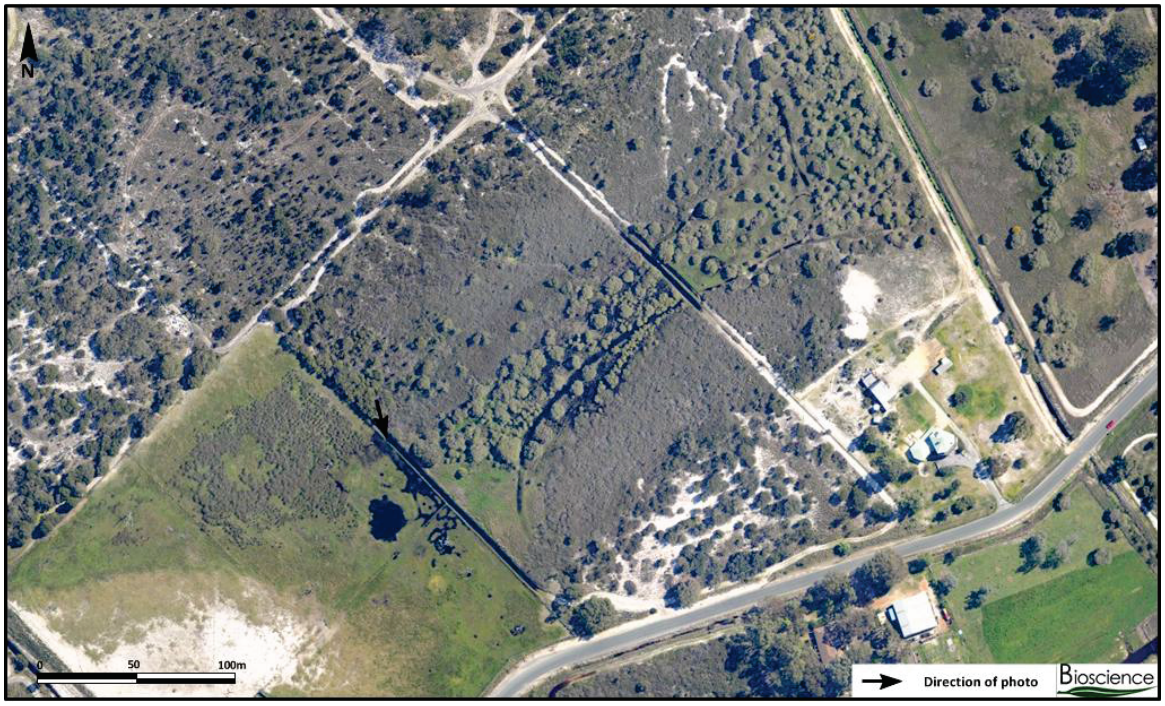

Image 2: Aerial photography of wetland inundation (26 September 2009)

Note: 2009 was a less than average rainfall year (745.8mm compared to 49 year average 824.1mm recorded at Gosnells City weather station)