Structure Plan

Lot 32 Barfield Road, Hammond Park

Prepared by:

RPS AUSTRALIA EAST PTY LTD

17 – 31 Station Street, West Perth
PO Box 170, West Perth WA 6872

T: +61 9211 1111
F: +61 9211 1122
E: planning@rpsgroup.com.au

Client Manager: Sheldon Day – Principal Urban Designer and Planner
Report Number: PR126191-1
Version / Date: Rev 3, January 2017

Prepared for:

DEPARTMENT OF TREASURY – STRATEGIC PROJECTS AND ASSET SALES

GOVERNMENT OF WESTERN AUSTRALIA
Department of Treasury

IMPORTANT NOTE

We have prepared this report for the sole purposes of Department of Treasury – Strategic Projects and Asset Sales ("**Client**") for the specific purpose of only for which it is supplied ("**Purpose**"). This report is strictly limited to the purpose and the facts and matters stated in it and does not apply directly or indirectly and should not be used for any other application, purpose, use or matter.

In preparing this report we have made certain assumptions. We have assumed that all information and documents provided to us by the Client or as a result of a specific request or enquiry were complete, accurate and up-to-date. Where we have obtained information from a government register or database, we have assumed that the information is accurate. Where an assumption has been made, we have not made any independent investigations with respect to the matters the subject of that assumption. We are not aware of any reason why any of the assumptions are incorrect.

Document Status

Version	Purpose of Document	Orig	Review	Review Date
Draft A	Internal and client review	CH	RS	12 March 2015
Draft B	Additional inputs from consultant team & client	RS	MG	17 April 2015
Rev 0	For submission to Council	RS	MG	4 May 2015
Rev 1	Incorporate comments from Council regarding Part 1 and Bushfire Management Plan	RS	MG	6 July 2015
Rev 2	Incorporate modifications as requested by Council and WAPC	RS	MG	28 October 2016
Rev 3	Incorporate modifications as requested by WAPC	SD	SD	31 January 2017

Approval for Issue

Name	Signature	Date
Sheldon Day		31 January 2017

ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Cockburn Town Planning Scheme No. 3.

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

07 February 2017

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the *Planning and Development (Local Planning Schemes) Regulations 2015.*

Date of Expiry: **07 February 2030**

Contents

Appendices

Tables

Figures

Table of Amendments

Table 1 – Table of Amendments

Amendment No.	Summary of the Amendment	Amendment type	Date approved by WAPC

Executive Summary

This Structure Plan (SP) applies to Lot 32 Barfield Road, Hammond Park. Lot 32 (subject site) is 4.0469 hectares in area, and is situated approximately 300 metres west of the Kwinana Freeway, and 24 kilometres to the south of the Perth Central Business District.

This SP will facilitate future subdivision to create residential lots at a density coding of Residential R 35, and a future secondary school site. This SP is consistent with the Southern Suburbs District Structure Plan – Stage 3 (DSP).

A summary of the key statistics for the SP area is provided in the following table.

Table 3 – Structure Plan Summary Table

Item	Data	Section number referenced within Part 2 of SP report
Gross Structure Plan area	4.0469 hectares	Table 5
Area of each land use proposed <u>Zones</u> - Residential <u>Reserves</u> - Secondary School Site	 0.8629 hectares 2.72 hectares	 5.2 5.3
<u>Composition of Public Open Space</u> Public Open Space Deduction [High School Site] Gross Subdivisible Area	 0.1327 hectares (10%) cash-in-lieu 2.72 hectares 1.3269 hectares	5.4
Estimated lot yield	20 lots	5.2
Estimated number of dwellings	20 dwellings	5.2
<u>Estimated Residential Site Density</u> - Dwellings per gross hectare as per Directions 2031 - Dwellings per gross hectare *less* high school site - Dwellings per site hectare as per Liveable Neighbourhoods	 5 dwellings per hectare (gross urban) 15 dwellings per gross hectare 25.8 dwellings per hectare (net residential)	5.2
Estimated Population	56 people @ 2.8 people/household	5.2

Structure Plan Content

This Structure Plan comprises:

Part One – Implementation

This section contains the Structure Plan Map, and outlines the purpose and intent of the Structure Plan.

Part Two – Explanatory Section

This section contains the explanatory component of the structure plan including background information, and an explanation of the structure plan including design methodology, relevance, and compliance with the applicable planning frameworks at the State and Local Government level.

This section also includes plans and maps in support of the structure plan.

Appendices

This section contains all of the technical reports and studies in support of the structure plan, with the level of detail contained within these reports and studies being commensurate with the context and scale of the proposed structure plan.

Part One – Implementation

1. Structure Plan Area

This structure plan applies to the land contained within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map.

2. Operation

This structure plan comes into effect on the date it is approved by the Western Australian Planning Commission.

3. Staging

Lot for high school to be created first. Residential subdivision to follow.

4. Subdivision and development requirements

a) Residential densities for the structure plan area are the residential densities shown on the Structure Plan Map.

b) Cash in lieu of public open space is to be provided.

c) Land use permissibility within the structure plan area shall accord with the corresponding land use classification in the City of Cockburn Town Planning Scheme No. 3.

d) This structure plan is supported by a Bushfire Management Plan (BMP), Bushfire Management Plan - Lot 32 Barfield Road, Hammond Park, 27 August 2015 by Ecological Australia, as amended. Any land falling within 100 metres of a bushfire hazard identified in the BMP is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.

e) Notifications on Title

The Council shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate of Title to suitably respond to the following:

- That a lot(s) with a bushfire attack level (BAL) rating of 12.5 or higher is within a designated bushfire prone area and subject to a Bushfire Management Plan.

5. Local Development Plan(s)

Local Development Plan(s) are to be prepared for lots:

a) with a bushfire attack level of 12.5 or greater;

b) having rear-loaded vehicle access; and/or

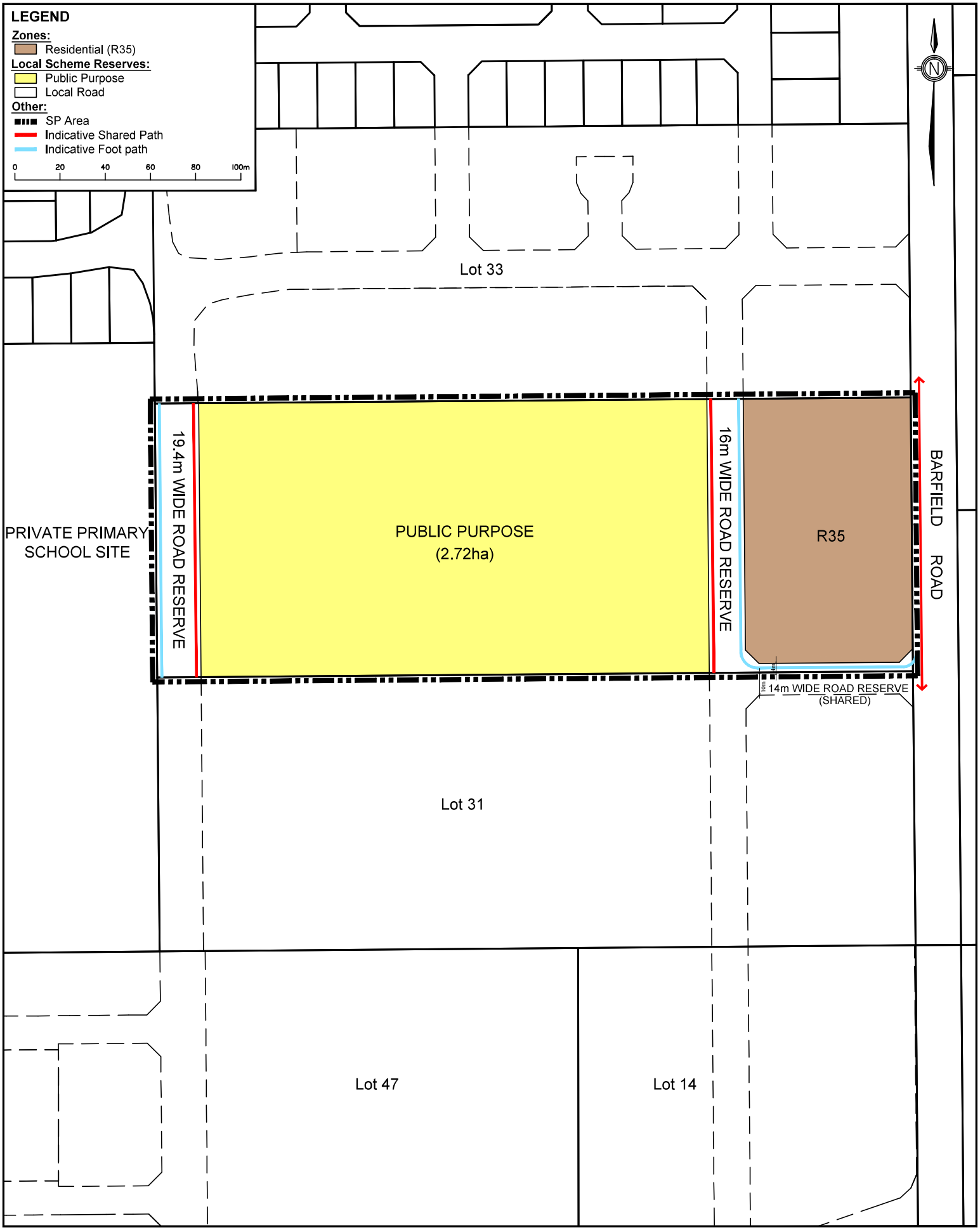
c) fronting on to Barfield Road (in order to manage stormwater detention within the road verge and any potential pedestrian and/or vehicular access).

6. Other requirements

a) Development Contribution Arrangements

DCA 9 and DCA 13 apply under the City of Cockburn Town Planning Scheme No. 3.

Attachment A – Structure Plan Map



PROJECT	**HAMMOND PARK**	CLIENT	**DEPARTMENT OF TREASURY STRATEGIC PROJECTS & ASSET SALES**
Job Ref. 129191	Date 21 MAY 2015	STRUCTURE PLAN LOT 32 BARFIELD ROAD	
Comp By. BC	DWG Name. 126191-5-005d.dwg		
Checked By. MW	Locality HAMMOND PARK		
Local Authority CITY OF COCKBURN			

RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762

Subiaco Office
38 Station Street
Subiaco WA 6008

T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

Scale	Sheet	Plan Ref	Rev
1 : 1500	A3	**126191-5-005**	**D**

Part Two – Explanatory Report

1.0 Background

1.1 Introduction

This Structure Plan (SP) has been commissioned by the Department of Treasury – Strategic Projects and Asset Sales on behalf of the landowners for Lot 32 Barfield Road, Hammond Park.

The SP will facilitate the future subdivision and development of the eastern portion of the subject site for residential purposes with a density coding for R35 being applicable. The SP will also facilitate the future subdivision and development of the western portion of the subject site as part of a larger landholding for the purposes of a future secondary school site.

In addition to the planning considerations canvassed within this SP report, the preparation of this SP has been informed by a number of technical and design investigations which are referred to in this report and the accompanying appendices.

This SP has been prepared in accordance with the guidelines published by the Department of Planning and WAPC (August 2012) for the preparation of structure plans. Part 1 of the structure plan has recently been updated in line with the Structure Plan Framework as published by WAPC reflecting the gazettal of the Planning and Development (Local Planning Schemes) Regulations 2015. This structure plan also responds to requirements outlined in the City of Cockburn Town Planning Scheme No 3 (TPS 3).

1.2 Location Details

The subject site is located within the suburb of Hammond Park, and is situated approximately 24 km south of the Perth CBD, and approximately 5 km south of the Cockburn Central Commercial Precinct (refer **Figure 1**).

1.3 Legal Description and Ownership

The subject site is comprised of a single landholding, with a total land area of 4.0469 hectares. This landholding is formally described as follows:

Table 4 – Land Title Particulars

Lot No.	Certificate of Title Details	Registered Proprietor(s)	Lot Area
32	Volume 13, Folio 61A on Diagram 32142	Tsao, Mei Li & Liao, Ching Hsi	4.0469 hectares

2.0 Planning Framework

2.1 Strategic Framework

2.1.1 Directions 2031

Directions 2031 is the current spatial planning framework for Perth and Peel, and outlines the planning vision and direction which will guide the planning of the region to 2031.

The Strategy recognises the benefits of a more consolidated city, which includes;

- A reduced overall need for travel via private vehicle;
- Supports the use of public transport, cycling and walking for access to services, facilities and employment; and
- A more energy efficient urban form.

The Strategy aims to provide for different lifestyle choices, vibrant nodes for economic and social activity and a more sustainable urban transport network. A key component of the strategy is to increase the gross residential densities in greenfield areas and to provide for greater housing diversity and community infrastructure, which are items specifically relevant to the SP.

Directions 2031 seeks a 50% increase in the current average residential density of 10 dwellings per gross urban zoned hectare in new development areas i.e. 15 dwellings per gross urban zoned hectare of land. The SP provides for residential densities well in excess of this target minimum on a pro-rata basis.

Endorsement of the proposed SP will facilitate subdivision and development of the subject site and assist in meeting the objectives established under Directions 2031. The proposed density outlined in the SP will assist in meeting the increase in density requirements as per Directions 2031.

The proposed future secondary school site identified in the SP will also assist in the delivery of community infrastructure in line with the objectives of Directions 2031.

2.1.2 Southern Suburbs District Structure Plan

The SP area is included in the Southern Suburbs District Structure Plan – Stage 3 (DSP). The DSP was adopted by Council in September 2012.

The DSP shows a broad land use framework including the major road network, neighbourhood structure, commercial, education, community and significant open space areas. It forms the basis of coordinating and considering structure plans and plans of subdivision to be prepared by landowners in the area (refer **Figure 4**).

The adopted DSP provides a base coding/minimum density of 15 dwellings per gross urban hectare of land, and 25 dwellings per hectare in areas near centres and areas of amenity.

The adopted DSP also illustrates the provision of important community facilities, specifically being two primary school sites (one public/one private), and a public high school site to service both areas within and beyond the boundaries of the DSP.

2.2 Statutory Framework

2.2.1 Metropolitan Region Scheme

The subject site is zoned 'Urban' in the Metropolitan Region Scheme (MRS).

2.2.2 City of Cockburn Town Planning Scheme No. 3

The subject site is zoned 'Development' in the City of Cockburn Town Planning Scheme No. 3 (TPS 3). A zoning plan illustrating the context of the subject site within TPS 3 is provided at **Figure 3.**

The provisions applicable to the Development zone within TPS 3 provide that subdivision and development is to be in accordance with a Structure Plan adopted pursuant to Section 6.2 of TPS 3.

The subject site is included in Development Area 26 (DA 26) as identified in Schedule 11 of TPS 3. The provisions of TPS 3 relating to DA 26 give rise to the requirement for an SP to be prepared and adopted in accordance with the structure planning provisions in TPS 3.

The subject site is also included in Development Contribution Area 9 (DCA 9) as identified in Schedule 12 of TPS 3. The DCA 9 area was created under Amendment 28, which was gazetted on 16th December 2014.

DCA 9 is the subject of a Development Contribution Plan (DCP). The DCP requires landowners within the DCA 9 area to contribute financially towards the provision of key service and community infrastructure upon further subdivision and development of their land. Each landowner is required to make a contribution payment (typically as a condition of subdivision approval) based on the number of lots/dwellings developed in accordance with the contribution rate set by the DCP.

2.2.3 Liveable Neighbourhoods

The Western Australian Planning Commission's (WAPC) Liveable Neighbourhoods Policy is intended to guide the subdivision and development of land in Western Australia. The key principles of this policy include:

- Providing a variety of lots sizes and housing types to cater for the diverse housing needs of the community at a density that can ultimately support the provision of local services;
- To set aside adequate and appropriate government and non-government school sites to accommodate the educational needs of existing and future communities;
- To ensure cost-effective and resource efficient development to promote affordable housing; and
- To maximise land efficiency.

Liveable Neighbourhoods provides guidance for the design and development of greenfield subdivision through eight design elements; community design, movement networks, lot layout, public parkland, urban water management, utilities, activity centres and employment, and schools. These various elements have been considered in the preparation of the SP, and are discussed as appropriate in later sections of this report (Section 5).

2.2.4 State Planning Policy No. 3 – Urban Growth and Settlement

This Policy sets out the principles and considerations which apply to the planning of urban growth settlements in Western Australia. The Policy aims to facilitate sustainable patterns of urban growth and settlement and recognises that the State is undergoing rapid growth and change which is expected to continue. The policy acknowledges that the spread of urban development intensifies pressures on valuable land and water resources, imposes costs for the provision of infrastructure and services, increases dependence on private cars and creates potential inequities for those living in the outer suburbs where job opportunities and services are not so readily available.

This SP is considered to meet the objectives of SPP No. 3, including:

- The promotion of a sustainable and well planned pattern of settlement with sufficient and suitable land to provide for a wide variety of housing
- Building on existing communities with established local and regional economies, concentrating investment on the improvement of services and infrastructure to enhance the quality of life in those communities
- The provision of a planned economic and employment base which can be efficiently serviced by local and regional infrastructure including roads, public transport, water supply, sewerage, drainage, energy, local parks, schools, shops, recreational facilities and other services

2.2.5 Pre-lodgement Consultation

Table 5 – Pre-lodgement Consultation

Agency	Date of consultation	Method of consultation	Summary of outcome
Department of Education	August 2014 – ongoing	Meetings and workshops to identify DoE requirements for future use of portion of site for school purposes.	Comments/recommendations addressed and incorporated into final report.
Department of Planning	4 December 2014 & 5 February 2015	Meeting to discuss SP requirements and process.	Comment/recommendations addressed and incorporated in final report.
	28 May 2015	Meeting to discuss local road network consideration	In principle agreement subject to advice from City of Cockburn traffic engineer.
Department of Environmental Regulation	30 January 2015	Meeting to discuss environmental approval requirements	School site, incorporating Lot 32, anticipated to be referred to State and Federal authorities under relevant environmental legislation.
City of Cockburn	5 February 2015	Meeting to discuss SP requirements and process.	Comment/recommendations addressed and incorporated in final report.
	22 April 2015	Pre-lodgement meeting	Validation of engineering methodology.
	19 May 2015	Pre-lodgement preliminary assessment by Council	Incorporate comments into final SP report.
	17 June 2015	Meeting with Council to confirm local road network considerations	Council support for proposed local road network confirmed.

3.0 Site Conditions and Environment

3.1 Existing and Surrounding Land Use

The subject site contains a dwelling and a number of outbuildings within the eastern portion. The western portion of the subject site is vacant and contains a number of unmade vehicle tracks and a sparse scattering of vegetation. This portion of the site shows historical evidence of clearing (refer **Figure 2**).

Hammond Park is a locality undergoing land use change from small rural-residential landholdings and horticultural activities to residential subdivision and development, consistent with the Urban zoning of the land. The land north of Gaebler Road has been extensively developed for residential purposes, whilst the land south of Gaebler Road is progressively being developed for urban purposes as the development front continues to move southwards, parallel to the Kwinana Freeway.

Hammond Park Catholic Primary School is located to the west of the subject site.

Surrounding lots to the north, south and east are relatively undeveloped and continue to be used for rural residential purposes. Land immediately south of Frankland Avenue approximately 500m to the south-west of the site, contains a number of commercial horticultural operations, comprising market gardens, turf farms and orchards.

3.2 Biodiversity and Natural Assets

3.2.1 Vegetation and flora

A flora, vegetation and fauna assessment was undertaken by GHD (2014) across the whole area proposed for the high school to determine any potential environmental constraints prior to the development progressing. The eastern section of Lot 32 designated for residential development was excluded from this survey.

Four Bush Forever sites occur within 2 km of the Study Area (Government of Western Australia, 2014), these include:

- Mandogalup Road Bushland (Bush Forever Site No. 268), 1.75 km south-west;
- Harry Waring Marsupial Reserve (Bush Forever Site No. 392), 0.74 km west;
- Thomsons Lake Nature Reserve and Adjacent Bushland (Bush Forever Site No. 391), 1.38 km north-west;
- Lyon Road Bushland (Bush Forever Site No. 492), 1.3 km north-east.

At a regional level, the area is located within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion, Perth Sub-Region. The Perth sub-region is dominated by woodlands of Banksia and Tuart (Eucalyptus gomphocephala) on sandy soils, sheoak on outwash plains, and paperbark in swampy areas. The colluvial and aeolian sand areas represent three phases of Quaternary marine sand dune development (which provide relief), and include a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several off-shore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while Banksia and Jarrah (Eucalyptus marginata) – Banksia woodlands are found on the older dune systems (GHD, 2014).

Three vegetation types were recorded within the SP area. No species listed under the EPBC Act or WC Act was recorded during the survey and no DPaW Priority species were identified during the survey.

- Vegetation Type 1 (VT1): 1.16 ha of Low Open Forest of *Banksia* spp. and *Allocasuarina fraseriana.* While VT1 overstorey was dominated by a variety of *Banksia* spp. and *Allocasuarina fraseriana* there were scattered Jarrah and Marri trees present with some of the trees in the wider study area identified as potential breeding trees for Black Cockatoo. VT1 represents the recently added Priority 3 Priority Ecological Community; Banksia dominated woodlands of the Swan Costal Plan IBRA region.
- Vegetation Type 2 (VT2): 0.80 ha of Low Woodland of *Banksia* spp. over Open Low Heath of *Scholtzia involucrate* was very similar in species composition to VT1, however, differed in having a more open *Banksia* overstorey, general reduction in species presence and having a midstorey dominated by *Scholtzia involucrata,* which was only very sparsely present within the remainder of the Study Area. While VT2 shows differences with VT1, these differences may have been caused by small changes in soil properties or various anthropogenic factors. As such, VT2 also shows similarities with the recently added Priority 3 Priority Ecological Community; Banksia dominated woodlands of the Swan Costal Plan IBRA region.
- Vegetation Type 3 (VT3): 0.91 ha of Low Open Woodland of *Melaleuca rhaphiophylla was* highly degraded. The areas representing VT3 have been largely cleared and subsequently invaded by weed species which has altered nature of this vegetation.

The eastern section of Lot 32 included in the survey has been subject to partial clearing and has been badly affected by weed species such as *Ehrharta calycina (Perennial Veldt Grass) and *Eragrostis curvula (African Lovegrass), with condition considered to range from Good (4) to Degraded (5). The remainder of the lot is in an Excellent (2) to Very Good (3) condition and shows very few signs of disturbance.

One species, *Asparagus asparagoides (Bridal Creeper), which is listed as a Declared Pest under Section 22 of the Biosecurity and Agriculture Management Act 2007 (BAM Act) and as a Weed of National Significance (WoNS) (Australian Weeds Committee, 2010) was identified on the eastern survey boundary of Lot 32 and another plant was identified approximately 20 m to the east of the study boundary.

3.2.2 Fauna

Two main fauna habitat types are present in the study area, namely Banksia Woodland and Melaleuca Dampland; both are present on Lot 32 (refer **Appendix 1**).

The Banksia woodland is in relatively good condition and features an overstorey of scattered Jarrah trees, Banksia and Sheoak (Allocasuarina) shrubs, grasstrees and others. While this woodland would support a large number of bird species, the presence of Jarrah and Banksia, especially, provides suitable foraging habitat for black cockatoo. One of these trees was on the western boundary of Lot 32 identified as a potential breeding tree. Other potential breeding trees could be present on the eastern section of Lot 32 that was not included in the survey. The potential breeding trees identified were concentrated on Lot 31 which adjoins the southern boundary. One dead stag currently able to support Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo breeding was recorded on Lot 31. This stag contained at least two hollows suitable for Black Cockatoo breeding.

Across this woodland there are also areas of loose sands that are particularly suitable for burrowing reptiles such as the Priority 3 listed fossorial Black-striped Burrowing Snake (Neelaps calonotos) and the Priority 3 listed Perth Lined Skink (Lerista lineata). Where the understorey is densely vegetated, this would provide foraging opportunities and refuge areas for ground-dwelling mammals such as the Echidna and Southern Brown Bandicoot (Priority 5) and reptiles such as goannas and skinks. Micro-habitat features such as tree hollows and cavities also provide habitat for a number of birds, reptiles and small mammal species.

Due to the highly degraded nature of the Melaleuca dampland and the large weed infestations in this area, its value as potential habitat is low.

The area surrounding the study area consists of numerous islands of remnant vegetation surrounded by a large variety of land uses, including roads, rural-residential, industrial, parklands and others. The study area is nevertheless connected to a substantial 47 ha block of remnant vegetation comprising semi-rural residential properties and has limited connectivity to a Conservation category wetland (UFI 14104) located approximately 450 m north-west of the Study Area. These areas provide habitat corridors for fauna movement within the local area and also in the larger regional area. Kangaroo droppings found on site provide evidence of fauna using the site for regional movement.

3.3 Landform and Soils

The study area occurs in the Bassendean Dune System, a landform of the Swan Coastal Plain. The Bassendean Dune System consists of a gently undulating aeolian sand plain over sedimentary rock. The sands of the Bassendean Dunes are leached and infertile, they contain little silt or clay, and very low levels of nutrient elements, with nutrient elements generally being associated with organic matter.

The sands within the Study Area are relatively porous and well drained, therefore there is little overland surface water flow, which minimises the risk of water erosion, but the risk of wind erosion is high.

A preliminary Acid Sulphate Soil (ASS) investigation was undertaken by GHD (2014) across the whole of the study area proposed for the high school to determine any potential environmental constraints prior to the development progressing. The GHD ASS investigation findings can be summarised as follows.

The ASS Swan Coastal Plain regional risk mapping indicates that the Study Area has a Moderate to Low risk of ASS within 3m of natural soil surface and the Australian Soil Resource Information System (ASRIS) database indicates that the Study Area is classified as 'Low Probability of Occurrence' with a high degree of confidence. As the topography is variable, it is possible that there is ASS closer to the surface than this.

The site topography is variable, with ridges and valleys. There is a potentially variable or difficult to define groundwater table, leading to potential ASS. Soil observed on the site is a loamy subsoil of low permeability; visible soil appeared to be sandy with peaty black fines. The subsoil drainage may be poor, and dewatering may experience issues with ASS when installing services or bulk earthworks on site.

The site contains pale sandy soil, which is dark and loamy just below the surface. Fines and organic matter (vegetation) were observed to be mixed into the soil in lower areas, indicating that ASS may be present. Vegetation in the lower lying areas was also indicative of a high water table.

The soil investigation confirmed the soil formations on the site consist of Bassendean sands overlying Guildford Formation across the site. This includes non-continuous lenses of coffee rock in the northern half of the site, and lenses of clay across the site. These soils are historically known to present weak ASS within previously oxidised areas.

The development is not likely to have any significant environmental impact on environmental values associated with landforms and ASS provided an ASS Management Plan is prepared if soil below the groundwater table is to be disturbed or dewatering is required. Once construction information such as site layout and final design levels is available to identify the depth and volume of any soil disturbances, the requirement for an ASS Management Plan will be able to be properly assessed.

The propensity of the sands for wind erosion does indicate the need for appropriate dust management during construction and the provision of adequate surface cover after construction.

The Site is not listed on the Department of Environment Regulation (DER) Contaminated Sites Database for any of the following classifications:

- Contaminated Remediation Required
- Contaminated Restricted use
- Remediated for Restricted use.

The closest contaminated site (a former piggery) is located approximately 1 km north east of the site boundary. There are microbiological indicators of possible pathogens in groundwater across the identified contaminated site as well as elevated levels of hydrocarbons and zinc. Remediation of affected soils has been conducted and the area is classed as "remediated for restricted use" with a number of restrictions on the use of groundwater.

3.4 Groundwater and Surface Water

The flora, vegetation and fauna assessment undertaken by GHD (2014) addresses the groundwater and surface water of the survey area. No naturally occurring bodies of surface water in, or in the immediate vicinity of the study area were recorded in the GHD survey. It is considered unlikely that the proposed works will disturb or interrupt any natural drainage and surface run-off patterns due to the deep sandy soils present in the area.

The Department of Water Geographic Data Atlas (DOW, 2014) was also queried and indicated that the study area is not associated with any Surface Water Areas, Irrigation Districts, Rivers or Public Drinking Water Source Areas proclaimed under the *Rights in Water and Irrigation* (RIWI) Act 1914.

A search of the EPBC Protected Matters database identified two Wetlands of International Importance (RAMSAR) are located within 5 km of the study area:

- Forrestdale and Thomsons Lakes (within RAMSAR site);
- Peel-Yalgorup system (upstream from RAMSAR).

A search of the DAFWA Wetland Base indicates that there are no wetlands in the Study Area (DAFWA 2014). The nearest wetland (an unnamed dampland) is located approximately 450 m north-west of the Study Area.

No lakes covered under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP Lakes) occur within the study area. The closest EPP lake is located approximately 1.6 km north-west of the Study Area (Unnamed Lake).

The Department of Water Geographic Perth Groundwater Atlas (PGA), 2014 indicates that the highest estimated groundwater is situated at around RL +22 m AHD. As the topography ranges from RL +23 to +28 m AHD across the site, the highest estimated groundwater level is situated between 1 m and 3 m below the natural ground surface level and therefore could potentially be intersected during construction, depending on the proposed design grade levels and timing of the works.

GHD indicates that the groundwater in the study area and surrounds is relatively fresh, with a TDS ranging between 500 to 1000 mg/L. (Palatable drinking water is described by the World Health Organisation as being below 600mg/L (WHO, 2004)).

3.5 Water Management

A Local Water Management Strategy (LWMS) has been prepared for the SP area (refer **Appendix 2**). The LWMS, which has been prepared in accordance with State Planning Policy 2.9, sets out the water management principles and design objectives for the SP, which will be implemented through future subdivision and development.

The LWMS proposes the following approach to the detention and management of urban water:

- Residential lot will maintain the 1:20 year storm on site
- The school site will maintain a 1:100 year storm on site
- Due to the lack of POS, the 1:50 year storm will be catered for in the road reserve (Barfield Road)
- 1:100 year storm being catered for on the school oval

Given the need for the detention of storm water drainage within the road reserve (verge), measures will need to be implemented in order to mitigate any potential adverse impact of development on the drainage swale contained within the verge. Such measures include fixed driveway locations, access restrictions, regulation of verge use, and passive measures such as planting within the verge.

3.6 Bushfire Hazard

A Bushfire Management Plan (BMP) has been prepared for the subject site due to the subject site containing, and being adjacent to bush fire prone land as identified by the City of Cockburn.

The BMP has been developed in line with:

- State Planning Policy (SPP) 3.7: Planning for Bushfire Risk Management (draft);
- Planning for Bushfire Risk Management Guidelines and appendices (draft);and
- AS 3959-2009 Construction of buildings in bushfire-prone areas (including Amendments 1-3)

The BMP identifies building protection and hazard separation zones based on existing conditions in the surrounding area. The BMP also identifies Bushfire Attack Level ratings for future development based on a number of scenarios.

The bushfire hazard assessment has essentially mapped the surrounding hazard and identified bushfire hazard controls to address the hazard and risk in order to achieve compliance with the Planning for Bushfire Risk Management Guidelines.

The BMP identifies that the SP area is capable of providing a level of bushfire hazard management for future development proportional to the post development risk.

A copy of the BMP is provided in **Appendix 3**.

3.7 Aboriginal and European Heritage

The SP area is included in an analysis of Aboriginal Heritage undertaken in 2014 for the proposed Hammond Park Secondary School site. The analysis concluded that the site is highly unlikely to contain any areas of Aboriginal significance and that the area does not contain any sites registered under the Aboriginal Heritage Act 1974.

The SP area does not contain any European heritage places listed on Federal, State or Municipal registers.

4.0 Infrastructure and Services

4.1 Traffic and Transport

4.1.1 Roads

The subject site is well connected given its close proximity to Kwinana Freeway, Russell Road and Rowley Road. The surrounding regional road network provides efficient access to the wider Perth Metropolitan Region including commercial and employment centres.

Frankland Avenue to the west of the site is designated as an Other Regional Road in the MRS which connects to Russell Road to the north and Rowley Road to the south.

The subject site has direct frontage to Barfield Road, which is an Access Street C with a 20 metre reserve width that connects to the regional road network via Rowley Road.

The road layout has been determined to some extent by the DSP, and is also governed by the surrounding SP areas for Lots 31, 33 and 47 Barfield Road, which contemplate additional local access road connections running on a north south axis to provide road frontage to the secondary school site, and on an east west axis to provide connectivity from Barfield Road to the school site and surrounding residential lots.

4.1.2 Public transport

The closest railway station from the subject site is Cockburn Station (Mandurah Line) situated approximately 5kms to the north.

The nearest bus stop is located approximately 750m north-west the subject site on Gaebler Road, and a similar distance to the north on Barfield Road. Buses routes that service these bus stops operate 7 days a week, and are timed to connect to the Mandurah Line rail service.

It is anticipated that the existing bus service will be expanded to provide additional bus stops along Barfield Road as the development of the surrounding area progresses.

4.1.3 Path network

The subject site is situated in close proximity to the principal shared path running along the western side of the Kwinana Freeway.

The subject and adjoining SP areas will be designed to encourage cycling through the provision of a shared path network, connecting to the external network as identified in the surrounding SP areas, which provide for shared path along Barfield Road, a shared path and footpath within the proposed 16 metre road reserve between the R35 coded street block and the High School site, and a shared path and footpath within the proposed 19.4 metre road reserve between the High School site and the Primary School site to the west of the SP area.

4.2 Utility Services

A desktop review of existing servicing information has confirmed that all essential urban infrastructure is available in the area and can be readily extended to service the SP area upon development.

4.2.1 Sewer

Information provided by "Dial Before You Dig" (DBYD) shows an existing Water Corporation sewer line running along Irvine Parade to the north east of the site. Through correspondence with the Water Corporation, it has been established that ample capacity is available.

A new 300mm sewer trunk main is scheduled to be built along the western boundary within the future road reserve (future Irvine Parade extension) of the site via an easement set 3.1m from the existing primary school site cadastral boundary. This sewer will service the southern and western bound developments currently in planning stage. It is proposed to discharge sewer from Lot 32 into the future 300mm sewer main which in turn will discharge the existing Irvine Parade trunk sewer main.

4.2.2 Power

On the western side of Barfield Road there are existing overhead power lines. Through correspondence with Western Power, it has been established that the existing infrastructure along the North West side of the site proposed to supply the school suffers from supply and capacity constraints. Hence, a new extension of an existing feeder circuit near Wattleup Road to the school site is proposed to meet the supply and capacity demands. Western Power will confirm what the capacity is to local infrastructure near Wattleup Road. It is proposed to supply a new transformer at the southern boundary of Lot 47 that will ultimately service Lot 32.

4.2.3 Telecommunications

NBN Co. cabling is available in proximity to the site along Barfield Road. Telstra is not the network provider and their services will be assigned on the NBN Co. cable. It is envisioned that a connection will be made to the existing service along Barfield Road and taken to site via pit and conduit to the western boundary of Lot 32. Alternatively, a connection may also be made to the eastern boundary of the site along a future eastern road alignment that runs past Lot 32. The final lot connection will be confirmed following further negotiations with NBN Co which are ongoing, but it is envisaged that the site can be serviced from both the western and eastern boundary.

4.2.4 Water

Information provided by "Dial Before You Dig" (DBYD) shows an existing Water Corporation water reticulation mains present along Atkins Parade, Irvine Parade, Bellingham Road and Woodrow Avenue. There is presently no direct connection to the school site. It is proposed to construct a new section of water main reticulation within the future western boundary road reserve (future Irvine Parade extension) that will service the site at a designated location along the Lot 32 western boundary.

4.2.5 Gas

Information received from ATCO Gas Australia displays existing Polyethylene High Pressure gas services (350kPa) exist along Atkins Parade, Irvine Parade, Bellingham Road and Woodrow Avenue. The locations do not provide a direct connection to the school site at present. The gas service is to be extended along Irvine Parade to Lot 32 with a medium to low pressure connection made along the Lot 32 western boundary within the future western boundary road reserve (future Irvine Parade extension).

5.0 Structure Plan

5.1 Design Principles

The key design parameters which underpin the SP are specifically guided by:

- The DSP
- The approved SP to the south for Lot 31 Barfield Road; and
- The approved SP to the north for Lot 33 Barfield Road.

5.2 Residential

The SP contemplates the provision of one residential street block within the eastern portion of the subject site, with a density coding of Residential R35. This density coding is consistent with the adjoining SP areas to the north and south.

The SP is estimated to yield approximately 20 dwellings. Based on this estimate of dwelling yield, the SP achieves an estimated residential density of approximately 5 dwellings per gross hectare of 'Urban' zoned land, 15 dwellings per grass 'Urban' zoned hectare less the area of the high school site, and 25.8 dwellings per net hectare of residential developable land which satisfies the density and yield targets set by Directions 2031 and Liveable Neighbourhoods.

5.3 Education Facilities

The SP contemplates the provision of a Reserve for Public Purposes (High School) within the western portion of the subject site. This land use is consistent with the DSP and other approved structure plans for surrounding landholdings.

A public primary school (under construction) is located at the corner of Frankland Avenue and Gaebler Road, 800 m north of the subject site.

An existing private primary school is situated to the west of the subject site on the opposite side of the future local road from where the proposed government secondary school site is designated as per the DSP, and as identified in this SP.

5.4 Open Space

The SP does not include the provision of any POS for the proposed Residential zone. The proposed High School Public Purpose reserve does not generate any requirement for the ceding of POS. This is in line with the DSP.

The DSP provides POS for at least 10% of the gross subdivisible area over the entire DSP area. The following table identifies the applicable public open space obligation for 10% of the gross subdivisible area in accordance with Liveable Neighbourhoods.

The future residents of Lot 32 will be located in proximity (a short walking distance) from four separate future areas of POS which will range in size and functionality. The provision of a small (1326.9 square metre) 'Local Park' on Lot 32 is not considered to be beneficial, both from an amenity perspective and also from a Council maintenance perspective.

Under the provisions of 153 of the Planning and Development Act 2005 ('the Act'), cash-in-lieu of public open space if the land area is such that a 10% contribution would be too small to be of practical use, and there is already adequate public parkland taking into account the overall objective of parkland and provision and distribution, is considered appropriate for Lot 32, and may be conditioned appropriately at the time of subdivision.

Table 6 – Public Open Space Schedule

Indicator	Area (ha)	
Total landholding		**4.0469**
Deductions		
High School Site	*2.72*	
Gross Subdivisible Area		**1.3269**
Public open space required @ 10%		**0.1327**

5.5 Activity Centres and Employment

There are no activity centres provided for within the SP.

The DSP identifies two local centres in close proximity to the subject site, being a local centre comprised of approximately 5,000m^2 of retail floor space centre to the south-west, which is adjacent to the extension of Frankland Avenue/Hammond Road. This local centre will provide shopping facilities such as a supermarket, specialty shops and mixed business opportunities. A smaller neighbourhood centre comprised of approximately 1,500m^2 of retail floor space is also proposed, which is situated approximately 350m south-west of the subject site.

The site is located in nearby proximity to the industrial areas of Henderson, Naval Base and Kwinana Beach, which provide employment opportunities at a local and regional level across a range of industries. The Latitude 32 Industrial Precinct is also located in nearby proximity to the subject site which will also provide for extensive employment opportunities as this area is developed.

5.6 Infrastructure Coordination, Servicing and Staging

No formal road or servicing infrastructure coordination or staging arrangements are contemplated by the SP owing to the limited number of properties affected i.e. one lot. The provision of infrastructure will therefore be relatively straightforward, and would typically be coordinated with the high school site at the time of development. The portion of the subject site designated as a high school site in the SP forms part of an incremental land assembly process that will ultimately enable the development of a secondary school within the western portion of the subject site as identified in the DSP. POS will be provided as cash in lieu as a condition of subdivision approval and it is anticipated that the site will be subdivided in a single stage.

5.7 Local Development Plans

To further guide development within the residential zoned portion of the SP area, a Local Development Plan will need to be prepared in accordance with clause 6.2.15 of TPS 3 for all lots identified by the Bushfire Management Plan as being subject to bushfire hazard (i.e. having a BAL rating of 12.5 or higher), and all lots with frontage to Barfield Road in order to manage stormwater detention within the road verge area and any potential pedestrian and/or vehicular access.

For lots affected by bushfire hazard, the LDP will include detail requiring dwellings to be constructed in accordance with the Australian Standard 3959-2009 Construction of Buildings in Bushfire Prone Areas as per the recommendations of the Bushfire Management Plan.

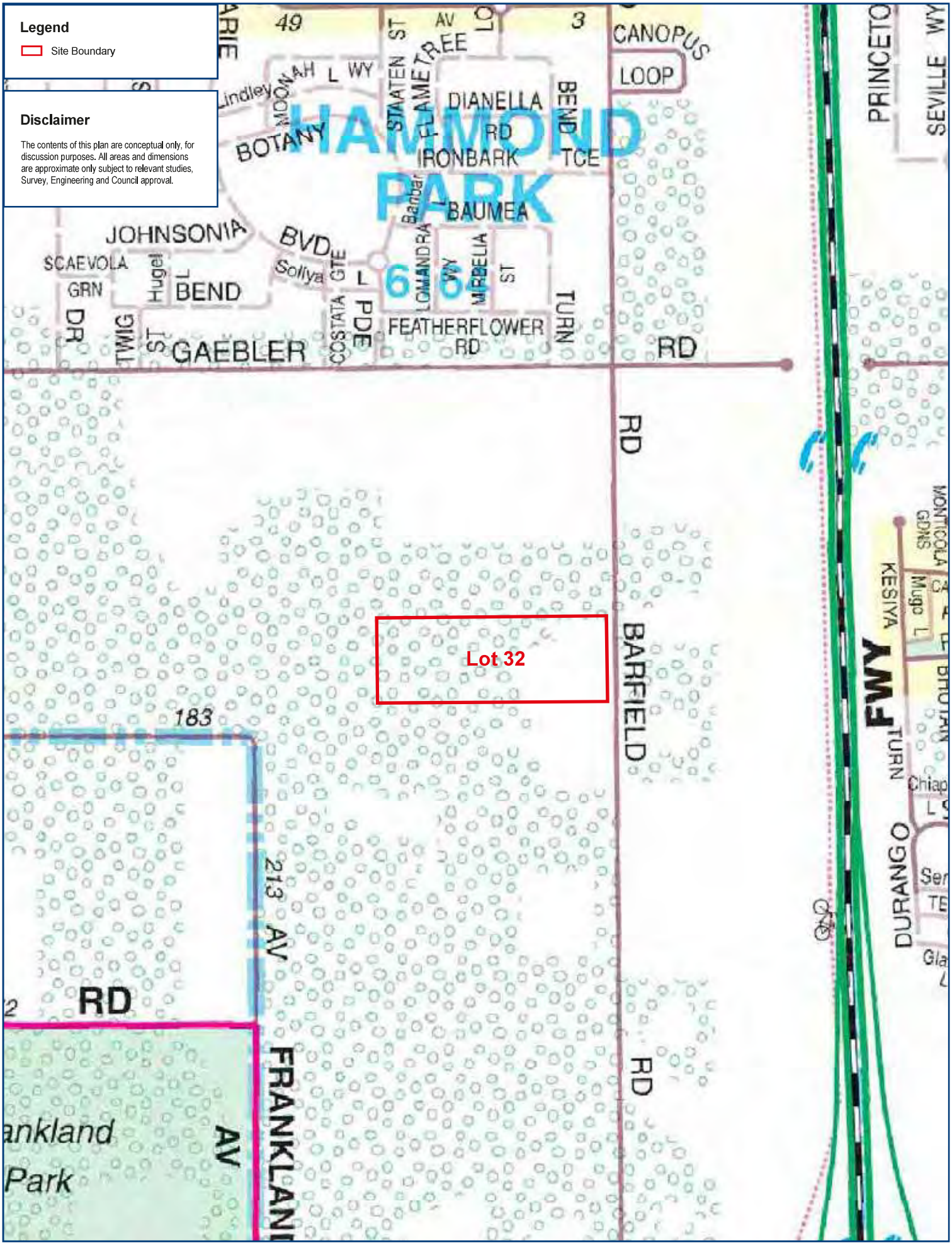
6.0 Conclusion

The design of this SP is based on best-practice urban design principles reflected within the WAPC Liveable Neighbourhoods policy.

The SP is consistent with the applicable strategic and statutory planning framework.

Approval of the SP will facilitate the future subdivision and development of the subject site in an orderly manner, and in line with the objectives of the Southern Suburbs District Structure Plan – Stage 3, specifically with respect to the establishment of a secondary school site to service the surrounding catchment.

FIGURES



Lot 32 Barfield Road, Hammond Park
Figure 1 - Location Plan

0 175 350

RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762
PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008
T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

Scale 1:7000@A4 | Date May 2015 | Project No 126191-5-001a

Lot 32 Barfield Road, Hammond Park

Figure 2 - Aerial Plan

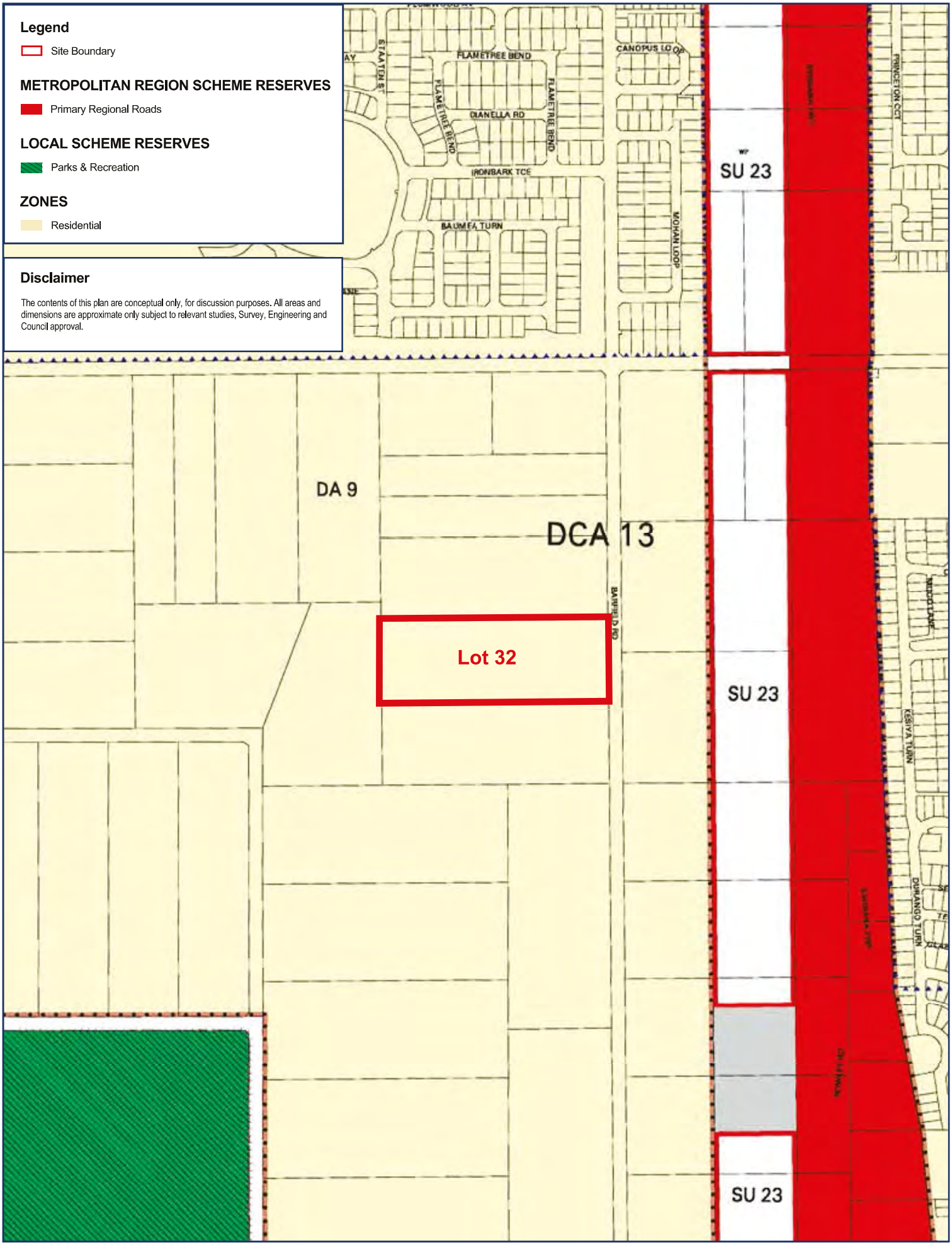
RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762

PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008

T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

Scale 1:2000@A4 | Date May 2015 | Project No 126191-5-002a



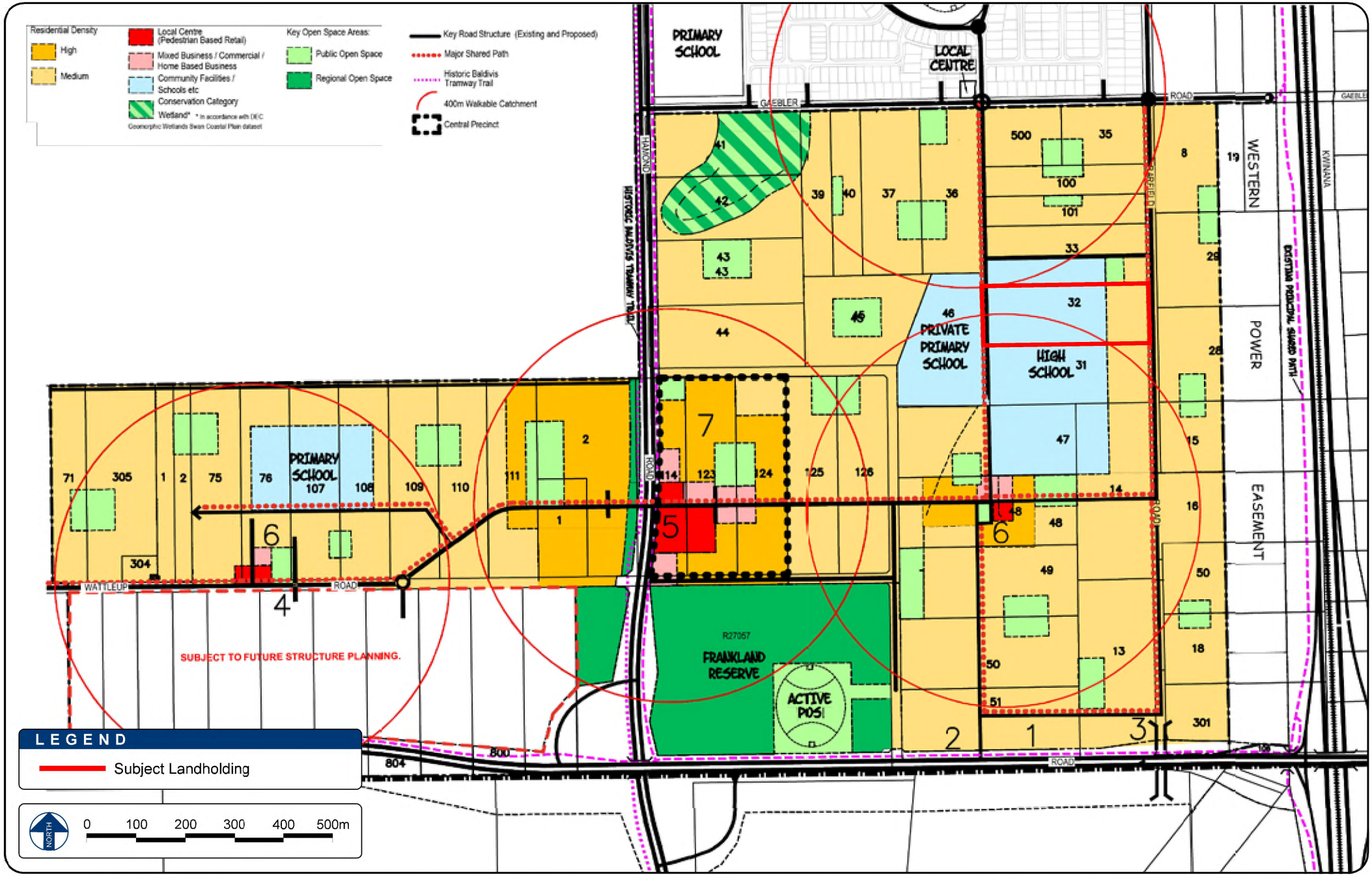
Lot 32 Barfield Road, Hammond Park
Figure 3 - TPS Mapping

0 175 350

RPS Australia East Pty Ltd
ACN 140 292 762
ABN 44 140 292 762
PO Box 465 Subiaco WA 6904
38 Station Street
Subiaco WA 6008
T +61 8 9211 1111
F +61 8 9211 1122
W rpsgroup.com.au

PRELIMINARY FOR DISCUSSION PURPOSES ONLY

Scale 1:7000@A4 | **Date** May 2015 | **Project No** 126191-5-003a



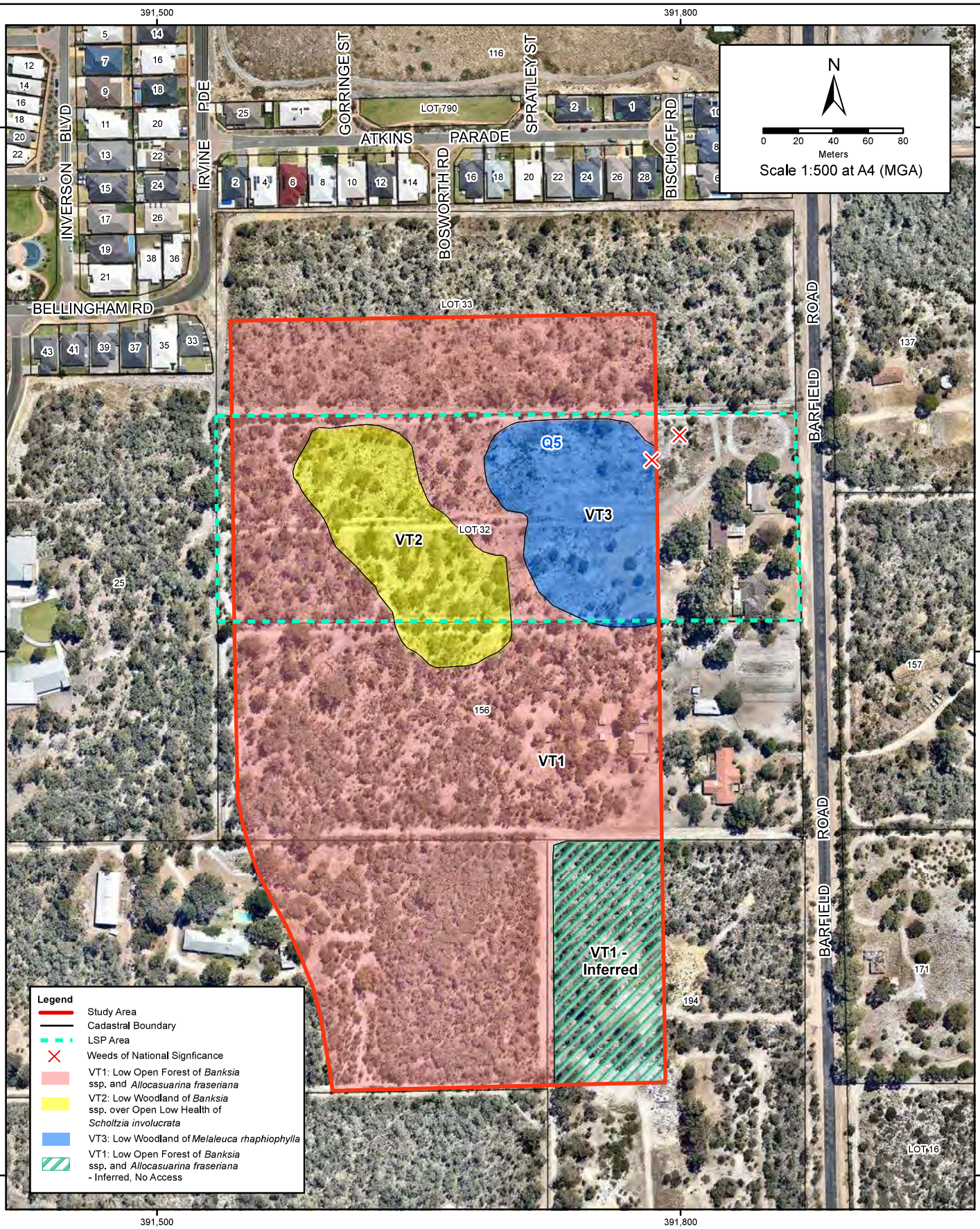
RPS Australia East Pty Ltd
ABN 44140292762
PO Box 465 SUBIACO WA 6904
38 Station Street SUBIACO WA 6008
T +61 8 9211 1111 W rpsgroup.com.au

1:10,000@A4 : SCALE
21 April 2015 : DATE
126191-5-004 : PLAN No
B.C. : DRAWN

SOUTHERN SUBURBS STAGE 3 DISTRICT STRUCTURE PLAN - Figure 4

Lot 32 Barfield Road, HAMMOND PARK

APPENDIX 1
Flora and Vegetation Plan



WSP

FIGURE 1: LOT 32 BARFIELD ROAD LOCAL STRUCTURE PLAN

Department of Treasury
Project No: 00046683
NATIVE VEGETATION CLEARING PERMIT
LOT 32 BARFIELD STREET, HAMMOND PARK, WA

Date: 9/04/2015
Drawn: S. Hultgren
Checked: K. Fox

Transverse Mercator, GDA 1994 MGA Zone 50
AERIAL PHOTOGRAPH SOURCE: Nearmap, March 2015
CADASTRAL SOURCE: Nearmap, March 2015

G:\4. Projects\00046683_Environmental Advisory Role\3. Project Output\00046683_GIS\Hammond Park\5. Working Figures\Native Vegetation Clearing Permit to Lot 32 Barfield Road, Hammond Park Local Structure Plan.mxd

WSP GROUP | Level 5, 503 Murray Street, Perth, WA 6000

APPENDIX 2
Local Water Management Strategy

Lot 32 Barfield Road, Hammond Park

Local Water Management Strategy

Department of Treasury

28 June 2016
Revision: 03
Reference: 242591

Leading. Vibrant. Global.
www.aurecongroup.com

Document control record

Document prepared by:

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5
863 Hay Street
Perth WA 6000
Australia

T +61 8 6145 9300
F +61 8 6145 5020
E perth@aurecongroup.com
W aurecongroup.com

Document control						aurecon
Report title		Local Water Management Strategy				
Document ID			**Project number**		242591	
File path		P:\242591 - WA Schools PPP Technical Advisor\3.0 PROJECT DELIVERY\REPORTS\LSP_Drainage\242591_WA Schools PPP_LWMS.docx				
Client		Department of Treasury	**Client contact**			
Rev	**Date**	**Revision details/status**	**Prepared by**	**Author**	**Verifier**	**Approver**
0	31 March 2015	Draft	RLR	RLR		
01	1 May 2015	Issued for Approval	RLR	RLR	MC	BOS
02	10 September 2015	Amended with council comments	RLR	RLR	MC	MC
03	28 June 2016	Re-Issued for Approval	RLR	RLR	MC	MC
Current revision		**03**				

Approval			
Author signature		Approver signature	
Name	Rebecca Redshaw	Name	Mark Cavaney
Title	Civil Engineer	Title	Senior Water Engineer

Lot 32 Barfield Road, Hammond Park

Date 28 June 2016
Reference 242591
Revision 03

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5
863 Hay Street
Perth WA 6000
Australia

T +61 8 6145 9300
F +61 8 6145 5020
E perth@aurecongroup.com
W aurecongroup.com

Contents

Executive summary

The Department of Treasury have commissioned Aurecon on behalf the property owner, to prepare a Local Water Management Strategy for Lot 32 Barfield Road, Hammond Park. The site is situated between Hammond Park Catholic Primary School and Barfield Road, and approximately 0.4 kilometres west of Kwinana Freeway.

Lot 32 will be subdivided, with a portion to the west being incorporated into a larger school lot. An eastern portion will be retained as residential, with the existing house being maintained. A road will be constructed on both the eastern and western sides of the school lot. The existing residential property fronts Barfield Road.

Lot 32 is landlocked and will need to cater for all storm water events with an Average Recurrence Interval (ARI) up to 1 in 100 year flows, on site. Surrounding lots cater for their own drainage.

The following approach will be employed:

- Residential lot will retain the 1 in 20 year ARI storm on site
- The school site will retain a 1 in 100 year ARI storm on site
- The road reserve will retain the balance of the 1 in 100 year ARI storm water from the road reserve and residential lot

1 Introduction

1.1 Background

Better Urban Water Management details that a strategy for managing all forms of water should be developed and integrated into subdivision design. Lot 32 is proposed for development of Hammond Park Senior School.

The Department of Treasury have commissioned Aurecon, to undertake a Local Water Management Strategy (LWMS) for Lot 32 on Barfield Road, Cockburn, Western Australia. This LWMS will be applicable to Lot 32 only and will form part of a Local Structure Plan compiled by RPS.

Lot 32 is rectangular and 4.04 hectares in size. The site is approximately 24 kilometres south of Perth and 0.4 kilometres east of Kwinana Freeway. Residential properties edge the north, east and south boundaries of the property with a Catholic Primary School adjacent a portion of the west boundary.

The property is currently in a predominantly natural state with minor access tracks and an existing residential dwelling in the south eastern corner. The potable water supply is to connect into the proposed Water Corporation infrastructure within Irvine Parade. Water Corporation infrastructure has recently been installed in Irvine Parade for waste water disposal.

Figure 1 – Lot 32 Extents

The proposed concept for Lot 32 consists of a school site of 2.72 hectares bounded by a road on each of the eastern and western sides. The remainder of the lot will be retained as a single lot and accommodate the existing dwelling. The school lot will be amalgamated with adjacent lots to form Hammond Park Secondary School.

2 Predevelopment site characteristics

2.1 Geotechnical characteristics

2.1.1 Site characteristics

Topography is typically gently sloping with localised low points throughout and a more prominent sag located at the north eastern corner adjacent to the road reserve. Irvine Parade falls naturally south, with Road 2 falling north. The site is surrounded by various lots which are currently in various stages of development.

The predevelopment site is a rural residential block with the western portion predominantly bushland and the eastern portion containing a home. Post development the existing home is to be retained and the lot is proposed to contain playing courts and an oval as part of a school development.

2.1.2 Soil Permeability

The GHD report "Report for Department of Treasury - Strategic Projects - WA Schools PPP - Site Investigations, 61/31027" suggests that a "design permeability of 1x10-5 m/s is recommended for the near surface sands, taking clogging effects into account."

2.1.3 Acid Sulphate Soils

Based on the data taken from the Department of Water (DoW) Perth Groundwater Atlas, there is a "moderate to low risk" classification that Acid Sulphate Soils (ASS) are present at the site.

2.1.4 Geology

The GHD report for "Gold Estates Holdings Pty Ltd - Hammond Park - Barfield Road, 61/27869" states that while no geotechnical investigations have been carried out onsite, a review of the Regional Geology Map indicates that the site is predominantly underlain by well drained Bassendean sand.

This is consistent with the LWMS prepared for Lot 31 by Emerge Associates. The Lot 31 report, suggests that the site is underlain by Bassendean sands as well as going further to suggest that the dominant phases include:

- Bassendean B1 Phase – Extremely low to very low relief dunes, undulating sandplain and discrete sad rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m: Banksia dominant.
- Bassendean B2 Phase – Flat to very gentle undulating well drained sandplain of the surface. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2m.

It is very likely that these dominant geology phases continue through to Lot 32.

2.1.5 Ground Water

Data taken from the DoW "Online Water Register" indicates that groundwater beneath the site is a multi-layered system comprised of the following:

- Perth – Superficial (unconfined) aquifer.
- Perth – Leederville (confined) aquifer.
- Perth – Yarragadee north (confined) aquifer.

The Perth Groundwater Atlas indicated that the minimum groundwater levels beneath the site range between 19.5m to 20.5m AHD. Historical groundwater maximum levels are between 21.5m and 22.5m AHD.

Control Ground Water Levels have been identified in the City of Cockburn's Russell Road Arterial Drainage Scheme; Drawing Number 02006_C3_A, from their online Engineering Guideline resources. This Drawing suggests the "Control Groundwater Levels" are 21.0 to 22.5m AHD and these are consistent with the Historical groundwater maximum levels obtained as above.

3 Water management objectives

3.1 Local and State Government Guidelines and Legislation

Various Local and State Government guidelines and legislation prescribe water management objectives and criteria to be accounted for within the vicinity of the site.

3.1.1 Better Urban Water Management

Better Urban Water Management (WAPC 2008) was prepared to provide guidance on the implementation of the *State Planning Policy 2.9*. It was developed to "*facilitate better management and use of our urban water resources by ensuring an appropriate level of consideration is given to the total water cycle at each stage of the planning system*." The document provides guidance on the actions/investigations required at each planning stage and identifies the agencies responsible for these actions.

3.1.2 State Planning Policy 2.9 – Water Resources

State Planning Policy 2.9: Water Resources (Government of WA 2006) is a state planning policy made under Section 26 of the *Planning and Development Act 2005* (WA). The objectives of this policy are to:

- Protect, conserve and enhance water resources that are identified as having significant economic, social, cultural and/or environmental values
- Assist in ensuring the availability of suitable water resources to maintain essential requirements for human and all other biological life with attention to maintaining or improving the quality and quantity of water resources
- Promote and assist in the management and sustainable use of water resources

3.1.3 Land Development Specifications

Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality (City of Cockburn, 2010) is a City of Cockburn specific document which serves as a basic guideline for sub divisional and related development requirements. Chapter 1 - Stormwater Drainage is particularly relevant to this report. Criteria provided in the specifications are as follows:

- 1 year recurrence / 1 hour duration environmental flows to be treated
- 10 year recurrence to be retained for commercial / industrial area minor drainage
- The major system is to be designed so that the floor levels of all habitable buildings are a minimum of 300mm above the 100-year ARI storm flood level.
- Finished lot levels are to be a minimum of 1.2m above the pre-developed AAMGL.
- Drainage detention basins are to be placed at the lowest point of the catchment and are to be designed to take the total catchment runoff from a critical storm event.

- Infiltration rates shall be determined by site testing and due consideration shall be given to the AAGML for the area. Test results and considerations are to be submitted with the design.
- The stormwater drainage system is to be designed in accordance with the manual "Australian Rainfall and Runoff, 1987".

3.1.4 Liveable Neighbourhoods

Livable Neighborhoods (Western Australian Planning Commission 2009) is an operational policy for the design and assessment of structure plans and subdivisions for new urban (predominantly residential) areas in metropolitan and country centers. Primary objectives of the Livable Neighborhoods document which relate to this Urban Water Management Plan are as follows:

- Promote increased integration of urban water management elements into the urban form.
- Public open space credits for retention of environmental features and adoption of water-sensitive urban design principles.
- "Deemed to comply" street cross-section standards are applicable across all local governments in the state.

3.2 Water Quantity Objectives

The site is landlocked and will need to cater for all ARI events up to 1 in 100 year flows on site. Surrounding lots cater for their own drainage as per previous developments.

The following approach will be employed:

- Residential lots will maintain the 1 in 20 year ARI storm on site
- The school site will maintain a 1 in 100 year ARI storm on the school site
- The 1 in 100 year ARI storm will be catered for in the road reserve, due to unavailability of a POS

The IFD chart sourced from the Bureau of Meteorology (2013) has been used to determine the volume of stormwater runoff.

Infiltration from storage basins has been assessed to occur at 0.864m/day from the available geotechnical information. Further investigations will be undertaken to refine the site infiltration during detailed design.

3.3 Water Quality Objectives

No environmental sensitive water ecosystem are identified on site, nor do flows go to downstream ecosystems.

Infiltration for the 1 year 1 hour storm will be encouraged by developing the provision of soakwells in the road reserve. Gross pollutant traps are required at the last pit before open drainage basins and underground storage as directed in the *City of Cockburn Guidelines and Standards for the Design, Construction and Handover of Subdivision within the Municipality (2010).*

4 Strategies

Lot 32 is proposed to cater for all drainage within the development boundaries.

4.1 Catchments

4.1.1 Eastern Road Catchment

The eastern road catchment is 0.208ha, and is adjacent the existing low point of the site. The 10 year ARI will be captured in drainage pits at an interval reducing the gutter flow below 1.5m, with the remainder being stored under the road. The 10 year ARI catchment is shown in the following figure. The 0.877ha residential portion of Lot 32 will store the 20 year ARI on the residential site.

The balance of the 1 in 100 year ARI storm will be stored within the road carriage way and underneath the road. This system will also cater for 1 in 1year environmental flows.

Figure 2 – 10year Road and 1 in 20yr Residential Lot ARI Catchments

4.1.2 Western Road Catchment

The Lot 32 portion of the Irvine Parade catchment is 0.248ha and has a higher elevation than the road directly to the south. The 10 year ARI will be captured in drainage pits at an interval reducing the gutter flow below 1.5m. The spacing for pits in this location varies dependent on the carriageway and grade of the road. For the western carriageway the spacing is approximately 40m. For the eastern carriageway, where the catchments also take the parking into consideration, the spacing is decreased to approximately 30m. The pit spacing's will be refined during detailed design.

The sag point of the Irvine Parade occurs to the south in Lot 31 as shown in Figure 3.

4.1.3 Barfield Road Catchment

The Barfield Road catchment is 0.121 ha. The 10 year ARI will be captured in drainage pits or a drainage swale, reducing the gutter flow below 1.5m. The 100 year ARI will flow towards a low point in the Eastern Road. Where possible the stormwater will be infiltrated at source.

4.1.4 Remainder of Lot 32 Catchment

The remainder of Lot 32 is 0.877 ha. The existing home will be retained on the remaining portion of Lot 32, with the 1 in 20 year ARI storm to be stored on site. The 1 in 100year ARI flows, in excess of the 1 in 20 year ARI volume, will be stored within the road reserve.

4.1.5 School Catchment

It is a contractual design requirement that the 2.72 ha school catchment retains all storms up to a 1 in 100 year ARI storm on the school site. The school stormwater drainage system must have capacity to carry the 1 in 100 year ARI storm.

4.2 Stormwater Detention

Underground detention will be provided underneath the road verge and carparking, using a detention product approved by the City of Cockburn, refer Figure 3. As all flows will be contained on site this will cater for the 1 in 1 year ARI environmental flows by default. Storage system will be fit for purpose and suitable to be trafficked.

An underground detention system in the Eastern Road will be required to store a total of 1411 m^3 based on:

- Eastern Road 467 m^3
- Barfield Road 82 m^3
- Remainder Lot 32 862 m^3 (in excess of 5 min 1:20 year)

All of this can be stored in the Eastern Road. We would recommend for Barfield Road a drainage swale be provided to store approximately 131m^3 in capacity. This implies on the Eastern Road we propose to store 1282 m^3. Additional storage is available for events in excess of the 1 in 100 year ARI flows.

Underground detention in the western road will be approximately 485m^3 to cater for the 1 in 100 year ARI flows for the western road.

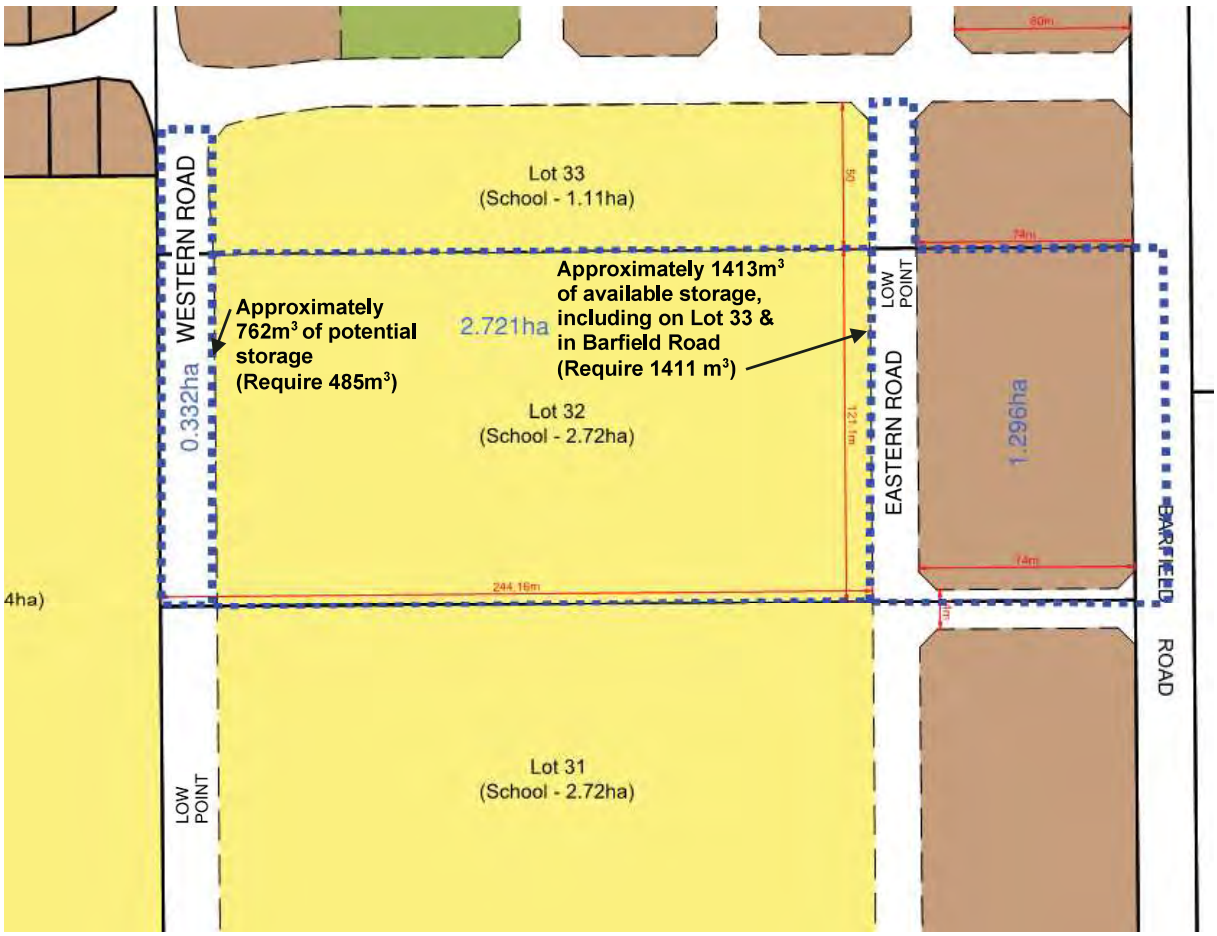


Figure 3 – 1 in 100 year ARI Catchments

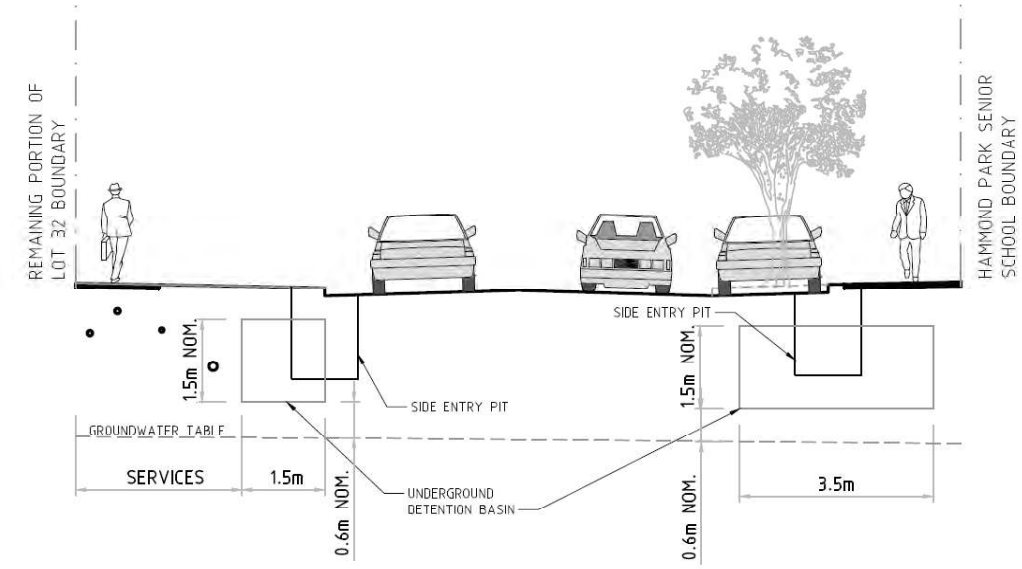


Figure 4 - Eastern Road Cross Section indicating space for underground detention basins (length of road 171.1m)

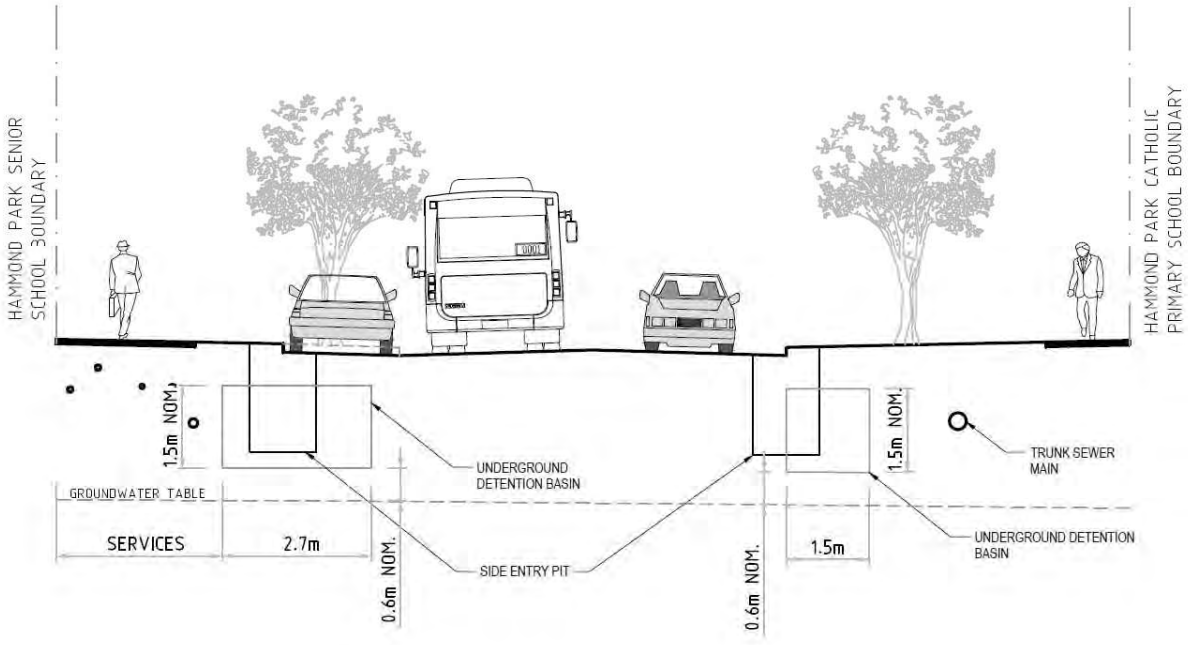


Figure 5 - Western Road Cross Section indicating space for underground detention basins (length of road 121.1m)

4.3 Drainage Design

It is proposed to keep kerb flow widths below 1.5m for the 1 in 10 year ARI storm by capturing stormwater by means of Side Entry Pits (SEP's). Pits are to be as per the City of Cockburn standard drawings 2423B03-08 Drainage SEP Soakwell & STD Linear Junction Pit. The 1 in 10 Year ARI flows are calculated using a 6 minute storm duration and utilising the IFD Design Rainfall Depth Charts from the Bureau of Meteorology as shown in Appendix D.

The 1 in 100 year ARI volumes have been calculated using the areas provided in Figure 3 above, and a 72 hour design storm from the IFD Deign Rainfall Depth for the Bureau of Meteorology as shown in Appendix D.

Soakwells with high level overflow pipes will convey the storm water into the underground detention.The Western Road has approximately 762m^3 of volume to locate storage. The Eastern Road has approximately 1413m^3 of volume to locate storage. This volume takes into consideration underground storage and a 0.6m deep swale drain on Barfield Road. The volume does not account for any above ground storage in the roadway of the Eastern Road.

Runoff co-efficients are as per Table 1.

Table 1 Runoff Coefficient

Catchment	Runoff Coefficient
Eastern Road	0.9
Western Road	0.9
Barfield Road	0.8
Remainder Lot 32	0.65

Estimates of storage volumes required are shown in Table 2 below, including allowance for infiltration.

Table 2 Catchment Volume Summary Table

Catchment	5 minute 20 year ARI Volumes*	72 hour, 100 year ARI Volumes*
Eastern Road	N/A	467m^3
Western Road	N/A	485m^3
Barfield Road	N/A	82m^3
Remainder Lot 32 (residential)	100m^3	962m^3 (require 862 m^3 when 20 year subtract)
School	To be contained on site	To be contained on site

Note: Volumes have been calculated based on the noted storm event using PC Sump Temporal model and include infiltration of 1m/day with a clogging factor of 0.15m/day (refer Appendix G).

The above volumes can be stored within the road reserve as per Figure 4 and 5. Detailed calculations for sizing storage will be completed in detailed design to the approval of the City of Cockburn when site infiltration rates are confirmed.

5 Groundwater Management

Ground water is assumed to be at approximately 1.5 to 2.0m below the existing surface as shown in Russell Road Buffer Lake Catchment – Drainage Design Criteria Control Ground Water Levels document. As the groundwater depth is greater than 1.2 subsoil drains are not proposed. Minor filling for the oval will be completed where required, to ensure a minimum depth of 1.5m.

5.1 Recharge

Soakwells are recommended to infiltrate stormwater where possible. The proposed soakwells will provide filtration to the 1 year, 1 hour storm prior to discharge into the groundwater. Soakwell bases are to be 0.6m above assumed groundwater levels.

5.2 Dewatering

Dewatering is not expected to be required due to the assumed depth of the ground water table and nature of the proposed structures.

Appendix A
Local Water Management Strategy Checklist

Appendix 2 Local water management strategy checklist

Local water management strategy item	Deliverable	☑	Notes
Executive summary			
Summary of the development design strategy, outlining how the design objectives are proposed to be met	Table 1: Design elements and requirements for best management practices and critical control points	☑	Refer Executive Summary
Introduction			
Total water-cycle management – principles and objectives Planning background Previous studies		☑	Refer Section 1
Proposed development			
Structure plan, zoning and land use Key landscape features Previous land use	Site context plan Structure plan	☑ ☑	Refer Figure 2
Landscape – proposed public open space areas, public open space credits, water source, bore(s), lake details, irrigation areas (if applicable)	Landscape plan	☑	N/A - Underground detention, School Oval
Design criteria			
Agreed design objectives and source of objectives		☑	Section 3.2
Pre-development environment			
Existing information and more detailed assessments (monitoring). How do the site characteristics affect the design?		☑	Section 2
Site conditions – existing topography/contours, aerial photo underlay, major physical features	Site condition plan	☑	Section 2
Geotechnical – topography, soils including acid sulfate soils and infiltration capacity, test pit locations	Geotechnical plan	☑	Section 2
Environmental – areas of significant flora and fauna, wetlands and buffers, waterways and buffers, contaminated sites	Environmental plan plus supporting data where appropriate	☑	None Identified
Surface water – topography, 100-year floodways and flood fringe areas, water quality of flows entering and leaving (if applicable)	Surface-water plan	☑	Section 2
Groundwater – topography, pre-development groundwater levels and water quality, test bore locations	Groundwater plan plus site investigations	☑	Section 2

Local water management strategy item	Deliverable	☑	Notes
Water sustainability initiatives			
Water efficiency measures – private and public open spaces including method of enforcement		☑	N/A
Water supply (fit-for-purpose) strategy, agreed actions and implementation		☒	Noted in local structure plan - Water Corporation has provided advise that sufficient capacity exists. Possibility of connecting to the north, south or west, dependent on surrounding development progress
Wastewater management		☒	
Stormwater management strategy			
Flood protection – peak flow rates, volumes and top water levels at control points, 100-year flowpaths and100-year detention storage areas	100-year-event plan Long section of critical points	☑ ☒	Section 4
Manage serviceability – storage and retention required for the critical 5-year ARI storm events Minor roads should be passable in the 5-year ARI event	5-year-event plan	☑	Section 4
Protect ecology – detention areas for the 1-year 1-hour ARI event, areas for water quality treatment and types of agreed structural and non-structural best management practices and treatment trains (including indicative locations). Protection of waterways, wetlands (and their buffers), remnant vegetation and ecological linkages	1-year-event plan Typical cross sections	☑ ☒	Section 4 Contained in detention, no overflow to downstream ecosystems
Groundwater management strategy			
Post-development groundwater levels, existing and likely final surface levels, outlet controls, and subsoil drain areas/exclusion zones	Groundwater/subsoil plan	☑	Section 5 No Groundwater subsoils proposed
Actions to address acid sulfate soils or contamination		☑	N/A
The next stage – subdivision and urban water management plans			
Content and coverage of future urban water management plans to be completed at subdivision. Include areas where further investigations are required before detailed design.		☑	Detailed design, storage method selection, Surrounding lots cater for own drainage
Monitoring			
Recommended future monitoring plan including timing, frequency, locations and parameters, together with arrangements for ongoing actions		☑	None proposed
Implementation			
Developer commitments		☑	N/A
Roles, responsibilities, funding for		☑	Section 1 - Department of Treasury

Local water management strategy item	Deliverable	☑	Notes
implementation			
Review			N/A

Appendix B
WA Schools PPP – Hammond Park, Site Investigations Report

Department of Treasury - Strategic Projects

WA Schools PPP – Hammond Park

Site Investigation Report

December 2014

Standard Disclaimer

This report has been prepared by GHD for Department of Treasury - Strategic Projects and may only be used and relied on by Department of Treasury - Strategic Projects for the purpose agreed between GHD and the Department of Treasury - Strategic Projects as set out in and as defined in the this report, letters of appointment and letters of aggregate liability dated 25 August 2014.

GHD otherwise disclaims responsibility to any person other than Department of Treasury - Strategic Projects arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible and as defined in the letters of appointment and letters of aggregate liability dated 25 August 2014.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury - Strategic Projects and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the EOI, RFP, Development Application or other documents beyond this report and has had no contribution to, or review of these documents. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of these other documents.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit, Department of Treasury - Strategic Projects may incur as a direct or indirect result of the PPP Schools Site Investigations Library, for any reason being inaccurate, incomplete or incapable of being processed on Department of Treasury - Strategic Projects's equipment or systems or failing to achieve any particular purpose. To the extent permitted by law, GHD excludes any warranty, condition, undertaking or term, whether express or implied, statutory or otherwise, as to the condition, quality, performance, merchantability or fitness for purpose of the PPP Schools Site Investigations Library.

GHD does not guarantee that the PPP Schools Site Investigations Library is free of computer viruses or other conditions that may damage or interfere with data, hardware or software with which it might be used. Department of Treasury - Strategic Projects absolves GHD from any consequence of Department of Treasury - Strategic Projects's or other person's use of or reliance on, PPP Schools Site Investigations Library.

Table of contents

Appendices

1. Introduction

1.1 General

The high school site is located off Barfield Road in the suburb of Hammond Park. The site extends across five lots (Lots 14, 31, 32, 33 and 47) along Barfield Road and measures approximately 10.2 Ha in plan area.

The site surface appears generally flat, with a typical elevation of 24 m AHD. A small sand dune in the south-east corner of the site rises from the flat area to an elevation of about 29 m AHD.

The majority of the site consists of undeveloped native bushland. Sandy access tracks are typically aligned with property boundaries with smaller tracks present within the lots. Some access tracks on the southern side of the site have a bituminous gravel layer at the surface.

Rubbish and refuse materials including general waste, household waste, old 44-gallon drums, fibreglass, gas cylinders, construction materials and scrap metals have been disposed of in localised piles across the site. A waste disposal site with concrete paving, a bituminous gravel hardstand and sand stockpiles is located in the south-east corner of the proposed development area.

1.2 Scope of Investigation

GHD was initially engaged to provide a desktop study for the proposed Hammond Park school, which can be found in Appendix C. The additional detailed site investigation reports listed below were subsequently prepared to further examine issues identified in the desktop study:

- Flora, Fauna and Vegetation Assessment
- Preliminary Stormwater Planning Report
- Preliminary Transport Assessment
- Servicing Report
- Site Contamination, Acid Sulfate Soil and Groundwater Assessment
- Geotechnical Investigation

Please note that the following summaries are to be read in conjunction with the full reports included in the Appendices.

2. Flora, Fauna and Vegetation Assessment

2.1 Conclusions

2.1.1 Flora and vegetation

The assessment identified the following key vegetation and flora constraints:

- Three vegetation types were identified within the Study Area. It is likely that VT1 (7.49 ha and additional 0.87 ha inferred) and VT2 (0.94 ha) align with Priority 3 PEC*: Banksia dominated woodlands of the Swan Coastal Plain IBRA region*. This PEC was added to the PEC list by DPaW after the completion of this field survey.
- A likelihood of occurrence assessment determined that three conservation significant species are likely to or may possibly occur within the Study Area:
  - *Caladenia huegelii*: State Threatened, Federal Endangered;
  - *Eremaea asterocarpa* subsp. *brachyclada*, State Priority 1
  - *Jacksonia gracillima*, State Priority 3

  Whilst targeted searching for *Caladenia huegelii* and other conservation significant species was not undertaken during the field survey, the survey timing was considered optimal and the Study Area was well traversed. No conservation significant flora species were recorded during the survey.
- One individual of **Asparagus asparagoides* (Bridal Creeper), which is listed as a Declared Pest under the BAM Act and as a WoNS was identified within the Study Area during the field survey.

2.1.2 Fauna

The assessment identified the following key fauna constraints:

- Habitat for two species of threatened Black Cockatoo including
  - A total of 9.3 ha of Black Cockatoo foraging habitat within the Study Area.
  - Potential breeding habitat (13 trees) within the Study Area, which is within proximity of the known breeding range of the Carnaby's Black Cockatoo and the modelled distribution of the Forest Red-tailed Black Cockatoo.
- During the survey, one conservation significant fauna species was recorded, Carnaby's Black Cockatoo. Two individuals were observed flying over the Study Area.
- A likelihood of occurrence assessment determined that 10 conservation significant species are known, likely to or may possibly occur within the Study Area:

2.1.3 Environmental Approvals

Based on the potential impact of the Project on Black Cockatoos, clearing for the Project may trigger referral to DotE due to the presence of potential breeding habitat and 9.3 ha of quality foraging habitat.

It is not anticipated that this Project will require referral to the EPA.

It is not anticipated that this Project will require permits under the WC Act.

The assessment against the Ten Clearing Principles determined that the Project is:

- Likely to be at variance with Clearing Principle (b) and Principle (f)
- May be at variance with Principle (a)

Any removal of native vegetation within the Study area will most likely require a clearing permit from the DER.

2.2 Recommendations

It is recommended that the Department of Treasury initiate consultation with DotE and refer the Project to DotE if development of the Study Area requires clearing of Black Cockatoo feeding habitat and/or potential breeding habitat.

Significant impacts associated with the Project are likely to be largely restricted to the construction phase, and should be mitigated through design as much as possible. It is recommended that DoE develop a Construction Environmental Management Plan (CEMP) to manage the potential construction impacts including a general fauna clearance program by qualified fauna relocation personnel.

3. Preliminary Stormwater Planning Report

3.1 Stormwater strategy

The principles behind the stormwater strategy aim to maintain the existing hydrology by retaining surface flows and to infiltrate the stormwater runoff as close to source as possible. Table 1 summarises the various strategies proposed to achieve the desired objectives consistent with the Barfield Road DWMS (Cardno, 2013).

Table 1 Summary of surface water management strategy

Principle	Strategy
Retain the 100 year ARI rainfall event onsite	Soakwells for each building sized to hold 1 year 1 hour ARI runoff from buildings
	Roadside swales to retain portion of runoff from road and parking reserves
	Bio-retention areas within green-space sized to hold residual 1 year 1 hour ARI event runoff from impervious areas.
	Infiltration basins within downstream POS sized to hold up to the 100 year ARI event runoff
Provide stormwater flowpath for runoff from the 100 year ARI event	Earthworks designed such that finished surface levels graded to allow surface runoff to flow towards retention areas within POS in a 100 year ARI event
Finished floor levels of building must have a minimum of 300 mm clearance above the 100 year ARI flood level in	Detailed earthworks design will detail finished surface levels with sufficient clearance from modelled 100 year ARI flood levels.

the onsite detention areas	
Infiltration areas designed to avoid creating mosquito habitat	Infiltration basins will be designed to ensure a maximum inundation time of 72 hours. Due to the high infiltration rate this will likely be considerably less.
Base of infiltration basins must be at least 500 mm above MGL.	Detailed earthworks plan will specify inverts of infiltration basins with a minimum clearance to MGL of 0.5 m.
Retain the 1 year 1 hour duration ARI rainfall event at or close to source.	Soakwells for building runoff, swale network for road and parking reserves and bio-retention pits for other impervious areas will be sized to retain the 1 year 1 hour ARI rainfall event.
The surface area of bio-retention areas is to be at least 2% of the connected impervious area.	Detailed landscape design will ensure provision of at least 2% of connected impervious area is allocated to bio-retention areas. Based on current master plans of the site this represents an area of 0.1 ha.
Apply appropriate structural and non-structural measures to reduce nutrient loads.	Minimise use of fertilisers within POS and road verges.
	Maintenance of POS and drainage areas

3.1.1 Storage requirement

Based on a site area of 10.6 ha of which approximately 4 ha will consist of impervious area, a storage volume of 2315 m^3 is required to retain and infiltrate the 100 year ARI event on site.

The basin size may be reduced depending on the volume of bio-retention area storage provided within the school site, as well as the size of soak wells provided for retention of roof runoff.

Based on the assumption that 2% of impervious area or 0.1 ha of land will be allocated to bio-retention, a depth of 0.5 m creates an additional 500 m^3 of storage upslope of the basin.

3.2 Groundwater management strategy

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology and to ensure sufficient separation between maximum groundwater level and proposed infrastructure. This can be achieved by:

- Treating stormwater runoff before infiltration to groundwater
- Using water sensitive design approaches to recharge the superficial aquifer
- Maintaining or improving groundwater quality onsite.
- Provision of engineering fill in areas where maximum groundwater is close to the natural surface

Earthworks plans should ensure sufficient separation between MGL and finished surface levels. In cases where groundwater is close to the surface, additional fill should be utilised to achieve the desired separation.

Preliminary site investigations and desktop research has revealed groundwater varies between 1 m to 3 m BGL being situated around RL+22 mAHD. Depending on the natural ground surface level, groundwater could potentially be intersected during construction, depending on the proposed design levels and timing of the works.

3.3 Future Work - Urban Water Management Plan

The local authority may request preparation of a more detailed water management plan, such as an Urban Water Management Plan (UWMP), prior to construction activities. If this is required, it should follow the guidance provided in Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions (DoW 2008).

While strategies have been provided within this stormwater plan for water management within the site, it is a logical progression that future designs and the supportive UWMP will clarify details not provided within this document.

The main areas that may need to be addressed within a UWMP include:

- Modelling of the drainage network
- Infiltration basin area configurations
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Structural and non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management plan
- Monitoring and evaluation program

4. Preliminary Transport Assessment

Following a review of the transport requirements for the Hammond Park High School, the following summary and recommendations are provided:

Anticipated trip generation:

- The total trips on the north-south road adjacent to the west side of the school are likely to be in the order of 4,000vpd.
- The total trips on the east-west road adjacent to the south side of the school are likely to be in the order of 1500vpd (assuming 50% of High School traffic access from this road).
- The total trips on the north-south road to the east of the school are likely to be in the order of 1000vpd.
- The planned road reservations will be able to accommodate the trips generated by the school.

Access arrangements:

- Access into the school from the southern Access Street should operate one way east bound with parking on the school side rather than opposite the school as shown, to reduce crossing activity.

Pedestrian access:

- Shared paths 2.5m wide should be provided on each side of the north-south road to the west of the High School with connectivity into the school.
- The future provision of a guard controlled crossing on the north-south road to the west of the school should be considered.

- A 2.5m shared path should be provided on the southern Access Street and preferably on the eastern Access Street adjacent to the School.

Bicycle parking:

- As discussed in Section 2.2 the DoE advise the recommended bike parking provision in the Secondary School Planning Guide (SSPG) is 1 bike rack for every 15 -20 students (73-97 racks).
- Staff will be provided 1 rack or bay for every 25 to 35 staff (3% - 5%).

Public transport accessibility:

- A bus embayment should be included in close proximity to the schools on the north-south road to the west of the High School for each direction.

Parking

- It is recommended that a designated parking onsite area is provided for senior students on site, this should be based on known demand elsewhere in similar established sites. Other public bays could be managed by time restrictions ie 4 hours maximum to maintain their availability for drop off/pick up use.
- The DoE formula for secondary school car parking provision is 1 bay for every 10 students (i.e. 145 bays on site) and street embayments of 7 bays per 100 students (i.e. 102 bays some may have to be located onsite). Therefore the total requirement is 247 car parking bays.

Further planning:

- It is recommended that a Green Travel Plan is developed for the school to minimise excessive car trips and promote other modes of travel.
- The City of Cockburn have advised that planning for the school will need to consider the timing of individual subdivisions in that area and any impact that might have on access to or/from the site.

5. Site Servicing Report

This section documents the associated financial risks to the development of the Hammond Park Primary School.

5.1 Roads and drainage infrastructure

All road infrastructures surrounding the proposed site will most likely be constructed by developers by the time the lot for the school is created. However, the western road will be dependent on the conditions for subdivision approval for lots 31 to 33 and whether this road needs to be constructed as part of the subdivision approval as there are no lots fronting it.

Risk Rating: Medium

5.2 Sewer

The gravity sewer will most likely be constructed by the developers south of the school site prior to the development of the school.

Risk Rating: Low

5.3 Water

The water reticulation main will most likely be extended by the developer south of the school prior to development of the school.

Risk Rating: Low

5.4 Power

Power can be provided to the school site off existing aerial lines in Barfield Road and a supply is therefore not entirely dependant on development in the area. It is assumed that the existing WPC network has sufficient capacity to supply the school site.

Risk Rating: Low

5.5 Gas

Gas will most likely be extended to supply the development south of the school, site prior to development of the school.

Risk Rating: Low

5.6 Telecommunications

The developer south of the school will most likely install NBN compliant infrastructure prior to the school development. If this does not happen, a connection off existing infrastructure in Barfield Road would be a possibility.

Risk Rating: Low

5.7 Multiple landowners

The school site is located in an area of multiple land ownership. If development of the school proceeds ahead of the adjacent developments, the required land for the school and surrounding road reserves will need to be acquired before any work on the infrastructure can proceed.

If the residential development proceeds ahead of the school, the developers will, be required to give up the land required for the school plus the road reserves as part of their subdivision approval conditions.

Risk Rating: Medium

6. Site Contamination, Acid Sulfate Soil and Groundwater Assessment

6.1 Conclusions

An assessment of potential for soil and groundwater contamination and ASS was completed by GHD at the proposed Hammond Park High School site in September and October 2014. In general accordance with applicable DER guidelines, the assessment included a desktop investigation of historical and current land uses and site condition, along with intrusive soil and groundwater investigation. A total of nine (9) locations were investigated for potential soil contamination and ASS, via soil bores. Four (4) groundwater wells were installed and monitored.

The findings of the assessment included:

- The site has a history of agricultural uses, with a potential for contamination associated with agricultural chemical use;
- The ASS regional risk mapping indicates the soil is at moderate to low risk of acid sulphate soils occurring within 3 m of the ground surface;
- Based on pH screening and quantitative ASS analysis of soil and groundwater conducted it is considered that an ASS Management Plan will likely be required for the site if soil below the groundwater table is to be disturbed or dewatering is required. A review of the available information will be required once construction information such as site layout and final design levels is available to identify depth and volume of any soil disturbance; and
- The assessment of potential contamination at the 9 locations included in this investigation did not indicate the presence of contamination due to heavy metals or pesticide above applicable guidelines or at levels considered to pose a significant risk to human health.
- Shallow groundwater quality was variable, with one well (MB04) showing signs of acidification with low pH, high salinity and high dissolved iron and aluminium (above irrigation guidelines). If shallow groundwater was to be used for irrigation purposes, it is likely water treatment would be required.

6.2 Recommendations

The following recommendations are made:

- If any dewatering or disturbance of in-situ soil is required for works associated with the proposed onsite development an Acid Sulphate Soil and Dewatering Management Plan will be required and may require treatment of dewatering effluent; and
- The groundwater results presented as part of this investigation are considered to be an initial groundwater geochemistry assessment at this time. It must be noted however that groundwater geochemistry within the wells sampled will likely change between the time this report is written and the commencement of construction. As such, it is recommended an additional groundwater sampling event be undertaken just prior to construction with both sets of results be considered baseline groundwater quality against which results collected during and post-construction should be assessed. The additional sampling event should include the wells that currently exist and any future wells determined necessary during the review of the construction programme.

7. Geotechnical Investigation Evaluation and Recommendations

7.1 General

The site extends across five lots (Lots 14, 31, 32, 33 and 47) along Barfield Road in Hammond Park and measures approximately 10.2 Ha in plan area. Subsurface conditions encountered comprise very loose to dense sand, with relative density generally and gradually increasing with depth.

Local areas of fill and waste including drums and gas canisters and assorted rubbish were observed across the site. Other areas of debris and waste may exist in other parts of the site.

The development is understood to comprise the construction of new single to double storey buildings, parking facilities, hard courts, public open spaces and playing fields. The proposed design grade is not known at the time of preparing this report. However, fill placement to raise the site level is considered likely, based on similar works undertaken across surrounding residential subdivisions.

Outlines of the structures proposed for the development are included in the full report.

7.2 Site preparation and earthworks

7.2.1 Site preparation

Site construction works should be preceded by appropriate preparation of the ground surface in areas of proposed development. Preparation should include the following as applicable:

- Identification of and diversion / protection of any buried services within the work areas;
- Initial clearing (including building debris, old structures, footings, slabs and refuse);
- Grubbing of any tree roots;
- Removal of topsoil, typically around 0.2 m thick, containing significant quantities of organic material (e.g. plant roots);
- Excavation and removal to spoil of any refuse, or localised softened zones identified by visual examination of the stripped ground surface; and
- Contouring and shaping of ground surface to ensure any surface runoff drains from the site.

7.2.2 Ground improvement

Ground improvement may be required within the building envelope(s) to increase bearing capacity of the subgrade/ reduce total settlement potential as loose sands locally persist up to depths of 5 m.

Various ground improvement methods and techniques are considered potentially applicable to this site. The following ground improvement techniques are considered suitable:

- Excavation followed by scarification and compaction of the base, then replacement in layers 300 mm thick (loose thickness) to achieve a minimum of 95% of modified maximum dry density (MMDD) or a density index of 75% (for sandy or granular soils);

- Impact rolling, with a variety of deep vibratory methods suitable the Contractor should aim to achieve a minimum of 95% of MMDD or a density index of 75% (for sandy or granular soils) throughout the improved soil profile; and
- Stone columns, installed using vibratory techniques, to improve the subsurface stiffness directly beneath each footing.

7.2.3 Earthworks

Earthworks should include the placement and compaction of additional fill (if required to achieve design site levels) in layers 300 mm thick or less (loose thickness) to achieve a minimum of 95% of modified maximum dry density (MMDD) or a density index of 75% (for sandy or granular soils).

Compliance with compaction requirements of fill or replaced loose sand should be made by field density testing in accordance with AS 3798. For each 0.75 m lift of fill (or less) the level of compaction should be verified by Perth Sand Penetrometer (PSP) probing, calibrated according to the requirements of AS 1289. A minimum blow-count of 8 blows per 300 mm, to 0.75 m depth, would be expected. All earthworks should be undertaken in accordance with current standards and to the specifications set by the designer.

7.3 Excavation

7.3.1 Excavation conditions

Excavation across the site is expected to be within loose to medium dense quartz sand. Excavation is therefore expected to be within the operating capacity of typical mechanical excavators. Bulk excavation could also be achieved using scrapers or bulldozers.

Shallow excavations (e.g. for utility trenches) across the school site are expected to be within loose to medium dense quartz sand, or fill. Excavation is therefore expected to be within the operating capacity of typical mechanical excavators.

7.3.2 Excavation stability

Based on the ground conditions intersected (i.e. predominantly loose to medium dense sand), it is expected that unretained temporary excavations above the groundwater level and less than 3 m in depth could be battered to a maximum slope of 1(V):2(H). Engineered support, such as shoring or trench-boxes, may be preferable for excavations in close proximity to existing features such as roads or buried services.

The maximum batter slope recommended is conditional upon dewatering being implemented when required, and the method chosen being verified as effective. Excavation during rainfall periods should be avoided, and appropriate procedures implemented to prevent possibly accumulation of rainfall runoff in the base of excavations. It is unlikely that the batters of any unsupported excavations opened during rainfall periods (or beneath the groundwater tablet) will require flattening or support of the slopes to maintain stability of the excavation.

No significant loads (dead or live loads) should be placed within a distance of the slope crest equivalent to the excavation depth. Steeper batter slopes may be adopted if it can be demonstrated to be appropriate by the Contractor. The Contractor should be required to verify the adequacy of each slope design on a case by case basis, and compliance to State OH&S regulations and Worksafe Australia's Excavation Code of Practice.

7.3.3 Suitability of excavated materials for re-use as fill

Sand excavated from across the site is considered generally suitable for re-use elsewhere on the site as general and structural fill. Material containing significant quantities of organic matter (i.e. topsoil) or other deleterious inclusions are not be considered appropriate for re-use as structural fill and should be removed off-site or stockpiled for future landscaping purposes.

7.4 Groundwater and dewatering

Groundwater was not encountered within 5 m of the current site levels, corresponding to an elevation of RL+19.3 mAHD. However, the historical maximum groundwater levels across the site are typically 2 to 3 m below ground level, at elevation RL+ 22mAHD. Therefore, dewatering may be required if construction work below these levels coincides with the wet season, or after prolonged periods of heavy rainfall.

7.5 Pavement subgrade conditions

Laboratory testing of bulk samples recovered near surface at CPT08 and CPT13 recorded soaked CBR values of 12% and 11% respectively.

Based on interpretation of laboratory testing, and the extensive library of published test results for Perth sands, a soaked CBR value of 12% is recommended for subgrades on this site, provided the subgrade is compacted to a minimum relative density of 96% MMDD.

7.6 Soil permeability / drainage

The site subsurface materials comprise free-draining granular soils. Accordingly, disposal of stormwater runoff by infiltration (e.g. soakwells or sumps) is considered feasible, provided the base of the infiltration infrastructure is above the design flood level.

A design permeability of $1x10^{-5}$ m/s is recommended for the near surface sands, taking clogging effects into account. Where stormwater runoff will infiltrate into fill, the design permeability may be different, dependent upon the material properties of the fill

7.7 Site classification and foundations

7.7.1 Site classification

A residential Site Class “A” would be considered appropriate provided that the buildings are designed with footing widths ranging between 0.7 m and 2.5 m to maintain an allowable maximum bearing pressure of at least 100kPa (refer to the full report) Foundations dimensions larger than this range may settle more than the acceptable building tolerances, which would classify the site as Class “P” (i.e. where excessive foundation settlement may occur under foundation loading) and therefore warrant ground improvement works.

7.7.2 Bearing capacity and settlement

Analysis of bearing capacity and settlement has been undertaken for the site. The results of the analysis are presented onin the full report as a plot of recommended maximum bearing pressure versus foundation width. Key assumptions underpinning the analysis are:

- Site preparation as described has been carried out;
- Settlement of 25 mm is acceptable;
- Horizontal loading and/or load eccentricity is not considered; and,
- The base of footings is at 0.5 m depth.

Where adjacent columns carry significantly different loads, foundation sizes should be selected to limit differential movement of the beams supported by the columns to less than 1:1000.

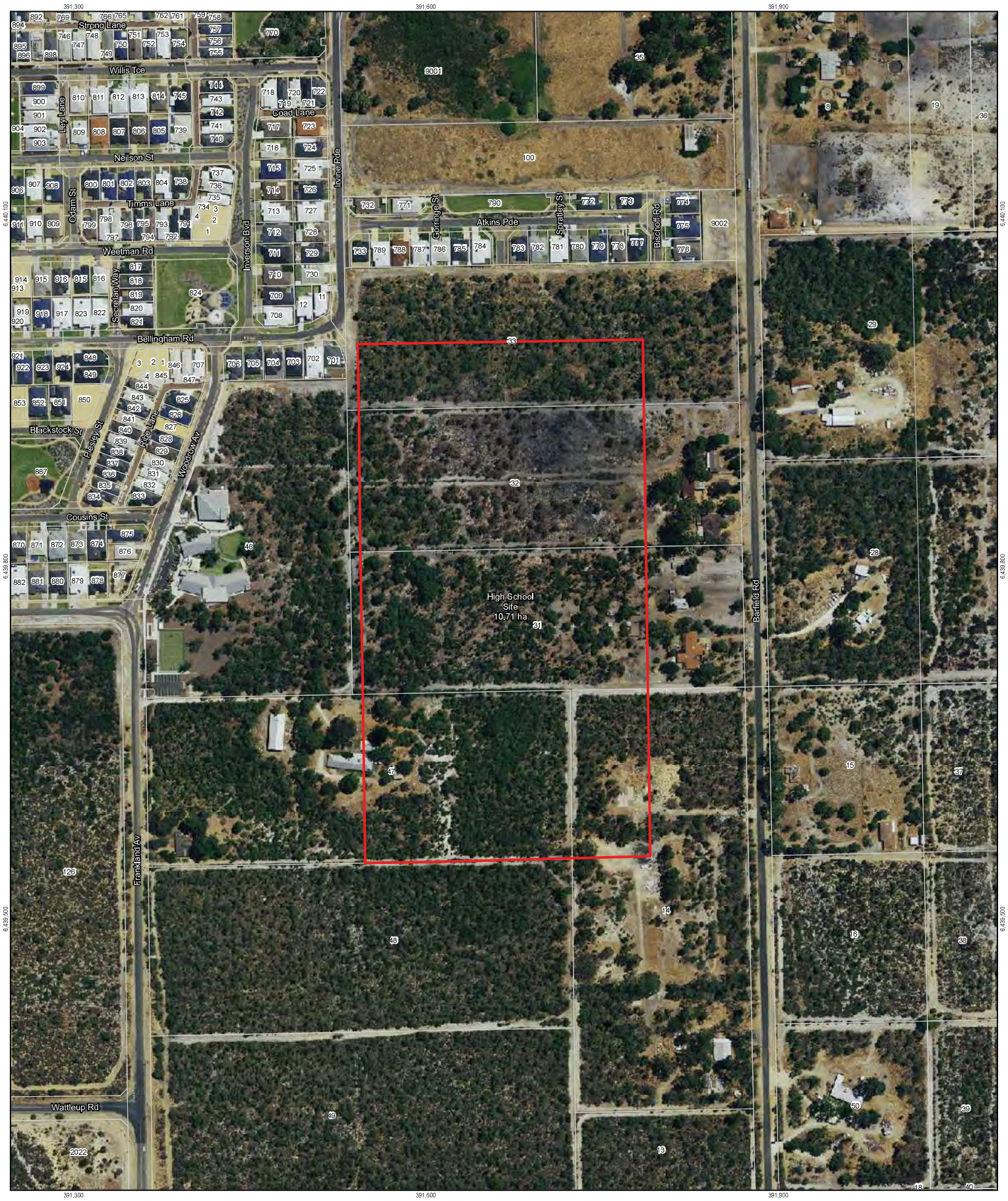
In all instances the base of footing excavations should be proof compacted using a plate compactor before footing construction takes place.

7.8 Fill and settlement

As the subgrade materials are granular, settlement due to fill placement is expected to be predominantly immediate, i.e. it will occur during construction. It will therefore pose a negligible risk to structures founded on the fill, provided that site preparation is completed in accordance with the recommendations made in the full report. Ongoing (time dependent) creep settlement is expected to be negligible.

Appendices

Appendix A – Locality map



LEGEND

- School Site
- Cadastre

Paper size : A3

0 15 30 60 90 120 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

SLIP ENABLER

Department of Finance
Schools PPP - Desktop Study

Hammond Park High School
Locality

Job Number	61-31027
Revision	0
Date	17 Sep 2014

Map 1

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G001_HammondParkHS_Rev0.mxd

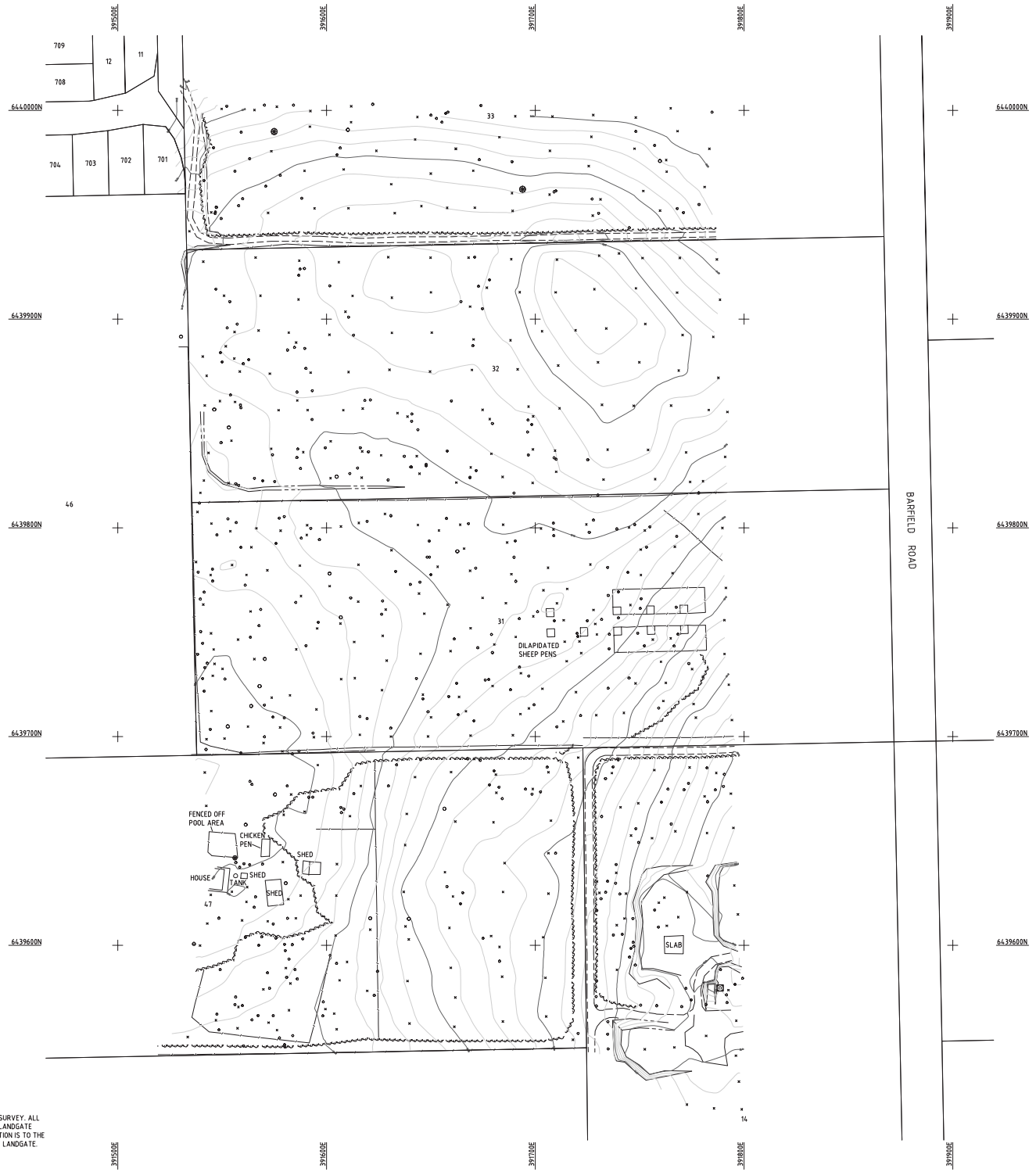
239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central 2014 Mosaic - 20140526, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jomonteignes

Appendix B – Survey

LEGEND OF FEATURES

- LARGE TREE
- MEDIUM TREE
- LIGHT POLE (ONLY)
- HOUSE POWER POLE
- WELL
- BORE MONITOR
- NATURAL SURFACE
- CADASTRAL BOUNDARY
- BUILDING
- ROOFLINE
- WALL
- TOP OF BANK
- BOTTOM OF BANK
- CHANGE OF GRADE
- EDGE OF CONCRETE
- EDGE OF BITUMEN
- FENCE LOW
- FENCE HIGH
- EDGE OF TRACK
- BUSHLINE



N

0 10 20 30 40 50m

SCALE 1:1000 AT ORIGINAL SIZE

NOTES:

1. CADASTRAL BOUNDARIES SHOWN ARE SUBJECT TO SURVEY. ALL CADASTRAL INFORMATION HAS BEEN PROVIDED BY LANDGATE AUGUST 2014. THE ACCURACY OF BOUNDARY DEFINITION IS TO THE ASSOCIATED ACCURACY STATEMENTS PROVIDED BY LANDGATE.
2. CONTOUR INTERVAL = 0.25m
3. DATUM: AHD. GRID: MGA 94 ZONE 50

No.	Revision	Drawn	Checked	Approved	Date
0	ISSUED FOR INFORMATION	KSJ	NS	NS	18.08.14

Drawing Revisions

GHD CLIENTS | PEOPLE | PERFORMANCE

GHD House, 239 Adelaide Terrace, Perth WA 6004 Australia
T 61 8 6222 8222 F 61 8 6222 8555
E permail@ghd.com.au W www.ghd.com.au

GHD JOB No. 61-31027

Government of Western Australia
Department of Finance
Building Management and Works

HAMMOND PARK HIGH SCHOOL

FEATURE AND LEVEL SURVEY

DRAWN	KSJ	DESIGNED	REDUCTION
CHECKED	NS	PRINCIPAL	0 25mm
APPROVED	NS		
SCALE 1:1000		DATE 18.08.14	DRAWING No. HPHU02A8
DHW PROJ No: - GHD JOB No: - 61-31027		DHW FILE No: 61-31027R-V05_Rev0	

DO NOT SCALE OR AMEND DRAWING MANUALLY 61-31027-V05_REVO 18/08/2014

Appendix C – Flora, Fauna and Vegetation Assessment (October 2014)

Department of Treasury

Hammond Park High School

Flora Fauna and Vegetation Assessment

October 2014

Executive summary

The Department of Treasury is undertaking site inspections and feasibility studies at a number of potential school sites. GHD was commissioned to undertake the flora, vegetation and fauna assessment for the proposed Hammond Park High School (the Study Area; 10.22 ha).

This Report will be used to assist the Department of Treasury in assessing the impact of clearing native vegetation at the site, to seek and comply with the appropriate environmental approvals and to enable works to be undertaken in an environmentally sensitive manner. This report provides recommendations and/or actions that need to be undertaken to assist in the continuation of the approval process.

Federal Approvals

Clearing for the Project will trigger referral to Department of the Environment due to potential impacts to 9.3 ha of Black Cockatoo foraging habitat and some potential breeding habitat. It is recommended that the Department of Treasury initiate consultation with DotE and/or refer the Project to DotE if development of the Study Area requires significant clearing of Black Cockatoo feeding habitat and/or potential breeding habitat.

State Approvals

It is not anticipated that this Project will require referral to the Environmental Protection Agency.

It is not anticipated that this Project will require permits under the WC Act for removal of Threatened flora.

An assessment against the Ten Clearing Principles, which inform impacts for a Native Vegetation Clearing Permit, determined that the Project is:

- Likely to be at variance with Clearing Principle (b) and Principle (f)
- May be at variance with Principle (a).

Any removal of native vegetation within the Study area will require a clearing permit from the Department of Environment Regulation.

Recommendations

It is recommended that the Department of Treasury considers a layout of the school that minimises impacts to Black Cockatoo foraging and potential breeding habitat.

Clearing of the Study Area will trigger referral to the Department of the Environment as clearing will result in the removal of approximately 9.3 ha of Black Cockatoo foraging habitat and potential breeding habitat (13 trees) identified within the Study Area. It is recommended the project be discussed with Department of the Environment before a final decision to refer is made. If the foraging habitat and potential breeding trees are not cleared then referral under the EPBC act will not be required.

Significant impacts associated with the Project are likely to be largely restricted to the construction phase, and should be mitigated through design as much as possible. It is recommended that DoE develop a Construction Environmental Management Plan (CEMP) to manage the potential construction impacts including a general fauna clearance program by qualified fauna relocation personnel.

Table 1 Summary of Environmental Issues and Recommendations

Aspect	Description	Issue	Recommendation	Indicative time to secure approvals and additional technical studies/next step
Presence of Cockatoo habitat	Approximately 9.3 ha of Black Cockatoo foraging habitat is present within the Study Area. Potential breeding habitat occurs within the Study Area (13 trees).	Clearing of vegetation that comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia at variance with Principle (b) and trigger referral of the project under the EPBC Act.	The design of the school should minimise clearing of the Black Cockatoo foraging habitat and retain the 13 potential breeding trees where possible.	If foraging habitat and potential breeding habitat cannot be avoided, timeline will depend on Department of Treasury's consultation with the Federal Department of the Environment.
Clearing of native vegetation	A Clearing Permit from Department of Environmental Regulation is required. Clearing of the Study Area is likely to be at variance with Clearing Principle (b) and Principle (f), and may be at variance with Principle (a).	Clearing of the Study Area is likely to be at variance with some of the Clearing Principles.	Department of Treasury should make an application for an 'Area Permit' through Department of Environment Regulation.	Dependent on the outcome of the assessment of the Native Vegetation Clearing Permit application and any offset conditions.
Potential construction impacts	Construction may cause adverse environmental impacts.		The Department of Treasury should develop a Construction Environmental Management Plan (CEMP) to manage potential environmental impacts during construction phase. It should include a general fauna clearance program by qualified relocation personnel.	

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Project background

As part of the Department of Treasury's strategic planning, site inspections and feasibility studies are being undertaken at a number of potential school sites. Flora, vegetation and fauna surveys are required to assess these sites for any potential environmental constraints prior to development progressing.

The proposed Hammond Park High School site is 10.22 hectares (ha) in size and would require clearing prior to commencement of any infrastructure works. As such, the Department of Treasury has commissioned GHD Pty Ltd (GHD) to conduct a flora, vegetation and fauna assessment for the proposed Hammond Park High School (the Study Area).

1.2 Purpose of this report

The purpose of the survey is to assess the environmental sensitivity of the Study Area and define all flora and fauna values associated with the site, in particular their spatial location and conservation significance. The report will document the potential impacts on flora and fauna from the proposed works, detail any potential environmental constraints and provide management recommendations to address these potential impacts.

This report will be used to assist the Department of Treasury in assessing the proposed impact of the clearing of native vegetation at the site to enable works to be undertaken in an environmentally sensitive manner.

1.3 Study Area

The Study Area is located in Hammond Park, approximately 26 kilometres (km) south of Perth, Western Australia. The Study Area occurs within an area bounded by Irvine Parade and Bellingham Road on the north-east, Atkins Parade to the north, Barfield Road to the east, Rowley Road to the south and Hammond Park Catholic Primary School to the west. The Study Area is 10.22 ha in area and is shown in Figure 1, Appendix A.

1.4 Scope of works

The general scope of the Project is to conduct a flora, vegetation and fauna assessment within the Study Area.

The scope of works as per the Project brief and GHD proposal was to:

- Undertake a desktop assessment
- Undertake a Level 1 vegetation and flora survey to provide:
  - Description and mapping of vegetation units and vegetation condition
  - Location and counts of any conservation significant flora (Threatened and Priority Flora) and Declared taxa
  - Inventory of vascular flora taxa (including weed species)
  - Preliminary identification and mapping of any Threatened or Priority Ecological Communities (TEC and/or PEC)
- Undertake a Level 1 fauna survey to provide:
  - Description and mapping of fauna habitat
  - Inventory of terrestrial fauna taxa

- Detail the presence or likelihood of occurrence of conservation significant fauna occurring within the Study Area
- Review of the presence of pest, declared or feral animals
- A Black Cockatoo habitat assessment

- Prepare a flora and fauna report including the results of the desktop assessment and field surveys

1.5 Relevant legislation, conservation codes and background information

In Western Australia, significant communities, flora and fauna are protected under both Australian Government and State legislation. In addition regulatory bodies also provide a range of guidance and information on expected standards and protocols for environmental surveys.

An overview of key legislation, conservation codes and background information relevant to this Project is provided in Appendix B.

1.6 Limitations

This report: has been prepared by GHD for Department of Treasury - Strategic Projects and *may only be used and relied on by Department of Treasury - Strategic Projects for the purpose agreed between GHD and the Department of Treasury - Strategic Projects as set out in and as defined in the this report, letters of appointment and letters of aggregate liability dated 25 August 2014.*

GHD otherwise disclaims responsibility to any person other than Department of Treasury - Strategic Projects arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible and as defined in the letters of appointment and letters of aggregate liability dated 25 August 2014.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury - Strategic Projects and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the EOI, RFP, Development Application or other documents beyond this report and has had no contribution to, or review of these documents. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of these other documents.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit, Department of Treasury - Strategic Projects may incur as a direct or indirect result of the PPP Schools Site Investigations Library, for any reason being inaccurate, incomplete or incapable of being processed on Department of Treasury - Strategic Projects's equipment or systems or failing to achieve any particular purpose. To the extent permitted by law, GHD excludes any warranty, condition, undertaking or term, whether express or implied, statutory or otherwise, as to the condition, quality, performance, merchantability or fitness for purpose of the PPP Schools Site Investigations Library.

GHD does not guarantee that the PPP Schools Site Investigations Library is free of computer viruses or other conditions that may damage or interfere with data, hardware or software with which it might be used. Department of Treasury - Strategic Projects absolves GHD from any consequence of Department of Treasury - Strategic Projects's or other person's use of or reliance on, PPP Schools Site Investigations Library.

1.7 Assumptions

This report has assessed the flora, vegetation and fauna associated with the Study Area (Figure 1, Appendix A). Should the Study Area change, further assessment would be required.

2. Methodology

2.1 Desktop assessment

A desktop review was conducted prior to the commencement of field surveys. This included:

- A review of the Department of the Environment (DotE) Protected Matters database to identify species and communities listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) potentially occurring within a 5 km buffer of the Study Area (DotE, 2013a)
- A review of the Department of Parks and Wildlife (DPaW) Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) databases to determine the potential for TECs or PECs to be present within a 5 km buffer of the Study Area
- A review of DPaW's Threatened and Priority Flora database (TPFL) and Western Australian Herbarium database (WAHERB) for Threatened and Priority flora species listed under *Wildlife Conservation Act 1950* (WC Act) and listed by DPaW, previously recorded within a 5 km buffer the Study Area.
- A review of the DPaW NatureMap database for flora and fauna species previously recorded within a 5 km buffer of the Study Area (DPaW, 2007–)
- A review of the DPaW database of known records of Black Cockatoo roosting and nesting sites on the Swan Coastal Plain
- A review of existing datasets including: previous vegetation mapping of the Study Area (Beard, 1979; Heddle et al. 1980), aerial photography, geology/soils and hydrology information to provide background information on the variability of the environment
- Review of previous flora and fauna assessments undertaken in the general area

2.2 Field survey

2.2.1 Flora and vegetation

GHD undertook a Level 1 flora and vegetation assessment of the Study Area on 11th October 2013. The survey was undertaken in accordance with the Environmental Protection Authority (EPA) Guidance Statement No. 51 (EPA, 2004a) and EPA Position Statement No. 3 (EPA, 2002). The survey was undertaken to provide identify and describe the dominant vegetation units present, assess vegetation condition and record vascular flora species present at the time of the survey. Additionally, opportunistic searching for conservation significant or other significant ecological communities and flora taxa were undertaken.

Field assessment methodology for the Level 1 survey involved sampling using a minimum of two 10 m x 10 m quadrats located in representative vegetation units. Field data at each quadrat was recorded on a pro-forma data sheet and included the parameters detailed in Table 2. The survey also included meandering transects of the Study Area on foot to record plant species present (visible) at the time of the survey.

Table 2 Data collected during the field survey

Aspect	Measurement
Physical features	Aspect, soil attributes. Percentage surface cover by: rocks, logs and branches, leaf litter, bare ground.
Location of important features	Coordinates recorded in GDA94 datum using a hand-held Global Positioning System (GPS) tool to accuracy approximately ± 5 m.

Aspect	Measurement
Vegetation condition	Vegetation condition was assessed using the condition rating scale devised by Keighery (1994).
Disturbance	Level and nature of disturbances (e.g. weed presence, fire and time since last fire, impacts from grazing, exploration activities).
Flora	List of dominant flora from each structural layer.

Vegetation units

Vegetation units were described based on structure, dominant taxa and cover characteristics as defined by field observations and quadrat data. The unit descriptions follow Keighery's (1994) vegetation structural classification, adapted from Muir (1977) and Aplin (1979). Vegetation units were identified and boundaries delineated using a combination of aerial photography interpretation, topographical features, previous mapping (Beard, 1979; Heddle et al., 1980) and field observations.

Vegetation units were also qualitatively compared against Floristic Community Types (FCT) identified by Gibson et al. (1994) as present on the Swan Coastal Plain. The Gibson et al. (1994) "analysis of plant communities on the Swan Coastal Plain … is the most recent regional floristic work on public lands, … [and considers] the patterning of plant distribution on the Plain and relates to the total flora of the Plain" (Government of Western Australia, 2000). FCT are based on the results of multivariate analysis conducted on 1,122 quadrats. Comparison of vegetation identified at the Study Area against FCT identified by Gibson et al. (1994) can assist in determining the presence of TEC or PEC, although clarification with DPaW is recommended for certainty. In addition, FCT cannot be definitively determined when the remaining vegetation has been too disturbed to sample adequately or not enough information about the vegetation can be obtained (Government of Western Australia, 2000).

Species identification and nomenclature

Species that were well known to the survey botanists were identified in the field, while species that were unknown were collected and assigned a unique collection number to facilitate tracking. Plant species were identified by the use of local and regional flora keys and by comparison with the named species held at the Western Australian Herbarium (WA Herbarium). When necessary, plant taxonomists considered to be authorities on particular plant groups were consulted.

The conservation status of all recorded flora was compared against the current lists available on *FloraBase* (WA Herbarium, 1998–) and the EPBC Act Threatened species database provided by DotE (2013c).

Nomenclature used in the report follows that used by the WA Herbarium as reported on FloraBase (WA Herbarium, 1998–).

Vegetation condition

The vegetation condition of the Study Area was assessed using the vegetation condition rating scale developed by Keighery (1994) that recognises the intactness of vegetation, which is defined by the following:

- Completeness of structural levels
- Extent of weed invasion
- Historical disturbance from tracks and other clearing or dumping
- The potential for natural or assisted regeneration

The scale consists of six rating levels as outlined in Table 3.

Table 3 Vegetation condition rating scale

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

2.2.2 Fauna

The fauna assessment was consistent with a Level 1 assessment (reconnaissance survey) in accordance with the EPA Guidance Statement No. 56 (EPA, 2004b). Nomenclature follows that used by the Western Australian Museum and the DPaW NatureMap database, as it is deemed to contain the most up-to-date species information for Western Australia, with the exception of birds, which uses Christidis and Boles (2008).

GHD ecologists conducted a reconnaissance fauna survey of the Study Area on foot on 11th October 2013. A fauna habitat assessment was undertaken which assessed:

- Habitat structure (e.g. vegetation type, presence/absence of overstorey, midstorey, understorey, ground cover)
- Presence/absence of refugia including: fallen timber (coarse woody debris), hollow-bearing trees and stags and rocks/boulder piles, and the type and extent of each refuge
- Presence/absence of waterways including type, extent and habitat quality within waterways
- Land use or disturbance history
- Location of habitat within the surrounding landscape and habitat connectivity
- Identification of wildlife corridors within and immediately adjacent Study Area
- Evaluation of the likelihood of occurrence of listed fauna occurring within the habitat (based on presence of suitable habitat)

Opportunistic fauna searches were also conducted across the Study Area. Opportunistic searches involved:

- Searching through microhabitats including turning over logs or rocks, turning over leaf litter and examining tree hollows and hollow logs
- Visual and aural surveys. This accounted for many bird species potentially utilising the Study Area
- Searching the Study Area for tracks, scats, bones, diggings and feeding areas for both native and feral fauna

A general assessment of the potential for Black Cockatoo habitat within the Study Area was also conducted. The Black Cockatoo assessment was undertaken with regard to the EPBC Act

Referral Guidelines for three threatened Black Cockatoo species: Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii* subsp. *naso*) (the Black Cockatoo Referral Guidelines) (DSEWPaC, 2012). Information collected during the field survey included:

- Identification of foraging habitat: the location and extent of suitable Black Cockatoo foraging habitat was identified and mapped for the Study Area, based on the vegetation associations and presence/absence of known foraging species. During the field surveys any direct or indirect evidence of foraging by cockatoos was recorded.
- Identification of potential breeding and roosting habitat: suitable breeding habitat for Black Cockatoos is defined by DSEWPaC (2012) as trees of species known to support breeding within the range* of the species which either have a suitable nest hollow or are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species, suitable DBH is 500 mm. For salmon gum and wandoo, suitable DBH is 300 mm (DSEWPaC, 2012). The location of all suitable breeding trees was recorded in the Study Area and the suitable breeding trees are referred to as 'Significant Trees'. Additionally, details of tree species, size and number of hollows observed, evidence of use and any other significant observations were recorded for each tree.
- Opportunistic observations (both visual and aural) for the presence of Black Cockatoos within the Study Area and surrounding region were also noted during the survey.

The above information was used to map and calculate the amount of foraging habitat, potential breeding habitat and roost sites within the Study Area.

*The Black Cockatoo Referral Guidelines (DSEWPaC, 2012) provide maps of the breeding areas and extent of occurrence for all three Cockatoo species, however consideration to the inaccuracy of the modelled distributions has been considered during this study. These considerations have included;;

- The maps presented in Black Cockatoo Referral Guidelines are modelled based on the best available information at the time of publication (2009). These maps are designed to provide an indicative location only and have been compiled from various sources. Species and ecology distributions are indicative only and are not to be used for localised assessment (DSEWPaC, 2012).
- Known breeding areas identified in the referral guidelines represent locations known to be used by the birds for breeding as December 2009. As habitat has been lost in traditional breeding areas the Cockatoos have begun breeding at new locations outside of the range indicated (DSEWPaC, 2012)..
- There are still a number of uncertainties in the understanding of Carnaby's Cockatoo ecology (Cockerill *et al* 2013).

2.3 Limitations

2.3.1 Desktop investigation limitations

Queries of the DotE Protected Matters database (using the Protected Matters Search Tool – PMST) are used to identify species listed under the EPBC Act and draw on various sources to report on the potential of the species occurrence within an area. The database is based on bioclimatic modelling for the potential presence of species. As such, this does not represent actual records of the species within the area. Additionally, it is broad-scale in its reporting and often the specific habitat requirements of the species do not occur, or are unlikely to occur, within a Study Area. For this reason not all species reported by the search tool need to be considered in management decisions. The DPaW NatureMap database reports on actual

records of the species within the designated area and can provide more accurate information of the likelihood of species presence. However, some records of collections, sightings or trappings can be dated and often misrepresent the current range of threatened species. Neither database can be considered exhaustive. Species of conservation significance may be found during surveys that are not listed in the databases.

2.3.2 Field survey limitations

The limitations surrounding the flora and fauna survey are provided in Table 4.

Table 4 Field survey limitations

Limitation	Constraint	Impact on survey outcomes
Sources of information and availability of contextual information	Nil	Adequate information is available for the Study Area, this includes: • Broad scale (1:250,000) mapping by Beard (1979) and Shepherd et al. (2002) • Broad scale (1:250,000) mapping by Heddle et al. (1980) • Regional biogeography (Mitchell et al 2002)
Scope (i.e. what life forms were sampled etc.)	Nil	Vascular flora and terrestrial vertebrate fauna taxa were sampled during the survey. Non-vascular flora taxa, invertebrate and aquatic fauna were not assessed as part of the survey.
Proportion of flora collected and identified (based on sampling, timing and intensity) Proportion of fauna identified, recorded and/or collected	Minor	The flora recorded from the field survey is detailed in Section 3.8.3 and a full flora species list provided in Appendix D. A total of 113 taxa representing 37 families and 87 genera were recorded during the survey. Due to the absence of adequate flowering parts and/or fruiting bodies required for identification, 13 taxa could be identified to genus only. The Level 1 survey was conducted mid-October 2013, which is within the optimal spring survey season. . It is considered that many of the taxa identifiable at the time of the survey would have been observed. The fauna assessment conducted was a reconnaissance (Level 1) survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats, diggings etc. Many cryptic and nocturnal species would not have been identified during a reconnaissance survey and seasonal variation within species often requires targeted surveys at a particular time of the year. The fauna assessment was aimed at identifying habitat types and terrestrial vertebrate fauna using the Study Area. No sampling for invertebrates or aquatic species occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.
Flora determination	Nil	Flora determination was undertaken by GHD ecologists in the field. The taxonomy and conservation status of the Western Australian flora is dynamic. This report was prepared with reliance on taxonomy and conservation current at the time issuing, but it should be noted this may change.
Completeness and further work which might be needed (e.g. was the relevant area fully surveyed?)	Minor	Lot 14 was not accessible at the time of the field survey, lot 14 is 0.87 ha or 8% of the total Study Area. The remainder of the Study Area was fully surveyed during the Level 1 flora, vegetation and fauna assessment.
Mapping reliability	Nil	The vegetation of the Study Area was mapped at a scale of 1:2,500, using aerial photography captured in 2013 (Landgate: Metro Central 2013 Mosaic – 20130821). As the majority of the Study Area had not been burnt for over five years, fire is not considered to have an impact upon the vegetation type or condition identified during the survey.

Limitation	Constraint	Impact on survey outcomes
Timing, weather, season	Minor	The field survey was conducted during spring, on 11th October 2013. In the period June–August, 2013, the Medina Bureau of Meteorology weather station (No. 9194) (located approximately 6.9 km from the Study Area) recorded 312 millimetres (mm) of rainfall (BoM, 2013). This is 23.4% percent lower than the long term average (407.4 mm) for the same period (BoM, 2013). There was no rainfall recorded during the survey. Climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to the aforementioned factors. Flora composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two). Therefore, the results of future botanical surveys in this location may differ from the results of this survey. Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present.
Disturbances (fire, flood, accidental human intervention etc)	Nil	As the Study Area is within the Perth metropolitan region, humans and domestic animals (especially dogs and cats) are a frequent occurrence. It is not considered that these disturbances impacted the survey.
Intensity (in retrospect, was the intensity adequate?)	Nil	The Study Area was sufficiently covered by GHD ecologists for Level 1 surveys with a total of 5 quadrats within the Study Area.
Resources	Nil	Adequate resources were employed during the survey. Two people days were spent conducting the flora and fauna survey.
Access problems	Minor	Lot 14 was not accessible during the survey, lot 14 is 0.87 ha or 8% of the total Study Area.
Experience levels	Nil	The ecologists who executed the survey were practitioners suitably qualified in their respective fields.

3. Results and discussion

3.1 Climate

The Study Area experiences a Mediterranean climate, with mild, wet winters and hot, dry summers. The closest Bureau of Meteorology (BoM) weather station to the Study Area is located approximately 6.9 km from the Study Area at the Medina weather station (station number 9194). A summary of the climatic data (BoM, 2013) for this weather station (1994–2013) is below:

- Mean maximum temperature: 18.3 °C (July) to 31.5 °C (February)
- Mean minimum temperature: 8.0 °C (July) to 17.6 °C (February)
- Mean annual rainfall: 763.9 mm
- Mean number of days of rain ≥ 1 mm: 90.1

3.2 Bioregion

The Study Area is located within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion, Perth Sub-Region (SWA02). This sub-region is dominated by woodlands of *Banksia* and Tuart (*Eucalyptus gomphocephala*) on sandy soils, sheoak on outwash plains, and paperbark in swampy areas. The colluvial and aeolian sand areas represent three phases of Quaternary marine sand dune development (which provide relief), and include a complex series of seasonal fresh water wetlands, alluvial river flats, coastal limestone and several off-shore islands. Younger sandy areas and limestone are dominated by heath and/or Tuart woodlands, while *Banksia* and Jarrah (*E. marginata*)–*Banksia* woodlands are found on the older dune systems (Mitchell et al., 2002).

3.3 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESAs) within the Study Area, however, there are four ESAs are within 2 km of the Study Area (Figure 2, Appendix A).

3.4 Conservation estates and reserves

There are no DPaW-managed estates or reserves within the Study Area, however, there are a number of reserves and conservation areas within the within the vicinity of the Study Area (Figure 2, Appendix A). These include:

- Harry Waring Marsupial Reserve (0.74 km west of the Study Area) – This is a Class A Reserve (R 29241) managed by DPaW and vested with the Conservation Commission of WA for the purpose of flora and fauna research and conservation.
- Thomsons Lake Nature Reserve (1.38 km north-west of the Study Area) – This is a Class A Reserve (R 15556) managed by DPaW and vested with the Conservation Commission of WA for the purpose of fauna conservation, research and drainage.
- Unamed Conservation Park (1.9 km north-west of the Study Area) – Adjacent to Harry Waring Marsupial Reserve, this Conservation Park (R 48291) is vested with the Conservation Commission of WA.

A search of the EPBC Protected Matters database identified a further two reserves occurring within 5 km of the Study Area:

- Wandi Nature Reserve (3.0 km south-east of the Study Area) – This is a Class C Reserve (R 36110) vested with the Conservation Commission of WA for the purpose of flora and fauna conservation, water and likely Aboriginal cultural values.
- Unamed Conservation Park (3.0 km north-west of the Study Area) – Adjacent to Thomsons Lake Nature Reserve, this Conservation Park (R 49561) is vested with the Conservation Commission of WA.

3.4.1 Bush Forever

Four Bush Forever sites occur within 2 km of the Study Area (Government of Western Australia, 2014), these include:

- Bush Forever Site No. 268 (1.75 km south-west of the Study Area) – Mandogalup Road Bushland
- Bush Forever Site No. 392 (0.74 km west of the Study Area) – Harry Waring Marsupial Reserve
- Bush Forever Site No. 391 (1.38 km north-west of the Study Area) – Thomsons Lake Nature Reserve and Adjacent Bushland
- Bush Forever Site No. 492 (1.3 km north-east of the Study Area) – Lyon Road Bushland

3.5 Geomorphology and soils

The Study Area lies on the Swan Coastal Plain, which consists of a series of distinct landforms including the Darling and Dandaragan Plateaus, Pinjarra Plain, and Bassendean, Spearwood and Quindalup Dune Systems that run sub-parallel to the present coastline. The Study Area occurs on the Bassendean Dune System, which is a gently undulating aeolian sand plain over sedimentary rock.

The sands of the Bassendean Dunes are described leached and infertile, they contain little silt or clay, and very low levels of nutrient elements, with any nutrient element content being associated with organic matter. Broad scale soil mapping by Tille (1996) indicates the following soil sub-units or phases of the Bassendean system occur within the Study Area:

- 212Bs_B1 – Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; banksia dominant.
- 212Bs_B2 – Flat to very gently undulating sandplain with well to moderately well-drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.

3.6 Hydrology

Groundwater in Western Australia is protected under the *Rights in Water and Irrigation Act 1914* (RIWI Act). A search of the DoW Geographic Data Atlas (DoW 2014) was undertaken for the Study Area. A summary of the Geographic Data Atlas queries for the Study Area is provided in Table 5.

Table 5 Department of Water Geographic Data Atlas queries (DoW 2014)

Aspect	Details	Results
RIWI Groundwater Areas	Groundwater areas proclaimed under the RIWI Act	None present
RIWI Surface Water Areas	Surface water areas proclaimed under the RIWI Act	None present

Aspect	Details	Results
RIWI Irrigation District	Irrigation Districts proclaimed under the RIWI Act	None present
RIWI Rivers	Rivers proclaimed under the RIWI Act	None present
Public Drinking Water Source Areas (PDWSA)	PDWSAs is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage Act 1909* (MWSSD) or the *Country Area Water Supply Act 1947* (CAWS).	None present
Waterway Management Areas	Areas proclaimed under the *Waterway Conservation Act 1976*.	None present

3.7 Wetlands

3.7.1 Ramsar wetlands

A search of the EPBC Protected Matters database identified two Wetlands of International Importance (Ramsar) within 5 km of the Study Area (Figure 2, Appendix A).

- Forrestdale and Thomsons lakes (within Ramsar site).
- Peel-Yalgorup system (upstream from Ramsar).

3.7.2 Lakes covered under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*

No Lakes covered under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) occur within the Study Area. Thirty six EPP Lakes occur within 5 km of the Study Area (Figure 2, Appendix A).

3.7.3 Geomorphic wetlands

No geomorphic wetlands occur within the Study Area. Twenty three geomorphic wetlands occur within approximately 2 km of the Study Area (Table 6 and Figure 2, Appendix A).

Table 6 Geomorphic wetlands occurring within approximately 2 km of the Study Area

UFI	Conservation Category	Classification	Name
1638	Resource Enhancement	Sumpland	Unknown
6529	Conservation	Lake	Thomson Lake
6530	Multiple Use	Dampland	Mandogalup Swamp North
6533	Resource Enhancement	Sumpland	Copulup Lake
6534	Conservation	Dampland	Unknown
6611	Conservation	Sumpland	Banganup Swamp
6665	Resource Enhancement	Dampland	Unknown

UFI	Conservation Category	Classification	Name
6719	Resource Enhancement	Sumpland	Mandogalup Swamp North
6724	Resource Enhancement	Sumpland	Mandogalup Swamp North
6725	Conservation	Sumpland	Mandogalup Swamp North
6726	Resource Enhancement	Sumpland	Mandogalup Swamp North
6886	Resource Enhancement	Dampland	Unknown
6888	Resource Enhancement	Dampland	Unknown
6889	Resource Enhancement	Dampland	Unknown
6893	Conservation	Sumpland	Unknown
14104	Conservation	Dampland	Unknown
14662	Multiple Use	Sumpland	Mandogalup Swamp North
15406	Multiple Use	Sumpland	Unknown
15408	Multiple Use	Sumpland	Unknown
15412	Conservation	Sumpland	Unknown
15520	Resource Enhancement	Dampland	Baler Court
15521	Multiple Use	Dampland	Baler Court
15886	Multiple Use	Dampland	Unknown

(Government of Western Australia, 2012)

3.8 Vegetation and flora

3.8.1 Broad vegetation associations and extent

Broad scale vegetation mapping of the Perth area was completed by Beard (1979) at an association level. Beard (1979) mapping indicates that one vegetation association is present within the Study Area (Government of Western Australia, 2012):

- Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina (association 1001, Bassendean)

Regional vegetation has been mapped by Heddle *et al.* (1980) based on major geomorphic units on the Swan Coastal Plain. Heddle *et al.* (1980) mapping indicates that one vegetation complex is present within the Study Area (Figure 2, Appendix A):

- Bassendean complex – Central and south: Vegetation ranges from woodland of *E. marginata* – *C. fraseriana* – *Banksia* spp. to low woodland of Melaleuca species, and sedgelands on the moister sites. This area includes the transition of *E. marginata* to *E. todtiana* in the vicinity of Perth.

The extent of remnant native vegetation has been assessed by Shepherd et al. (2002) and maintained by DPaW (latest update 2012 – Government of Western Australia, 2013), based on broad scale vegetation association mapping by Beard (1979). As shown in Table 7, the extent remaining of Beard (1979) vegetation association 1001 is less than 30 % at the State, IBRA Bioregion and IBRA Sub-region level, which is below the threshold level. The extent remaining at the Local Government Area (LGA) level is greater than 30 %. Although the extent remaining of vegetation association 1001 is below the threshold level at the State, IBRA bioregion and

IBRA sub-region level, the Study Area is located within an area of urban development on the Swan Coastal Plain. Therefore as there is greater than 10 percent of the vegetation association remaining, vegetation association 1001 is not considered to be a critical asset.

The Local Biodiversity Program (2013) and Perth Biodiversity Project (2010) have assessed the extent of Heddle et al. (1980) vegetation complexes against presumed pre-European extents for the Swan Coastal Plain and City of Cockburn. As shown in Table 8 and , the Bassendean complex – central and south is regarded as being below the threshold level on the Swan Coastal Plain, but above the threshold level in the City of Cockburn. At both levels the Bassendean complex – central and south, has greater than 10 % remaining and therefore is not considered to be a critical asset.

Table 7 Extent of Beard vegetation association within the Study Area

Vegetation association and description	Region	Pre-European extent (ha)	Current extent (ha)	Percentage remaining[1]	Current extent in all DPaW managed lands (%)
Vegetation association 1001: Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina	State	57,410.23	14,151.90	24.65	5.66
	IBRA bioregion Swan Coastal Plain	57,410.23	14,151.90	24.65	5.66
	IBRA sub-region Perth	57,410.23	14,151.90	24.65	5.66
	LGA City of Cockburn	7,328.40	2,474.19	33.76	12.14

(Beard, 1979; Government of Western Australia, 2013; Shepherd et al., 2002).

[1]When present at >10% of pre-European extents not considered a critical asset.

Table 8 Extent of Heddle *et al* vegetation complex within the Study Area on the Swan Coastal Plain

Vegetation complex description	Pre-European extent (ha)	2013 extent (ha)	% of pre-European extent	Total with informal protection (% of pre-European extent
Bassendean complex – Central and south. Vegetation ranges from woodland of *E. marginata* – *C. fraseriana* – *Banksia* spp. to low woodland of Melaleuca species, and sedgelands on the moister sites. This area includes the transition of *E. marginata* to *E. todtiana* in the vicinity of Perth.	87,392.73	24,206.24	27.70	8.56

(Heddle et al., 1980; Local Biodiversity Program, 2013)

3.8.2 Vegetation types

Three vegetation types were recorded within the Study Area (Table 9 and Figure 3, Appendix A); these types are described as:

- VT1: Low Open Forest of *Banksia* spp. and *Allocasuarina fraseriana*
- VT2: Low Woodland of *Banksia* spp. over Open Low Heath of *Scholtzia involucrata*
- VT3: Low Open Woodland of *Melaleuca rhaphiophylla*

VT1: Low Open Forest of *Banksia* spp. and *Allocasuarina fraseriana* was the most dominant vegetation type within the Study Area. As a result of previous disturbances there were differences in species diversity between quadrats within VT1. Species diversity in one area had been impacted by sheep grazing and as a result there was almost no understory remaining except for the most unpalatable species. While VT1 overstorey was dominated by a variety of *Banksia* spp. and *Allocasuarina fraseriana* there were scattered Jarrah and Marri trees present. Comparison with FCTs indicates VT1 shows strong similarities with SCP23a – Central *Banksia attenuata – B. menziesii* woodlands.

VT2: Low Woodland of *Banksia* spp. over Open Low Heath of *Scholtzia involucrata* was very similar in species composition to VT1, however, differed in having a more open *Banksia* overstorey, general reduction in species presence and having a midstorey dominated by *Scholtzia involucrata,* which was only very sparsely present within the remainder of the Study Area. VT2 covers a small area within the Study Area and while it shows differences with VT1, these differences may have been caused by small changes in soil properties or various anthropogenic factors. As such VT2 also shows similarities with SCP23a – Central *Banksia attenuata – B. menziesii* woodlands.

The third vegetation type present within the Study Area was a highly degraded Low Open Woodland of *Melaleuca rhaphiophylla.* Areas representing VT3 have been largely cleared and subsequently invaded by weed species which has altered nature of this vegetation,

As noted in section 2.3.2, access to Lot 14 was not available during the survey. Assessment of the vegetation type is limited to an inferred assessment based on visual assessment from the property boundaries while surveying Lots 31 and 47 and from assessment of aerial photography.

Table 9 Vegetation types within the Study Area

Vegetation type and description	Area of Study Area (ha)	Potential corresponding Gibson et al. (1994) Floristic Community Type	Photograph
VT1: Low Open Forest of *Banksia* spp. and *Allocasuarina fraseriana*. Low Open Forest of *Banksia attenuata, Banksia menziesii* and *Allocasuarina fraseriana* over Tall Shrubland of *Kunzea glabrescens* and *Xanthorrhoea preissii* over Shrubland of *Xanthorrhoea preissii* and *Eremaea pauciflora* var. *pauciflora* over Open Low Heath of *Hibbertia racemosa, Calytrix fraseri* and *Leucopogon polymorphus* over Sedgeland of *Lepidosperma pubisquameum* and *Schoenus curvifolius* over a Herbland of *Phlebocarya ciliata, Desmocladus flexuosus* and *Dasypogon bromeliifolius* and assorted herbs and weedy grass spp.	7.49 ha (additional 0.87 ha inferred)	SCP23a – Central *Banksia attenuata – B. menziesii* woodlands.	
VT2: Low Woodland of *Banksia* spp. over Open Low Heath of *Scholtzia involucrata*. Low Woodland of *Banksia menziesii* and *Banksia illicifolia* over Tall Open Shrubland of *Kunzea glabrescens* over Open Low Heath of *Scholtzia involucrata, Conostephium pendulum* and *Calytrix fraseri* over Open Herbland of *Dasypogon bromeliifolius, Phlebocarya ciliata* and *Desmocladus flexuosus*.	0.94 ha	SCP23a – Central *Banksia attenuata – B. menziesii* woodlands.	

Vegetation type and description	Area of Study Area (ha)	Potential corresponding Gibson et al. (1994) Floristic Community Type	Photograph
VT3: Low Open Woodland of *Melaleuca rhaphiophylla*. Low Open Woodland of *Melaleuca rhaphiophylla* over Tall Open Scrub of *Kunzea glabrescens* and *Astartea scoparia* over Open Low Heath of *Hypocalymma angustifolium* over Grassland of **Ehrharta calycina* and herbaceous weed species	0.92 ha	SCP4 – *Melaleuca preissiana* damplands.	

3.8.1 Vegetation condition

The Study Area consists of six residential/semi-rural properties, five of the properties have been developed and the sixth shows signs of use. As a result, the remnant vegetation in all six properties shows signs of disturbance. The vegetation condition of the Study Area ranged from *Excellent* (2) to *Degraded* (5) (Figure 4, Appendix A), with:

- 2.5 ha rated as *Excellent* (2)
- 2.17 ha rated as *Excellent* (2) – *Very Good* (3)
- 3.15 ha rated as *Good* (4)
- 2.14 ha rated as *Degraded* (5)
- 0.26 ha rated as *Completely Degraded* (6)

Condition within Lot 31 ranges from *Good* (4) to *Degraded* (5), only a small portion of the lot has been cleared for a shed and yards (Plate 1, A) while the remainder is remnant vegetation. Severe overgrazing has resulted in significant impacts to the mid and understorey species, with only the least palatable native species remaining. Current overgrazing has resulted in a ground level vegetation cover of 2-10 %, but it is likely that with cessation of grazing, weed species would dominate the understorey. Old farm infrastructure and some rubbish is scattered throughout the Lot (Plate 1, B).

The upper section of Lot 32 has been subject to partial clearing and has been badly affected by weed species such as **Ehrharta calycina* and **Eragrostis curvula* (Plate 1, C), with condition considered to range from *Good* (4) to *Degraded* (5). The remainder of the lot is in an *Excellent* (2) to *Very Good* (3) condition and shows very few signs of disturbance but does have a small amount of rubbish dumped on the property (Plate 1, D).

Within the Study Area a small section of Lot 47 has been partially cleared, with the understorey now dominated by weed species such as **Ehrharta calycina.* This partially cleared area is *Good* (4) in condition. The reminder of the lot is in *Excellent* (2) condition with few weeds present and minimal signs of previous disturbances.

Lot 33 is also in *Excellent* (2) condition. While there is some evidence of damage as a result of rubbish dumping and wood cutting (Plate 1, E and F), the portion of the property within the Study Area shows minimal signs of disturbance.

As noted in section 2.3.2, access to Lot 14 was not available during the survey. Assessment of the vegetation condition is limited to an inferred assessment based on visual assessment from the property boundaries while surveying Lots 31 and 47 and from assessment of aerial photography. As such condition in the vegetated areas is considered to range from *Excellent* (2) to *Very Good* (3) while the cleared areas are *Completely Degraded* (6).

Plate 1 Vegetation condition, Left to right A, B, C, D, E and F.

3.8.2 Threatened and Priority Ecological Communities

Desktop investigations identified three PECs within 5 km of the Study Area. These are:

- SCP21c – Low lying *Banksia attenuata* woodlands or shrublands (Priority 3), three occurrences
- SCP22 – *Banksia ilicifolia* woodlands (Priority 3), two occurrences
- SCP24 – Northern Spearwood shrublands and woodlands (Priority 3), one occurrence

The three vegetation types identified within the Study Area are considered unlikely to align with any of the PECs described above.

A new Priority 3 PEC was added to the PEC list by DPaW after the completion of this field survey:

- *Banksia dominated woodlands of the Swan Coastal Plain IBRA region.* The main feature of these Banksia woodlands is the presence of *Banksia attenuata* and/or *B. menziesii* occurring on deep sands.

It is likely that vegetation type 1 (VT1: Low Open Forest of *Banksia* spp. and *Allocasuarina fraseriana* – 7.49 ha) and vegetation type 2 (VT2: Low Woodland of *Banksia* spp. over Open Low Heath of *Scholtzia involucrate* – 0.94 ha) represent this PEC.

3.8.3 Flora diversity

The desktop assessment (DPaW, 2007–) identified 360 plant taxa (including subspecies and varieties), representing 70 families and 211 genera, previously been recorded within 5 km of the Study Area. This total comprised 285 native species and 75 introduced (exotic) species. Dominant families recorded within 5 km of the Study Area include:

- Myrtaceae: 41 taxa
- Fabaceae: 39 taxa
- Poaceae: 27 taxa

The GHD survey identified a total of 113 flora species from 37 families and 87 genera within the Study Area (Appendix D). This total included 94 native species and 19 introduced/planted species. Dominant families recorded during the survey of the Study Area were:

- Myrtaceae: 13 taxa
- Fabaceae: 11 taxa
- Poaceae: 11 taxa (9 weed species)
- Orchidaceae: 9 taxa

3.8.4 Conservation significant flora

Searches of the DPaW TPFL and WAHERB databases, EPBC Act PMST (DotE, 2013a) and DPaW NatureMap records (DPaW, 2007–) identified the presence/potential presence of 16 conservation significant flora species previously recorded within 5 km of the Study Area ((Figure 2, Appendix A and Appendix C). These included:

- Eight species listed under both the EPBC Act and WC Act
- One species listed under the EPBC Act and by DPaW
- Seven species listed by DPaW

No species listed under the EPBC Act or WC Act were recorded during the survey. In addition, no DPaW Priority species were identified during the survey.

Likelihood of occurrence assessment

A likelihood of occurrence assessment of conservation significant species (based on the range, habitat requirements and previous records of the species as well as taking into account the intensity of field survey and season) was undertaken for all conservation significant species identified in the desktop assessment (Appendix D). The likelihood of occurrence assessment determined three species may occur within the Study Area; this is summarised in Table 10.

Table 10 Summary of conservation significant flora species identified as likely to occur or possibly occurring within the Study Area

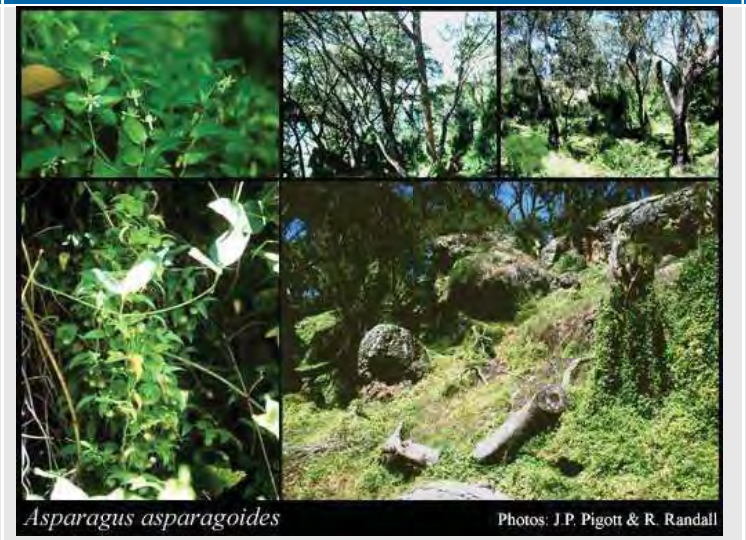
Family	Taxon	Status	
		State (WC Act/ DPaW listing)	Australian Government (EPBC Act listing)
Orchidaceae	*Caladenia huegelii*	T	E
Myrtaceae	*Eremaea asterocarpa subsp. brachyclada*	P1	
Fabaceae	*Jacksonia gracillima*	P3	

3.8.5 Introduced flora

A total of 19 introduced (exotic) species were recorded within the Study Area. This included one species, **Asparagus asparagoides* (Bridal Creeper), which is listed as a Declared Pest under Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and as a Weed of National Significance (WoNS) (Australian Weeds Committee, 2010).

Asparagus asparagoides is listed under C3 Management which means it is a Prohibited species for the whole of the State. One plant was identified within the Study Area and one plant was identified approximately 20 m to the east of the Study Area (Table 11 and Figure 4, Appendix D).

Table 11 Locations of Declared Pests and Weeds of National Significance

Species	Common name	Status	Description (WA Herbarium 1998–)	Indicative photograph (WA Herbarium 1998–)	Presence within the Study Area
**Asparagus asparagoides*	Bridal Creeper	Declared Pest C3 Management for the Whole of the State	Rhizomatous and tuberous, perennial, herb and climber, 1-5 m high. Fl. white, Aug to Sep. Sand, loam, clay, granite.		One plant was within the Study Area E 391780 N 6439911 One plant was approximately 20 m outside of the Study Area E 391799 N 6439920

3.9 Fauna

3.9.1 Fauna habitat

Two broad fauna habitat types have been identified in the Study Area based on the predominant landforms, soil and vegetation structure in the area. These habitat types closely correspond to the vegetation types outlined above:

- *Banksia* woodland
- *Melaleuca* dampland

Banksia woodland

The *Banksia* woodland habitat type is relatively intact and is dominated by *Banksia* species (*Banksia attenuata* and *Banksia menziesii*) and Sheoak (*Allocasuarina fraseriana*). The overstorey consists of scattered Jarrah trees and *Banksia* and *Allocasuarina* shrubs, tall *Kunzea* and *Xanthorrhoea* shrubs, and a relatively sparse understorey of low shrubs, sedges and herbs. This habitat type was generally in *Good* condition, however, in some areas there was evidence of disturbance from previous clearing, dumped rubbish and weed encroachment. In areas where there is less evidence of disturbance, the understorey vegetation is relatively dense, with leaf litter up to 5 cm.

This woodland habitat type would be expected to support a high diversity of bird species and would provide feeding and potential breeding habitat for the conservation significant Black Cockatoo species. The presence of Jarrah, *Banksia* sp. as well as other proteaceous species provides suitable foraging habitat for Black Cockatoo species (approximately 9.3 ha), and some of the larger Jarrah trees provide potential breeding habitat (Figure 5, Appendix E).

Across this woodland there are also areas of loose sands that are particularly suitable for burrowing reptiles such as the Priority 3 listed fossorial Black-striped Burrowing Snake (*Neelaps calonotos*) and the Priority 3 listed Perth Lined Skink (*Lerista lineata*). Where the understorey is densely vegetated, this would provide foraging opportunities and refuge areas for ground-dwelling mammals such as the Echidna and Southern Brown Bandicoot (Priority 5) and reptiles such as goannas and skinks. Micro-habitat features such as tree hollows and cavities also provide habitat for a number of birds, reptiles and small mammal species.

Melaleuca dampland

The *Melaleuca* dampland habitat type is highly degraded, with a large proportion that has previously been cleared and has been invaded by weeds species. This habitat consists of scattered *Melaleuca rhaphiophylla* and denser areas of *Kunzea glabrescens* and *Astartea scoparia*. The understorey is dominated by introduced weed species. This habitat type covers only a small portion of the Study Area (north-eastern corner, Figure 5, Appendix E) and provides foraging habitat for small birds and may potentially provide refuge areas for ground-dwelling mammals such as the Southern Brown Bandicoot (Priority 5) and reptiles such as snakes and skinks. Overall the value of this habitat type is limited due to its small size.

3.9.2 Fauna habitat connectivity

Habitat linkages are important to allow animals to move between areas of resource availability. They are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small,

species may still be able to move between these habitat areas, but may be more exposed to predation pressures in the cleared areas.

The area surrounding the Study Area has been highly fragmented with native vegetation remnants surrounded by a mosaic of other land uses, including roads, industry, parklands and urban development and infrastructure (Figure 1, Appendix A). Locally, the Study Area is connected to remnant vegetation occurring within a larger block, approximately 47 ha in size, of semi-rural residential properties. This block is bound by Barfield Road, Rowley Road, Frankland Avenue, Hammond Park Catholic Primary School and Atkins Parade. The Study area also has limited connectivity a Conservation category wetland (UFI 14104) located approximately 450 m north-west of the Study Area. These areas provide habitat corridors for fauna movement within the local area.

Regionally, the Study Area has some connectivity to larger areas of remnant vegetation, which would provide valuable corridors for movement of fauna (Figure 1, Appendix A). The Study Area has limited connectivity to the west to the DPaW managed Harry Waring Marsupial Reserve (Class A, R 29241), which is part of Bush Forever Site 392 (271.6 ha). This reserve is connected to adjacent bushland to the north (Site 391, across the road), south (Site 393), east and west, and forms part of a regionally significant contiguous bushland/wetland linkage (Government of Western Australia 2000). The Study Area also has some connectivity, albeit fragmented, to Bush Forever Site 268 (Mandogallup Road Bushland, 95.9 ha).

The remnant vegetation remaining within the Study Area and surrounds provide shelter, food resources and habitat corridors to allow movement of fauna between these sites, particularly to the larger areas of contiguous vegetation and associated wetlands. Evidence of fauna movement was recorded in Western Grey Kangaroos where droppings were recorded over both sites, but no animals were recorded. This suggests the species is persisting locally and moving through the area in search of food.

3.9.3 Fauna diversity

A NatureMap search (DPaW, 2007–) identified 194 fauna species as previously recorded within 5 km of the Study Area, of which 186 species are native and eight are pest (introduced) or naturalised species (Appendix E). These results consisted of 123 birds, 16 mammals, 31 reptiles, seven amphibians, and 17 invertebrate species.

During the field surveys, a total of 26 fauna species, consisting of 22 birds and four mammals were recorded within the Study Area. Of these, three were introduced (feral) mammal species. The list of fauna species recorded during the survey is provided in Appendix E.

3.9.4 Conservation significant fauna

Searches of the EPBC Act PMST (DotE, 2013a) and Western Australian Museum/DPaW NatureMap records (DPaW, 2007–) identified the presence or potential presence of 27 conservation significant species:

In addition to these, the desktop searches identified a number of marine and/or wetland bird species. These species have been excluded from this assessment as no marine or wetland habitat is present within the Study Area or will be impacted as a result of the proposed Project. The list of conservation significant fauna species identified in the desktop review is provided in Appendix E.

During the field survey, one conservation significant fauna species was recorded, the Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). Two birds were seen flying over the Study Area during the survey. Carnaby's Black Cockatoo habitat is discussed further below.

While only Carnaby's Black Cockatoo was observed during the field survey, there is also foraging habitat for the Forest Red-tailed Black Cockatoo within the Study Area. Baudin's Black Cockatoo is also known to occur on the southern Swan Coastal Plain, and may opportunistically use the habitat within the Study Area for foraging. Potential breeding habitat for Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo is also present, as the Study Area is located within the breeding range of both of these species (DSEWPaC 2012). This habitat includes 13 potential breeding trees and 9.3 ha of high quality *Banksia* woodland foraging habitat (Figure 5). Of the 13 trees identified as potential breeding trees one was just on the boundary of the Study Area and another was just out of the Study Area. It was decided to include these trees within the potential breeding tree tally for several reasons, GPS devices can be inaccurate (±5 m), branches from these trees may overhang into the Study Area and construction within the Study Area may damage these trees. Details of the significant habitat/potential breeding trees are provided in Appendix E and Black Cockatoo habitat types are detailed in Table 12.

Table 12 Black Cockatoo habitat recorded in the Study Area

Habitat type	Presence
Actual breeding	No breeding events were recorded for Black Cockatoos.
Potential breeding (trees with hollows currently suitable for breeding)	One dead stag currently able to support Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo breeding was recorded. This stag contained at least two hollows suitable for Black Cockatoo breeding.
Tree diameter at breast height (DBH) greater than 500 mm	13 trees were recorded with a DBH >500 mm and potentially may be used by Carnaby's and Forest Red-tailed Black Cockatoos for breeding in the future.
Foraging	9.3 ha of suitable Banksia woodland foraging habitat for Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo. May be opportunistically used by Baudin's Black Cockatoo.
Roosting	No roosting sites used by Black Cockatoos were recorded. The closest known roosting sites are approximately 5 kms north of the Study Area (Department of Planning Western Australia 2011)

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

The Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and Threatened (Schedule 1) under the WC Act. It is distributed across the south-west of Western Australia in uncleared or remnant areas of *Eucalyptus* woodland and shrubland of kwongan heath.

The Study Area provides suitable foraging habitat for the Carnaby's Black Cockatoo (as shown in Figure 5). The 9.3 ha *Banksia* woodland contains foraging habitat for the species, which provide suitable foraging species including Jarrah (*Eucalyptus marginata*), *Banksia attenuata*, *B. menziesii, B. grandis,* and *B. ilicifolia.* No evidence of Black Cockatoo foraging was recorded during the field survey.The Study Area is located in proximity to the known breeding range for the Carnaby's Black Cockatoo (DSEWPaC 2012) and as habitat has been lost in traditional breeding areas all three species of Cockatoos have begun breeding at new locations outside of the area previously considered to be the breeding range (DSEWPaC, 2012).

The species nests in hollows in live or dead trees of Jarrah, Marri (*Corymbia calophylla*), Salmon Gum (*E. salmonophloia*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Flooded Gum (*E. rudis*), York gum (*E. loxophleba* subsp. *loxophleba*), Powderbark (*E. accedens*, and Karri (*E. diversicolor*). A total of 13 potential breeding trees with a (DBH) greater than 500 mm were recorded in the Study Area (Appendix E). One of these trees was a dead stag with hollows

currently able to support nesting; however no actual breeding was recorded during the field survey. The closest known breeding site to the Study Area, as mapped by the Department of Planning (2011), is located approximately 27 km north of the Study Area.

No suitable roosting habitat or evidence of roosting was identified within the Study Area during the field survey. Suitable roosting habitat is identified based on the presence of suitable tall trees, stem clippings (with leaves), excessive droppings, branch chewing, feathers, proximity to known roosting sites (Department of Planning, 2011) and presence of suitable foraging habitat. The closest known roosting site, as mapped by the Department of Planning (2011), is located approximately 5 km north of the Study Area.

Likelihood of occurrence assessment

In addition to the fauna species recorded during the field survey, a number of conservation significant fauna species were identified as potentially occurring within the Study Area during the desktop investigation. An assessment on the likelihood of these species occurring in the Study Area was undertaken. This assessment is based on species biology, habitat requirements, the quality and availability of suitable habitat and records of the species in the area. The assessment is provided in Appendix E.

The assessment concluded that one species is known to occur, five species are likely to occur, four species may potentially occur, and 17 species are considered unlikely to occur within the Study Area. The species determined as present, likely to occur or could possibly occur within the Study Area are listed in Table 13.

Table 13 Conservation significant species determined as present, likely to occur within the Study Area.

Taxa	Common name	Status		Likelihood of Occurrence
		State (WC Act/ DPaW listing)	Federal (EPBC Act listing)	
Birds				
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Threatened	Vulnerable	Likely
Calyptorhynchus baudinii	Baudin's Black Cockatoo	Threatened	Vulnerable	Possible
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	Threatened	Endangered	Known
Merops ornatus	Rainbow Bee-eater	Schedule 3	Migratory	Likely
Falco peregrinus	Peregrine Falcon	Schedule 4		Possible
Mammals				
Isoodon obesulus fusciventer	Quenda / Southern Brown Bandicoot	Priority 5		Likely
Reptiles				
Neelaps calonotos	Black-striped Snake	Priority 3		Likely
Lerista lineata	Perth Lined Skink	Priority 3		Likely
Invertebrates				
Synemon gratiosa	Graceful Sun Moth	Priority 4		Possible
Throscodectes xiphos	Cricket	Priority 1		Possible

3.1 Acid Sulphate Soils (ASS)

The ASS Swan Coastal Plain indicates that the Study Area has a Moderate to Low risk of ASS. The ASRIS database indicates that the Study Area is classified as 'Low Probability of Occurrence' with a high degree of confidence (ASRIS 2014).

4. Environmental approvals

4.1 Commonwealth

Referral to DotE (formerly DSEWPaC) under the EPBC Act is triggered if a proposed action has/or potentially has a significant impact on Matter of National Environmental Significance (MNES).

MNES are factors that require legislated protection in order to conserve biodiversity, protect world and national heritage places, and comply with international treaties. An assessment od the Project against MNES is provided in Table 14.

Table 14 Assessment of the Project against Matters of National Environmental Significance

Matters of National Environmental Significance (MNES)	Present	Impact
World Heritage Places	No	None
National Heritage Places	No	None
Wetlands of International Significance	No	None
Threatened Species and Ecological Communities	Yes	Removal of suitable foraging habitat and potential breeding habitat for Black Cockatoo species.
Migratory Species	May be present	No significant impacts
Commonwealth Marine Areas	No	None
Great Barrier Reef Marine Park	No	None
Nuclear Actions	No	None
A Water Resource (in relation to coal seam gas development and large coal mining development)	No	None

The Study Area is located within the modelled distribution for the Carnaby's Black Cockatoo and the Forest Red-tailed Black Cockatoo and outside the modelled distribution of the Baudin's Black Cockatoo (DSEWPaC, 2012). It should be noted, however, that there have been recent records of Baudin's Black Cockatoo on the southern Swan Coastal Plain. During the fauna survey, two Carnaby's Black Cockatoos were observed flying over the Study Area, however, no evidence of use by Black Cockatoos was recorded within the Study Area. The potential impacts on Black Cockatoo species are discussed in further detail in Section 4.1.1.

4.1.1 Risk referral table for threatened Black Cockatoos

In October 2012, DSEWPaC (now DotE) released the referral guidelines for the assessment of projects for potential impacts on Black Cockatoos (DSEWPaC, 2012). These guidelines are for all Black Cockatoo species, and do not provide information relative to particular areas of the State, but provide information to decide whether a project may trigger referral.

Within these guidelines, DSEWPaC provided a risk table that gives guidance on what it views as risks/impacts to Black Cockatoos that will trigger referral. Risk is broken into three categories, high, uncertain and low, and primarily focuses on breeding, feeding and roosting areas as well as indirect impacts. If there is uncertainty in regards to risks on Black Cockatoos then DSEWPaC recommended referring the project or contacting the Department to ensure legal certainty.

The risk referral table is shown in Table 15 with an assessment of the Project against each of the potential risks. As detailed in Table 15, based on the potential impact of the Project on Black Cockatoos, clearing for the Project may trigger referral to DotE due to the presence of potential breeding habitat and approximately 9.3 ha of quality foraging habitat. Therefore, it is recommended that the Department of Treasury refer the Project to the DotE.

Table 15 Department of the Environment risk referral table for Black Cockatoos

Risk type	Referral trigger
High risk of significant impacts: referral to DotE recommended	
Clearing of any known nesting tree.	Referral is not triggered. No currently known nesting trees occur within the Study Area.
Clearing of any part or degradation of breeding habitat in a woodland or forest within a species' known breeding range.	Referral is triggered. Potential breeding habitat was identified within the *Banksia* woodland habitat within Study Area which is within proximity of the known breeding range of the Carnaby's Black Cockatoo
Clearing of more than 1 ha of quality foraging habitat.	Referral is triggered. There is approximately 9.3 ha of high quality foraging habitat present within the Study Area (*Banksia* woodland).
Creating a gap or greater than 4 km between patches of Black Cockatoo habitat (breeding, foraging or roosting).	Referral is not triggered. The Study Area is connected to larger areas of remnant native vegetation which contain suitable Black Cockatoo habitat. Clearing of the foraging and potential breeding habitat will not create a gap greater than 4 km between patches of habitat in the surrounding area.
Clearing or degradation (including pruning of top canopy) of a known roosting site.	Referral is not triggered, no known roosting sites have been recorded within the Study Area.
Uncertainty: referral recommended or contact the DotE	
Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	Referral is unlikely to be triggered. Clearing of approximately 9.3 ha of quality foraging habitat within the Study Area is unlikely to significantly degrade the surrounding foraging habitat through altered hydrology.
Clearing or disturbance in areas surrounding Black Cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increase human visitation or fire.	Referral is not triggered. Portions of the Study Area and surrounding area are already highly modified due to various external impacts (such as introduced species, edge effects, clearing, human visitation, etc.). There are however areas of habitat within the Study Area, connected to habitat outside the Study Area which are considered to be in *Excellent* condition and may be impacted on by the Project.
Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.	Referral is unlikely to be triggered. The clearing of the single suitable nesting hollow would reduce the amount of available nesting habitat in area, however, this is unlikely to significantly increase competition for remaining hollows in the area.

Risk type	Referral trigger
Actions with the potential to introduce known plant diseases such as *Phytophthora* spp.	Referral is unlikely to be triggered. *Phytophthora* is known to occur widely in the region and may already be present at the site. Portions of the Study Area are already degraded. Management measures should be implemented to reduce the risk of introduction and spread of *Phytophthora*.
Low risk of significant impacts: referral may not be required but may refer to DotE for legal certainty	
Actions that do not affect Black Cockatoo habitat or individuals.	Not applicable
Actions whose impacts occur outside the modelled distribution of the three Black Cockatoos.	Not applicable

4.2 State

4.2.1 Environmental Protection Authority

Significant proposals (e.g. subdivision and development applications) must be referred to the EPA under Section 38 of the EP Act.

In deciding whether a proposal will be subject to the formal environmental impact assessment process, the EPA takes into account the environmental significance of any potential impacts that may result from the implementation of the scheme or proposal.

The EPA considers that environmental significance is a function of:

- The extent and consequence of impacts on biophysical aspects.
- The environmental values of the areas affected.
- The extent of emissions and their potential to unreasonably interfere with the health, welfare, convenience, comfort or amenity of people.
- The extent and rigour to which potential impacts have been investigated and described in the referral, and the confidence in the reliability of predicted impacts.
- The extent to which the proposal implements the principles of sustainability.
- The ability of decision-making authorities to place conditions on the proposals to ensure required environmental outcomes are achieved.
- The likely level of public interest and the extent to which the proponent has consulted with interested and affect people and responded to issues raised.

It is not anticipated that this Project will require referral to the EPA.

4.2.2 Department of Environment Regulation

Any clearing of native vegetation is regulated by the Department of Environment Regulation (DER) and requires a permit under Part V of the EP Act, except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the Environmental Protection (Clearing of Native Vegetation) Regulations 2004, and not in an ESA.

Assessment against the Ten Clearing Principles

An assessment of the Study Area against the “10 clearing principles” was undertaken to determine whether the Project is likely to be at variance to the Principles (Table 16). These

Principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

The assessment against the Ten Clearing Principles determined that the Project is:

- Likely to be at variance with Clearing Principle (b)
- May be at variance with Principle (a) and (f)

Any removal of native vegetation within the Study area will require a State Native Vegetation Clearing Permit.

Table 16 Assessment against the Ten Clearing Principles

Principle	Assessment	Outcome	Data sources
(a) – Native vegetation should not be cleared if it comprises a high level of biological diversity.	The Study Area is located within the Swan Coastal Plain bioregion and the Perth sub-region as described by the Interim Biogeographic Regionalisation of Australia (IBRA). The flora of the Perth sub-region is diverse, with 3,332 recorded native vascular species (DPaW 2007–). Desktop assessments identified a total of 360 native flora taxa within 5 km of the Study Area (DPaW, 2007–). A field survey of the Study Area recorded a total of 94 native flora species. The Study Area is considered to have low to moderate level of flora biodiversity. Desktop assessments identified the presence/potential presence of 16 conservation significant flora species within 5 km of the Study Area. A likelihood of occurrence assessment (based on the range, habitat requirements and previous records of the species) identified that three conservation significant flora species likely to occur or may potentially occur within the Study Area. These included: • *Caladenia huegelii* (Endangered, Threatened) • *Eremaea asterocarpa* subsp. *brachyclada* (Priority 1) • *Jacksonia gracillima* (Priority 3) No EPBC Act, WC Act or Priority listed flora species were recorded within the Study area during the field survey. Broad-scale vegetation mapping of the Perth area undertaken by Beard (1979) identified the following vegetation association within the Study Area: • Medium very sparse woodland; jarrah, with low woodland; banksia & casuarina (association 1001, Bassendean) Heddle et al. (1980) mapping indicates that one vegetation complex is present within the Study area: • Bassendean complex – Central and south: Vegetation ranges from woodland of *E. marginata* – *C. fraseriana* – *Banksia* spp. to low woodland of *Melaleuca* species, and sedgelands on the moister sites. This area includes the transition of *E. marginata* to *E. todtiana* in the vicinity of Perth. Beard (1979) vegetation association 1001 and Heddle et al. (1980) Bassendean complex – Central and south are both below the threshold level at all levels (state,	Proposal may be at variance with this Principle.	Beard (1979) EPA (2006a) DPaW (2007–) DotE (2013a) GHD field survey Heddle et al. (1980)

Principle	Assessment	Outcome	Data sources
	IBRA bioregion and IBRA sub-region), except LGA (i.e. less than 30 % of their pre-European extents remaining). However, as the Study Area is located within an area of urban development on the Swan Coastal Plain, and as there is greater than 10 percent remaining of vegetation association 1001 and vegetation complex Bassendean complex – Central and south, they are not considered to be a critical asset (EPA, 2006a). The Study Area comprises largely remnant vegetation and consists of three vegetation types including: • VT1; Low Open Forest of *Banksia* ssp. and *Allocasuarina fraseriana* • VT2; Low Woodland of *Banksia* ssp. over Open Low Heath of *Scholtzia involucrata* • VT3; Low Open Woodland of *Melaleuca rhaphiophylla* The vegetation condition of the Study Area ranged from *Excellent* (2) to *Degraded* (5), with 24.5 % rated as *Excellent (2)*, 21.2 % rated as *Excellent (2) – Very Good (3)*, 30.8 % rated as *Good (4)*, 20.9 % rated as *Degraded (5)* and 2.6 % rated as *Completely Degraded (6)*. Disturbances in the Study Area include grazing, weed incursion and dumping of rubbish. Three PECs were identified in the desktop searches occurring within 5 km of the Study Area. The three vegetation types identified within the Study Area are considered unlikely to align with any of these PECs. A new Priority 3 PEC was added to the PEC list by DPaW after the completion of this field survey and initial report, namely Banksia dominated woodlands of the Swan Coastal Plain IBRA region. It is likely that VT1: (7.49 ha, and additional 0.87 ha inferred) and VT2 (0.94 ha) represent this PEC. No reserves, conservation areas or other DPaW-managed estates are located within the Study Area. There are five state and territory reserves occurring within 5 km of the Study Area and four Bush Forever sites within 2 km of the Study Area. Desktop assessments identified a total of 194 native fauna species within 5 km of the Study area (DPaW, 2007–). A field survey of the Study Area recorded a total of 23 native fauna species. Desktop assessments identified the presence/potential presence of 27 conservation significant fauna species within 5 km of the Study area. A likelihood of occurrence assessment (based on the range, habitat requirements and previous records of the species) identified five conservation significant fauna		

Principle	Assessment	Outcome	Data sources
	species likely to occur within the Study Area. One conservation significant fauna species, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), was recorded during the field survey. Two broad fauna habitat types were described within the Study Area, including *Banksia* woodland and *Melaleuca* dampland. These habitats would provide a variety of habitat resources for fauna species, and given the local and regional connectivity to other larger areas of remnant bushland, the Study Area is likely to provide a habitat linkage for fauna.		
(b) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Desktop assessments identified the presence/potential presence of 27 conservation significant fauna species within 5 km of the Study area. A likelihood of occurrence assessment (based on the range, habitat requirements and previous records of the species) identified five conservation significant fauna species likely to occur within the Study Area. These include: • *Calyptorhynchus banksii naso* (Forest Red-tailed Black Cockatoo): State Threatened, Federal Vulnerable • *Merops ornatus* (Rainbow Bee-eater): State Schedule 3, Federal Migratory • *Isoodon obesulus fusciventer* (Quenda/ Southern Brown Bandicoot): State Priority 5 • *Neelaps calonotos* (Black-striped Snake): Priority 3 • *Lerista lineata* (Perth Lined Skink): Priority 3 One conservation significant fauna species, Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*), was recorded during the field survey. The Study Area is within proximity of the known breeding range of the Carnaby's Black Cockatoo and the modelled distribution of the Forest Red-tailed Black Cockatoo. One potential breeding tree (dead stag with at least two hollows suitable for Black Cockatoo breeding) and 13 trees with DBH greater than 500 mm were recorded within the Study Area. Furthermore, 9.3 ha of high quality foraging habitat (*Banksia* Woodland) was also recorded within the Study Area. Locally, the Study Area is connected to remnant vegetation occurring within a larger block of semi-rural residential properties. Regionally, the Study Area retains some linkages to conservation reserves and Bush Forever sites, which form part of a regionally significant contiguous bushland/wetland linkage. The remnant vegetation within the Study Area would provide corridors for fauna movement, in particular for	Proposal is likely to be at variance with this Principle.	DPaW (2007–) DotE (2013a) GHD field survey Government of Western Australia (2000)

Principle	Assessment	Outcome	Data sources
	the Quenda, as well as a considerable area of foraging habitat for Black Cockatoos.		
(c) – Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	Desktop assessments identified the presence/potential presence of nine EPBC Act and/or WC Act-listed within 5 km of the Study area. These taxa included: • *Andersonia gracilis* (Endangered, Threatened) • *Caladenia huegelii* (Endangered, Threatened) • *Centrolepis caespitosa* (Endangered, Priority 4) • *Darwinia foetida* (Critically Endangered, Threatened) • *Diuris micrantha* (Vulnerable, Threatened) • *Diuris purdiei* (Endangered, Threatened) • *Drakaea elastica* (Endangered, Threatened) • *Drakaea micrantha* (Vulnerable, Threatened) • *Lepidosperma rostratum* (Endangered, Threatened) A likelihood of occurrence assessment (based on the range, habitat requirements and previous records of the species) identified that one species, *Caladenia huegelii,* may possibly occur within the Study Area. The survey timing was considered optimal to record *Caladenia huegelii* and the Study area was well traversed to determine the presence of this species. No Threatened flora was recorded within the Study area during the field survey.	Proposal not likely to be at variance with this Principle.	DPaW (2007–) DotE (2013a) GHD field survey
(d) – Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	Desktop searches did not identify any TECs within 5 km of the Study Area. No EPBC Act or State listed TECs were identified within the Study Area during the field survey.	Proposal not likely to be at variance with this Principle.	DPaW TEC/PEC databases DotE (2013a) GHD field survey
(e) – Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been	The Project footprint is located within the Swan Coastal Plain IBRA bioregion. This IBRA bioregion has approximately 39 % of its pre-European extent remaining (GoWA 2013). The extent remaining of Beard (1979) vegetation association 1001 and Heddle et al. (1980) vegetation complex Bassendean complex – Central and south is less than 30 % at the State, IBRA Bioregion and IBRA Sub-region level. This is below the	Proposal not likely to be at variance with this Principle.	Beard (1979) EPA (2006a) Heddle et al. (1980) Government of Western Australia

Principle	Assessment	Outcome	Data sources
extensively cleared.	threshold level (of 30%) at which species loss appears to accelerate exponentially at an ecosystem level (Commonwealth of Australia 2001). At the LGA level, both Beard (1979) vegetation association 1001 and Heddle et al. (1980) vegetation complex Bassendean complex – Central and south have greater than 30 % of their pre-European extents remaining. The Study Area is located within an area of urban development on the Swan Coastal Plain. As there is greater than 10 % of the vegetation association 1001 and vegetation complex Bassendean complex – Central and south remaining, they are not considered to be critical assets. Locally, the Study Area is connected to remnant vegetation occurring within a larger block of semi-rural residential properties. Regionally, the Study Area retains some linkages to conservation reserves and Bush Forever sites, which form part of a regionally significant contiguous bushland/wetland linkage. However, the Study Area does not provide any significant linkages to surrounding remnant vegetation or is considered a significant remnant.		(2012)
(f) – Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	Desktop searches identified 23 geomorphic wetlands within 2 km of the Study Area and 36 EPP Lakes within 5 km of the Study Area. No wetlands, lakes or drainage channels were recorded within the Study Area during the field survey. However the Study Area contained vegetation associated with damp conditions including *Melaleuca rhaphiophylla, Kunzea glabrescens* and *Hypocalymma angustifolium*. These species were recorded in VT3 which occurs in the eastern part of the Study Area (0.92 ha). This vegetation type was highly degraded due to extensive clearing and weed invasion. Vegetation that grows in or in association with a dampland occurs within the Study area.	Proposal may be at variance with this Principle.	DPaW (2007–) GHD field survey Government of Western Australia (2012)
(g) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The groundwater salinity in Study Area is relatively fresh, ranging from typically 500 to 1000 mg/L TDS. The Natural Resource Management Shared Land Information Platform (SLIP) has mapped the salinity risk as '30-50% high to extreme hazard of salinity risk' (GoWA 2014). Native vegetation clearing in the Study Area is unlikely to increase salinity in the Study Area and surrounding areas, especially as the vegetation mainly comprises *Banksia* woodland and not deep-rooted trees. The Natural Resource Management SLIP has mapped the waterlogging risk as '3-10% moderate to very high hazard' and flooding risk as '0-2% Moderate to high hazard' (GoWA 2014). It is unlikely that clearing of native vegetation in the project area will increase waterlogging and flooding within and surrounding the project area.	Proposal is not likely to be at variance with this Principle.	GHD field survey Government of Western Australia (2014) ASRIS (2014)

Principle	Assessment	Outcome	Data sources
	The risk of water erosion was mapped as '3-10% and 10-30% high to extreme hazard' for the majority of project area. The Study Area occurs on the Bassendean Dune System and the following soil sub-units or phases of the Bassendean system occur within the Study Area: • 212Bs_B1 – Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m. • 212Bs_B2 – Flat to very gently undulating sandplain with well to moderately well-drained deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m. The sands within the Study Area are relatively porous and well drained, therefore there is little overland surface water flow, which minimises the risk of water erosion. The Natural Resource Management SLIP has mapped wind erosion risk as '>70% high to extreme hazard' for the Study Area (GoWA 2014). The high sand content of the soils and ease with which these materials can be transported by the wind means there is a high risk of wind erosion in this area. The ASS Swan Coastal Plain indicates that the Study Area has a Moderate to Low risk of ASS and the ASRIS database indicates that the Study Area is classified as 'Low Probability of Occurrence' with a high degree of confidence (ASRIS 2014). The Study Area is largely adjacent to existing cleared areas. This indicates that the Study Area exists within land which is capable of withstanding the intended use and is not considered likely to increase ground water recharge, surface water runoff, soil erosion or nutrient export. Given the small size of vegetation clearing (10.22 ha) required for the project, the project is unlikely to cause significant land degradation.		
(h) – Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values	There are no DPaW-managed estates or reserves within the Study Area, however, there are a number of reserves and conservation areas within the within the vicinity of the Study Area (Government of Western Australia, 2014). These include: • Harry Waring Marsupial Reserve (Bush Forever Site No. 392) (0.74 km west of the Study Area)	Proposal is not likely to be at variance with this Principle.	Bush Forever (GoWA 2000) DotE (2013a) DPaW database (DPaW managed

Principle	Assessment	Outcome	Data sources
of any adjacent or nearby conservation area.	• Thomsons Lake Nature Reserve (Bush Forever Site No. 391) (1.38 km north-west of the Study Area) • Unamed Conservation Park (1.9 km north-west of the Study Area) • Wandi Nature Reserve (3.0 km south-east of the Study Area) • Unamed Conservation Park (3.0 km north-west of the Study Area) Additionally a further two bush Forever sites occur within 2 km of the Study Area: • Bush Forever Site No. 268 (Mandogalup Road Bushland) (1.75 km south-west of the Study Area) • Bush Forever Site No. 492 (Lyon Road Bushland) (1.3 km north-east of the Study Area) Furthermore, there are 23 geomorphic wetlands within 2 km of the Study Area, and 36 EPP lakes, and two Wetlands of International Importance within 5 km of the Study Area. Locally, the Study Area is connected to remnant vegetation occurring within a larger block of semi-rural residential properties. Regionally, the Study Area retains some linkages to conservation reserves and Bush Forever sites, which form part of a regionally significant contiguous bushland/wetland linkage. These linkages provide corridors for fauna movement. However, the Study Area does not provide any significant linkages to surrounding remnant vegetation or is considered a significant remnant. Any clearing of the Study Area is not considered to significantly impact or further fragment these conservation area or result in a significant loss of connectivity function between local and region linkages. However, clearing of the Study Area will result in a direct loss of native vegetation (albeit small) in a highly fragmented landscape.		lands and waters) GHD field survey Government of Western Australia, 2012
(i) – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	No rivers or surface water bodies listed under the RIWI Act were identified within the Study Area (DoW 2014a). There are no drainage lines or lakes in the Study Area (DoW 2014a). It is unlikely that the proposed works will disturb or interrupt any natural drainage and surface run-off patterns due to the deep sandy soils present in the area. A search of the DoW Perth Groundwater Atlas and DAFWA WetlandBase indicates that there are no wetlands in the Study Area (DAFWA 2014). The nearest wetland is located approximately 450 m north-west of the Study Area (Unnamed Dampland). It is unlikely that the proposed works will impact any wetlands in the vicinity of the	Proposal is not likely to be at variance with this Principle.	GHD field survey Government of Western Australia, 2012

Principle	Assessment	Outcome	Data sources
	project area. There are no EPP Lakes protected under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 within the Study Area. There are however 36 EPP Lakes located within 5 km to the Study Area. The nearest EPP lake is located approximately 1.6 km north-west of the Study Area (Unnamed Lake) and therefore no direct impacts are expected to occur to any EPP lakes as a result of the proposed project. The ASS Swan Coastal Plain indicates that the Study Area has a Moderate to Low risk of ASS and the ASRIS database indicates that the Study Area is classified as 'Low Probability of Occurrence' with a high degree of confidence (ASRIS 2014). Native vegetation clearing in the Study Area is unlikely to result in ASS. There are also no known contaminated sites are present within or immediately adjacent to the Study Area. The NRM SLIP has mapped the salinity risk as '30-50% high to extreme hazard of salinity risk' (GoWA 2014). Native vegetation clearing in the Study Area is unlikely to increase salinity in the Study Area and surrounding areas, especially as the vegetation mainly comprises *Banksia* woodland and not deep-rooted trees. The project is not likely to be at variance to this principle as clearing of the 10.22 ha of vegetation is unlikely to cause deterioration in the quality of surface or underground water.		
(j) – Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	The Study Area is within a generally low lying area, as shown by the number of wetlands and EPP lakes in the broader area. However, the Study Area comprises largely upland vegetation on sandy porous soils. The Natural Resource Management SLIP has mapped the waterlogging risk for the Study Area as '3-10% moderate to very high hazard' and flooding risk as '0-2% Moderate to high hazard' (GoWA 2014). It is unlikely that the removal of vegetation (10.22 ha) proposed for this project would cause or exacerbate the incidence or intensity of flooding in the local or regional area.	Proposal is not likely to be at variance with this Principle.	GHD field survey Natural Resource Management SLIP (GoWA 2014)

5. Conclusions and recommendations

5.1 Conclusions

5.1.1 Flora and vegetation

The assessment identified the following key vegetation and flora constraints:

- Three vegetation types were identified within the Study Area. It is likely that VT1 (7.49 ha and additional 0.87 ha inferred) and VT2 (0.94 ha) align with Priority 3 PEC*: Banksia dominated woodlands of the Swan Coastal Plain IBRA region*. This PEC was added to the PEC list by DPaW after the completion of this field survey.
- A likelihood of occurrence assessment determined that three conservation significant species are likely to or may possibly occur within the Study Area:
  - *Caladenia huegelii*: State Threatened, Federal Endangered;
  - *Eremaea asterocarpa* subsp. *brachyclada*, State Priority 1
  - *Jacksonia gracillima*, State Priority 3

  Whilst targeted searching for *Caladenia huegelii* and other conservation significant species was not undertaken during the field survey, the survey timing was considered optimal and the Study Area was well traversed. No conservation significant flora species were recorded during the survey.
- One individual of **Asparagus asparagoides* (Bridal Creeper), which is listed as a Declared Pest under the BAM Act and as a WoNS was identified within the Study Area during the field survey.

5.1.2 Fauna

The assessment identified the following key fauna constraints:

- Habitat for two species of threatened Black Cockatoo including
  - A total of 9.3 ha of Black Cockatoo foraging habitat within the Study Area.
  - Potential breeding habitat (13 trees) within the Study Area, which is within proximity of the known breeding range of the Carnaby's Black Cockatoo and the modelled distribution of the Forest Red-tailed Black Cockatoo.
- During the survey, one conservation significant fauna species was recorded, Carnaby's Black Cockatoo. Two individuals were observed flying over the Study Area.
- A likelihood of occurrence assessment determined that 10 conservation significant species are known, likely to or may possibly occur within the Study Area:

5.1.3 Environmental Approvals

Based on the potential impact of the Project on Black Cockatoos, clearing for the Project may trigger referral to DotE due to the presence of potential breeding habitat and 9.3 ha of quality foraging habitat.

It is not anticipated that this Project will require referral to the EPA.

It is not anticipated that this Project will require permits under the WC Act.

The assessment against the Ten Clearing Principles determined that the Project is:

- Likely to be at variance with Clearing Principle (b) and Principle (f)

- May be at variance with Principle (a)

Any removal of native vegetation within the Study area will most likely require a clearing permit from the DER.

5.2 Recommendations

It is recommended that the Department of Treasury initiate consultation with DotE and refer the Project to DotE if development of the Study Area requires clearing of Black Cockatoo feeding habitat and/or potential breeding habitat.

Significant impacts associated with the Project are likely to be largely restricted to the construction phase, and should be mitigated through design as much as possible. It is recommended that DoE develop a Construction Environmental Management Plan (CEMP) to manage the potential construction impacts including a general fauna clearance program by qualified fauna relocation personnel.

6. References

Aplin, TEH 1979, '*The Flora', Environment and Science*, Perth, University of WA Press.

Australia New Zealand Environment and Conservation Council (ANZECC) 2000, *Core Environmental Indicators for Reporting on the State of Environment*, ANZECC State of the Environment Reporting Task Force.

Australian Government 2012, *Weeds in Australia*, retrieved April 2013, from http://www.environment.gov.au/biodiversity/invasive/weeds/index.html.

Australian Weeds Committee 2010, *Weeds of National Significance: Update 2010*, Launceston, Commonwealth of Australia.

Beard, JS 1979, *Vegetation Survey of Western Australia: Perth Map and Explanatory Memoir 1:250,000 series*, Perth, Vegmap Publications.

Bureau of Meteorology 2013, *Climate Data Online*, retrieved September 11, 2013, from http://www.bom.gov.au/climate/data/?ref=ftr.

Christidis, L & Boles, WE 2008, *Systematics and Taxonomy of Australian Birds*, Melbourne, CSIRO Publishing.

Cockerill, A., Lambert, T, Conole, L. and Pickett, E. (2013). Carnaby's Cockatoo Population Viability AnalysisModel Report. Report funded by the Department of Sustainability, Environment, Water, Population, and Communities through the Sustainable Regional Development Program. Parsons Brinckerhoff, Perth

Commonwealth Conservation Advice on Darwinia sp. Muchea (B.J. Keighery 2458) (Muchea Bell) (Threatened Species Scientific Committee (TSSC), 2009ab) [Conservation Advice].

Commonwealth Conservation Advice on Diuris purdiei (Purdie's Donkey-orchid) (Threatened Species Scientific Committee, 2008j) [Conservation Advice].

Commonwealth Conservation Advice on Lepidosperma rostratum (Threatened Species Scientific Committee, 2008rh) [Conservation Advice].

Commonwealth of Australia 2001, *National Targets and Objectives for Biodiversity Conservation 2001–2005*, Canberra, AGPS.

Department of Environment and Conservation (2006). Slender Andersonia (*Andersonia gracilis*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 228.

Department of Environment and Conservation (2009). National recovery plan for the Glossy-leafed Hammer Orchid (Drakaea elastica) (Department of Environment and Conservation, 2009l)

Commonwealth Conservation Advice on Drakaea micrantha Hopper & A.P.Brown nom. inval. (Dwarf Hammer-orchid) (Threatened Species Scientific Committee, 2008k) [Conservation Advice].

Department of Parks and Wildlife (DPaW) 2007–, *NatureMap: Mapping Western Australia's Biodiversity*, retrieved September 11, 2013, from http://NatureMap.dec.wa.gov.au/.

Department of Parks and Wildlife (DPaW) 2012, *Department of Environment and Conservation Threatened Flora (Rare Flora Notice 2012(2)*), updated 6 November, 2012.

Department of Parks and Wildlife (DPaW) 2013a, *Priority ecological communities for Western Australia*, 26 March 2013.

Department of Parks and Wildlife (DPaW) 2013b, *Threatened ecological communities endorsed by the Minister for the Environment*, May 2013.

Department of Planning Western Australia 2011, *Metropolitan Region Scheme (MRS) South West – Potential habitat for the Carnaby's Black Cockatoo which may require further assessment*, Perth, Department of Planning WA on behalf of Western Australian Planning Commission.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, Environmental Protection and Biodiversity Conservation Act 1999 *referral guidelines for three threatened Black Cockatoo species*, Canberra, DSEWPaC.

Department of the Environment (DotE) 2013a, *Protected Matters Search Tool Results*, retrieved September 11, 2013, from http://www.environment.gov.au/epbc/pmst/index.html.

Department of the Environment (DotE) 2013b, The Ramsar Convention on Wetlands, retrieved June 4, 2013, from http://www.environment.gov.au/water/topics/wetlands/ramsar-convention/index.html.

Department of the Environment (DotE) 2013c, *Threatened species & ecological communities*, retrieved July, 2013, from http://www.environment.gov.au/biodiversity/threatened/index.html.

Environmental Protection Authority (EPA) 2000, *Environmental Protection of Native Vegetation in Western Australia. Clearing of native vegetation, with particular reference to the agricultural area. Position Statement No. 2*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2002, *Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3*, Perth, EPA.

Environmental Protection Authority (EPA) 2004a, *Guidance Statement No. 51: Terrestrial Flora and Vegetation Surveys for Impact Assessment in Western Australia*, Perth, EPA.

Environmental Protection Authority (EPA) 2004b, *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2006a, *Guidance for the Assessment of Environmental Factors (in accordance with the* Environmental Protection Act 1986*): Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region (No. 10)*, Perth, Environmental Protection Authority.

Environmental Protection Authority (EPA) 2006b, *Position Statement No. 9: Environmental Offsets*, Perth, Environmental Protection Authority.

Gibson, N, Keighery, BJ, Keighery, GJ, Burbidge, AH & Lyons, MN 1994, *A Floristic Survey of the Southern Swan Coastal Plain*, unpublished report prepared for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and The Conservation Council of Western Australia (Inc.).

Government of Western Australia 2000, *Bush Forever – Keeping the Bush in the City. Volumes 1 (Policies, Principals and Processes) & 2 (Directory of Bush Forever Sites)*, Perth, Government of Western Australia.

Government of Western Australia 2013, *2012 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Full Report): current as of October 2012*, retrieved July 20, 2013, from https://www2.landgate.wa.gov.au/web/guest/downloader.

Government of Western Australia 2014, *Natural Resource Management Shared Land Information Platform*, retrieved June, 2014, from http://spatial.agric.wa.gov.au/slip/.

Heddle, EM, Loneragan, OW, & Havel, JJ 1980, '*Vegetation Complexes of the Darling System, Western Australia*', In Atlas of Natural Resources, Darling System, Western Australia, Perth, Department of Conservation and Environment.

Keighery, B 1994, *Bushland Plant Survey: a Guide to Plant Community Survey for the Community*, Nedlands, Wildflower Society of WA (Inc.).

Local Biodiversity Program 2013, *2013 Native vegetation by vegetation complex dataset for the South West of Western Australia*, retrieved July, 2013, from http://pbp.walga.asn.au/Publications.aspx

Mitchell, D, Williams, K & Desmond, A 2002, '*Swan Coastal Plain 2 (SWA2 — Swan Coastal Plain subregion)*', In A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002, Perth, Department of Conservation and Land Management.

Muir, BG 1977, '*Biological Survey of the Western Australian Wheatbelt Part II*', Perth, Records of the Western Australian Museum, Supplement No. 3.

Perth Biodiversity Project 2010, *Native vegetation extent by vegetation complexes for each Local Government in Perth and Peel*, retrieved July, 2013, from http://pbp.walga.asn.au/Publications.aspx.

Shepherd, DP, Beeston, GR, & Hopkins, AJM 2002, *Native Vegetation in Western Australia – Extent, Type and Status, Resource Management Technical Report 249*, Perth, Department of Agriculture.

Western Australian (WA) Herbarium 1998–, *FloraBase—the Western Australian Flora*, retrieved July, 2013, from http://florabase.dpaw.wa.gov.au/.

Appendices

Appendix A – Figures

Appendix B – Background information

B.1 Legislation

B.1.1 Federal *Environment Protection and Biodiversity Conservation Act 1999*

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Federal Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, which are defined in the EPBC Act as matters of national environmental significance (MNES).

The biological aspects listed as MNES include:

- Nationally threatened flora and fauna species and ecological communities.
- Migratory species.

A person must not take an action that has, will have, or is likely to have a significant impact MNES, without approval from the Federal Minister for the Environment.

B.1.2 State *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the primary legislative Act dealing with the protection of the environment in Western Australia. It provides for an Environmental Protection Authority (EPA), for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the above.

Clearing of native vegetation in Western Australia requires a permit from the Department of Parks and Wildlife (DPaW) (formerly the Department of Environment and Conservation – DEC), unless exemptions apply. Native vegetation includes aquatic and terrestrial vegetation indigenous to Western Australia, and intentionally planted vegetation declared by regulation to be native, but not vegetation planted in a plantation or planted with commercial intent.

In the EP Act Section 51A, clearing is defined as the killing or destruction of; the removal of; the severing or ringbarking of trunks or stems of; or the doing of substantial damage of some or all of the native vegetation in an area, including the flooding of land, the burning of vegetation, the grazing of stock or an act or activity that results in the above.

When making a decision to grant or refuse a permit to clear native vegetation the assessment considers clearing against the ten clearing principles as specified in Schedule 5 of the EP Act:

a. Native vegetation should not be cleared if it comprises a high level of biodiversity.

b. Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a significance habitat for fauna indigenous to Western Australia.

c. Native vegetation should not be cleared if it includes, or is necessary, for the continued existence of rare flora.

d. Native vegetation should not be cleared if it comprises the whole or part of native vegetation in an area that has been extensively cleared.

e. Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

f. Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

g. Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

h. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

i. Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

j. Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

There are a number of Environmentally Sensitive Areas (ESA) within Western Australia where exemptions in regulations do not apply. ESA include locations of threatened communities and species.

B.1.3 State *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*

ESA are declared by a notice under Section 51B of the EP Act. Table B.1 outlines the aspects of areas declared as ESA (under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* – Reg 6).

Table B.1 Aspects of Environmentally Sensitive Areas

Aspects of Environmentally Sensitive Areas
A declared World Heritage property as defined in Section 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
An area that is registered on the Register of the National Estate (RNE), because of its natural values, under the *Australian Heritage Commission Act 1975* of the Commonwealth (the RNE was closed in 2007 and is no longer a statutory list – all references to the RNE were removed from the EPBC Act on 19 February 2012).
A defined wetland and the area within 50 m of the wetland.
The area covered by vegetation within 50 m of rare flora, to the extent to which the vegetation is continuous with the vegetation in which the rare flora is located.
The area covered by a Threatened Ecological Community (TEC).
A Bush Forever Site.
The areas covered by the following policies:
a. The *Environmental Protection (Gnangara Mound Crown Land) Policy 1992*.
b. The *Environmental Protection (Western Swamp Tortoise Habitat) Policy 2002*.
The areas covered by the lakes to which the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (SCPL) (EPP Lakes) applies.
Protected wetlands as defined in the *Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998*.
Areas of fringing native vegetation in the policy area as defined in the *Environmental Protection (Swan and Canning Rivers) Policy 1997*.

B.1.4 State *Wildlife Conservation Act 1950*

The *Wildlife Conservation Act 1950* (WC Act) provides for the conservation and protection of wildlife. It is administered by the DPaW and applies to both flora and fauna. Any person wanting to capture, collect, disturb or study fauna requires a permit to do so. A permit is required under the WC Act if removal of threatened species is required.

B.1.5 State *Biosecurity and Agriculture Management Act 2007*

Under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), a Declared Pest is a prohibited organism or an organism for which a declaration under Section 22(2) is in force. The Department of Agriculture and Food Western Australia (DAFWA) maintains a list of Declared Pests for Western Australia. If a Pest is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control. Declared plants are gazetted under categories, which define the action required. The category may apply to the whole of the State, districts, individual properties or even paddocks. Categories of control are defined in Table B.2. Among the factors considered in categorising Declared Pests are:

- The impact of the plant on individuals, agricultural production and the community in general
- Whether it is already established in the area
- The feasibility and cost of possible control measures

The BAM Act replaces the repealed *Agriculture and Related Resources Protection Act 1976*.

Table B.2 Department of Agriculture and Food (Western Australia) Categories for Declared Pests under the *Biosecurity and Agriculture Management Act 2007*

Control class code	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

B.2 Background information

B.2.1 Reserves & conservation areas

Bush Forever, which was released in December 2000 and proclaimed in 2010, is a Government initiate aimed to retain and protect regionally significant bushland on the Swan Coastal Plain within the Perth Metropolitan Region. Bush Forever aims to protect more than 51,000 hectares of regionally significant bushland within 287 sites across the metropolitan portion of the Swan Coastal Plain (Government of Western Australia, 2000).

B.2.2 Vegetation extent & status

The National Objectives and Targets for Biodiversity Conservation 2001–2005 (Commonwealth of Australia, 2001) recognise that the retention of 30 percent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected. This is the threshold level below which species loss appears to accelerate exponentially and loss below this level should not be permitted. This level of recognition is in keeping with the targets recommended in the review of the National Strategy for the Conservation of Australia's

Biological Diversity (ANZECC, 2000) and in EPA Position Statement No. 2 on environmental protection of native vegetation in Western Australia (EPA, 2000).

From a purely biodiversity perspective and taking no account of any other land degradation issues, there are a number of key criteria now being applied to the clearing of native vegetation in Western Australia (EPA, 2000c).

- The "threshold level" below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30 percent of the pre-European extent of the vegetation type.
- A level of 10 percent 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.
- From a biodiversity perspective, stream reserves should generally be in the order of at least 200 metres (m) wide.

Within the Swan Coastal Plain, EPA Position Statement No. 9 (EPA, 2006b) identifies vegetation complexes with 30 percent or less or their pre-clearing extent remaining in a bioregion, or 10 percent or less of their pre-clearing extent remaining in constrained areas (i.e. areas of urban development in cities and major town) on the Swan Coastal Plain, to be critical assets.

The extent of remnant native vegetation has been assessed by Shepherd et al. (2002) and the Government of Western Australia (2013), based on broadscale vegetation association mapping by Beard (1979).

The EPA Guidance Statement No. 10 (EPA, 2006a) assesses the extent of Heddle et al. (1980) vegetation complexes currently present against presumed pre-European extents. It is important to note that the "*remnant native vegetation mapping used in the Region is derived from dated aerial photography (in this case 1998) with limited ground-truthing. As a consequence, the percentages of ecological communities remaining are generally an overestimate of the native vegetation remaining at present and at the date of this Guidance (2006). The principal factors contributing to this overestimation are:*

- *The preferential mapping of treed landscapes, leading to some mapping of areas that are parkland cleared or completely degraded*
- *The inclusion of areas that are approved for clearing through development approvals and/or clearing permits*
- *Some areas that have been cleared since the time of the aerial photography*

It is therefore important to bear these issues in mind when the percentage of the vegetation complexes remaining is approaching 30 percent" (EPA, 2006a). Furthermore, as a result of the clearing of the Swan Coastal Plain since 1998, it is likely that the actual percentage remaining of each vegetation type is less.

B.3 Conservation codes

Species of significant flora, fauna and communities are protected under both Federal and State Acts. The Federal EPBC Act provides a legal framework to protect and manage nationally important flora and communities. The State WC Act is the primary wildlife conservation legislation in Western Australia. Information on the conservation codes is summarised in the following sections.

B.3.1 Conservation significant communities

Ecological communities are defined as naturally occurring biological assemblages that occur in a particular type of habitat (English and Blyth, 1997). Federally listed Threatened Ecological Communities (TEC) are protected under the EPBC Act administered by the Department of the Environment (DotE – formerly the Department of Sustainability, Environment, Water, Population and Communities DSEWPaC). The DPaW also maintains a list of TEC for Western Australia; some of which are also protected under the EPBC Act. TEC are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable (Table B.3).

Possible TEC that do not meet survey criteria are added to the DPaW Priority Ecological Community (PEC) List under Priorities 1, 2 and 3 (Table B.4). These are ecological communities that are adequately known; are rare but not threatened, or meet criteria for Near Threatened. PEC that have been recently removed from the threatened list are placed in Priority 4. These ecological communities require regular monitoring. Conservation dependent ecological communities are placed in Priority 5. PEC are not listed under any formal Federal or State legislation.

Table B.3 Conservation codes & definitions for Threatened Ecological Communities (TEC) endorsed by the Western Australian Minister for the Environment & listed under the EPBC Act

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Presumed Totally Destroyed (PD)	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.	Critically Endangered (CR)	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future
Critically Endangered (CR)	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	Endangered (EN)	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future
Endangered (EN)	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.	Vulnerable (VU)	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future

Western Australia conservation categories		Federal Government Conservation Categories (EPBC Act)	
Vulnerable (VU)	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.		

Table B.4 Conservation categories & definitions for Priority Ecological Communities (PEC) as listed by the DPaW

Category	Description
Priority 1	**Poorly known ecological communities.** Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	**Poorly known ecological communities.** Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	**Poorly known ecological communities.** (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Category	Description
Priority 4	**Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.** (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	**Conservation Dependent ecological communities.** Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

B.3.2 Other significant vegetation

Vegetation may be significant for a range of reasons, other than a statutory listing as TEC or because the extent is below a threshold level. The EPA (2004a) states that significant vegetation may include vegetation that includes the following:

- Scarcity
- Unusual species
- Novel combinations of species
- A role as a refuge
- A role as a key habitat for Threatened species or large population 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 range, recently discovered range extensions, or isolated outliers of the main range)
- A restricted distribution

This may apply at a number of levels, so the unit may be significant when considered at the fine-scale (intra-locality), intermediate-scale (locality or inter-locality) or broad-scale (local to region).

B.3.3 Conservation significant flora & fauna

Species of significant flora are protected under both Federal and State legislation. Any activities that are deemed to have a significant impact on species that are recognised by the EPBC Act, and/or the WC Act can warrant referral to the DoE and/or the EPA. According to the DPaW (WA Herbarium, 1998–): "Threatened flora are plants which have been assessed as being at risk of extinction. In Western Australia the term Declared Rare Flora (DRF) is applied to Threatened flora due to the laws regarding threatened flora conservation. The WC Act is the primary wildlife conservation legislation in the State and the Minster for the Environment can declare taxa (species, subspecies or variety) as "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection." For the purposes of this report, flora listed by the WC Act as DRF is described as Threatened.

The Federal conservation level of flora and fauna species and their significance status is assessed under the EPBC Act (Table B.5). The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

The State conservation level of fauna species and their significance status is assessed under the State WC Act (*Wildlife Conservation (Specially Protected Fauna) Notice 2010(2)*). This Act uses a set of Schedules (Table B.6) but also classifies species using some of the IUCN categories. Schedule 3 fauna species are those which are "subject to an agreement between the Government of Australia and the Governments of Japan, China and the Republic of Korea relating to the protection of migratory birds, are declared to be fauna that is in need of special protection".

In Western Australia, the DPaW also maintains a list of Priority listed flora species. Conservation codes for Priority species are assigned by the DPaW to define the level of conservation significance (Table B.6). Priority species are not currently protected under the WC Act.

In addition to conservation significant species flora and fauna can be considered important if they are significant either on the Swan Coastal Plain or in the Perth metropolitan region. This includes species discussed in Government of Western Australia (2000) as being rare, poorly known, restricted in distribution or with some other distinctive feature.

For the purposes of this assessment, all species listed under the EPBC Act, WC Act and DPaW Priority species are considered conservation significant.

Table B.5 Conservation categories & definitions for *Environment Protection and Biodiversity Conservation Act 1999* listed flora & fauna species

Conservation category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Table B.6 Conservation codes and descriptions for Western Australian flora & fauna

Code	Conservation category	Description
Wildlife Conservation Act 1950		
T	Schedule 1 under the WC Act	**Threatened Fauna (Fauna that is rare or is likely to become extinct)** **Threatened Flora (Declared Rare Flora – Extant)** Taxa that 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. ***CR: Critically Endangered* –** considered to be facing an extremely high risk of extinction in the wild. ***EN: Endangered* –** considered to be facing a very high risk of extinction in the wild. ***VU: Vulnerable* –** considered to be facing a high risk of extinction in the wild.
X	Schedule 2 under the WC Act	**Presumed Extinct Fauna** **Presumed Extinct Flora (Declared Rare Flora – Extinct)** Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.
IA	Schedule 3 under the WC Act	**Birds protected under an international agreement.** Birds that are subject to an agreement between governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction.
S	Schedule 4 under the WC Act	**Other specially protected fauna.** Fauna that is in need of special protection, otherwise than for the reasons mentioned in the above schedules.
DPaW Priority Listed		
1	Priority One: Poorly-known taxa	Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
2	Priority Two: Poorly-known taxa	Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
3	Priority Three: Poorly-known taxa	Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

Code	Conservation category	Description
4	Priority Four: Rare, Near Threatened and other taxa in need of monitoring	(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
5	Priority 5: Conservation Dependent taxa	Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxon becoming threatened within five years.

Migratory species listed under the EPBC Act

The EPBC Act also protects land and migratory species that are listed under International Agreements. The list of migratory species established under section 209 of the EPBC Act comprises:

- Migratory species which are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
- Migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China–Australia Migratory Bird Agreement (CAMBA)
- Native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the republic of Korea–Australia Migratory Bird Agreement (ROKAMBA)

B.3.4 Introduced plants (weeds)

Weeds of National Significance

The spread of weeds across a range of land uses or ecosystems is important in the context of socio-economic and environmental values. The assessment of Weeds of National Significance (WoNS) is based on four major criteria:

- Invasiveness
- Impacts
- Potential for spread
- Socio-economic and environmental values

Australian state and territory governments have identified thirty two Weeds of National Significance (WoNS); a list of 20 WoNS was endorsed in 1999 and a further 12 were added in 2012 (Australian Government, 2012).

Information on species considered to be Declared Pests is provided in B.1.5.

Appendix C – Desktop searches

Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search

NatureMap flora search

NatureMap fauna search

EPBC Act Protected Matters Report

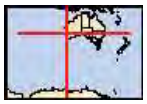
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 15/10/13 18:42:07

Coordinates
Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	15

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	23
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

Place on the RNE:	5
State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	41
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (RAMSAR)	[Resource Information]
Name	Proximity
Forrestdale & thomsons lakes	Within Ramsar site
Peel-yalgorup system	Upstream from Ramsar

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Pseudocheirus occidentalis Western Ringtail Possum [25911]	Vulnerable	Species or species habitat likely to occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area

Name	Threatened	Type of Presence
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat likely to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur

Name	Threatened	Type of Presence
		within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]		Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Gibbs Road Wetland System	WA	Indicative Place
Beeliar Regional Park and Adjacent Areas	WA	Interim List
Reserve 7756 (March 1978 Boundary)	WA	Registered
Thomson Lake Reserve	WA	Registered
Wandi Nature Reserve	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Harry Waring Marsupial Reserve	WA
Thomsons Lake	WA
Unnamed WA48291	WA
Unnamed WA49561	WA
Wandi	WA

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species

Name	Status	Type of Presence
		habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands	[Resource Information]
Name	State
Gibbs Road Swamp System	WA
Spectacles Swamp	WA
Thomsons Lake	WA

Coordinates

-32.171341 115.852176,-32.171359 115.852154,-32.175155 115.852219,-32.175174 115.850051,-32.174901 115.850073,-32.174611 115.85003,-32.174356 115.849837, -32.174156 115.849687,-32.171323 115.849687,-32.171341 115.852176

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of Sustainability, Environment, Water, Population and Communities
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

NatureMap
Mapping Western Australia's biodiversity

NatureMap Flora Hammond 11_09_2013

Created By Guest user on 11/09/2013

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°51' 02" E,32°09' 34" S
Buffer 5km
Group By Family

Family	Species	Records
Aizoaceae	2	6
Anarthriaceae	2	9
Apiaceae	6	11
Apocynaceae	1	1
Araceae	1	1
Araliaceae	1	7
Asparagaceae	19	32
Asteraceae	24	62
Boraginaceae	1	1
Campanulaceae	3	6
Caryophyllaceae	3	5
Casuarinaceae	2	4
Celastraceae	2	4
Centrolepidaceae	2	7
Colchicaceae	1	1
Commelinaceae	1	3
Convolvulaceae	1	1
Crassulaceae	3	4
Cupressaceae	1	1
Cyperaceae	21	41
Dasypogonaceae	2	8
Dilleniaceae	4	25
Droseraceae	7	10
Elaeocarpaceae	1	2
Ericaceae	14	37
Euphorbiaceae	2	2
Fabaceae	39	78
Gentianaceae	1	2
Geraniaceae	1	2
Goodeniaceae	4	9
Haemodoraceae	9	26
Haloragaceae	4	9
Hemerocallidaceae	6	8
Iridaceae	6	13
Juncaceae	4	6
Juncaginaceae	1	1
Lamiaceae	3	6
Lauraceae	2	3
Loganiaceae	1	1
Lythraceae	1	1
Menyanthaceae	1	1
Molluginaceae	1	2
Moraceae	1	1
Myrtaceae	41	89
Onagraceae	4	4
Orchidaceae	9	31
Orobanchaceae	1	2
Papaveraceae	1	1
Phyllanthaceae	2	4
Phytolaccaceae	1	1
Plantaginaceae	3	3
Poaceae	27	60
Polygalaceae	1	3
Portulacaceae	2	2
Primulaceae	1	1
Proteaceae	21	43
Restionaceae	5	15
Rhamnaceae	1	1
Rutaceae	4	7
Salviniaceae	1	1
Santalaceae	3	8
Sapindaceae	1	14
Solanaceae	2	2
Stylidiaceae	9	28
Thymelaeaceae	3	4
Tropaeolaceae	1	1
Violaceae	1	1
Xanthorrhoeaceae	1	6
Zamiaceae	1	4
Zygophyllaceae	1	1
TOTAL	**360**	**797**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Aizoaceae					
1.	2794	*Carpobrotus aequilaterus (Angular Pigface)*	Y		
2.	2795	*Carpobrotus edulis (Hottentot Fig)*	Y		
Anarthriaceae					
3.	1097	*Lyginia barbata*			
4.	18049	*Lyginia imberbis*			
Apiaceae					
5.	6214	*Centella asiatica*			
6.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
7.	6222	*Homalosciadium homalocarpum*			
8.	6249	*Platysace compressa (Tapeworm Plant)*			
9.	6253	*Platysace filiformis*			
10.	6289	*Xanthosia huegelii*			
Apocynaceae					
11.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
Araceae					
12.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		
Araliaceae					
13.	6280	*Trachymene pilosa (Native Parsnip)*			
Asparagaceae					
14.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
15.	1280	*Chamaescilla corymbosa (Blue Squill)*			
16.	1287	*Dichopogon capillipes*			
17.	1307	*Laxmannia ramosa (Branching Lily)*			
18.	11911	*Laxmannia ramosa subsp. ramosa*			
19.	11464	*Laxmannia sessiliflora subsp. australis*			
20.	1309	*Laxmannia squarrosa*			
21.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
22.	1228	*Lomandra hermaphrodita*			
23.	1243	*Lomandra sericea (Silky Mat Rush)*			
24.	1246	*Lomandra suaveolens*			
25.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
26.	1318	*Thysanotus arbuscula*			
27.	1338	*Thysanotus manglesianus (Fringed Lily)*			
28.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
29.	1343	*Thysanotus patersonii*			
30.	1351	*Thysanotus sparteus*			
31.	1357	*Thysanotus thyrsoideus*			
32.	1358	*Thysanotus triandrus*			
Asteraceae					
33.	7833	*Angianthus preissianus*			
34.	7851	*Asteridea pulverulenta (Common Bristle Daisy)*			
35.	7937	*Cirsium vulgare (Spear Thistle)*	Y		
36.	20074	*Conyza sumatrensis*	Y		
37.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
38.	29594	*Helichrysum luteoalbum (Jersey Cudweed)*			
39.	12741	*Hyalosperma cotula*			
40.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
41.	9352	*Hypochaeris radicata (Flat Weed)*	Y		
42.	18585	*Lagenophora huegelii*			
43.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
44.	42281	*Pithocarpa cordata*			
45.	8175	*Podolepis gracilis (Slender Podolepis)*			
46.	8182	*Podotheca angustifolia (Sticky Longheads)*			
47.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
48.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
49.	8195	*Quinetia urvillei*			
50.	13300	*Rhodanthe citrina*			
51.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
52.	9367	*Sonchus hydrophilus (Native Sowthistle)*			
53.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
54.	8255	*Ursinia anthemoides (Ursinia)*	Y		
55.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
56.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Boraginaceae					
57.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
Campanulaceae					
58.	9289	*Lobelia anceps (Angled Lobelia)*			
59.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
60.	7389	*Wahlenbergia preissii*			
Caryophyllaceae					
61.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
62.	19825	*Petrorhagia dubia*	Y		
63.	2918	*Stellaria media (Chickweed)*	Y		
Casuarinaceae					
64.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
65.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
Celastraceae					
66.	4733	*Stackhousia monogyna*			
67.	16998	*Tripterococcus paniculatus*		P4	
Centrolepidaceae					
68.	1125	*Centrolepis drummondiana*			
69.	1134	*Centrolepis polygyna (Wiry Centrolepis)*			
Colchicaceae					
70.	12770	*Burchardia congesta*			
Commelinaceae					
71.	1162	*Cartonema philydroides*			
Convolvulaceae					
72.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
Crassulaceae					
73.	3137	*Crassula colorata (Dense Stonecrop)*			
74.	3139	*Crassula exserta*			
75.	3140	*Crassula glomerata*	Y		
Cupressaceae					
76.	36600	*Callitris pyramidalis (Swamp Cypress)*			
Cyperaceae					
77.	741	*Baumea articulata (Jointed Rush)*			
78.	743	*Baumea juncea (Bare Twigrush)*			
79.	15837	*Baumea preissii subsp. laxa*			
80.	749	*Bolboschoenus caldwellii (Marsh Club-rush)*			
81.	16245	*Cyathochaeta teretifolia*		P3	
82.	816	*Cyperus tenuiflorus (Scaly Sedge)*	Y		
83.	20200	*Isolepis cernua var. setiformis*			
84.	917	*Isolepis marginata (Coarse Club-rush)*	Y		
85.	925	*Lepidosperma angustatum*			
86.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
87.	940	*Lepidosperma pubisquameum*			
88.	945	*Lepidosperma squamatum*			
89.	955	*Mesomelaena pseudostygia*			
90.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
91.	978	*Schoenus brevisetis*			
92.	982	*Schoenus clandestinus*			
93.	984	*Schoenus curvifolius*			
94.	986	*Schoenus efoliatus*			
95.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
96.	1017	*Schoenus subbulbosus*			
97.	12048	*Tricostularia neesii var. neesii*			
Dasypogonaceae					
98.	19309	*Calectasia narragara*			
99.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
Dilleniaceae					
100.	5134	*Hibbertia huegelii*			
101.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
102.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
103.	5173	*Hibbertia subvaginata*			
Droseraceae					
104.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
105.	3106	*Drosera macrantha (Bridal Rainbow)*			
106.	14298	*Drosera macrantha subsp. macrantha*			
107.	3109	*Drosera menziesii (Pink Rainbow)*			
108.	3117	*Drosera paleacea (Dwarf Sundew)*			
109.	13188	*Drosera paleacea subsp. paleacea*			
110.	3135	*Drosera zonaria (Painted Sundew)*			
Elaeocarpaceae					
111.	4524	*Platytheca galioides*			
Ericaceae					
112.	6334	*Astroloma pallidum (Kick Bush)*			
113.	6339	*Astroloma xerophyllum*			
114.	30142	*Brachyloma preissii subsp. obtusifolium*			
115.	30136	*Brachyloma preissii subsp. preissii*			
116.	6348	*Conostephium pendulum (Pearl Flower)*			
117.	6349	*Conostephium preissii*			
118.	13527	*Croninia kingiana*			
119.	6360	*Leucopogon australis (Spiked Beard-heath)*			
120.	6374	*Leucopogon conostephioides*			
121.	6425	*Leucopogon oxycedrus*			
122.	6434	*Leucopogon polymorphus*			
123.	6436	*Leucopogon propinquus*			
124.	6456	*Lysinema ciliatum (Curry Flower)*			
125.	34736	*Lysinema pentapetalum*			
Euphorbiaceae					
126.	20014	*Euphorbia hyssopifolia*	Y		
127.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
Fabaceae					
128.	11731	*Acacia browniana var. browniana*			
129.	3262	*Acacia cochlearis (Rigid Wattle)*			
130.	3282	*Acacia cyclops (Coastal Wattle)*			
131.	3374	*Acacia huegelii*			
132.	3502	*Acacia pulchella (Prickly Moses)*			
133.	30032	*Acacia saligna subsp. saligna*			
134.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
135.	3686	*Aotus cordifolia*			
136.	3688	*Aotus gracillima*			
137.	3692	*Aotus procumbens*			
138.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
139.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
140.	3832	*Daviesia physodes*			
141.	3845	*Daviesia triflora*			
142.	3872	*Euchilopsis linearis (Swamp Pea)*			
143.	3880	*Eutaxia virgata*			
144.	20475	*Gastrolobium capitatum*			
145.	20483	*Gastrolobium linearifolium*			
146.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
147.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
148.	3968	*Hovea trisperma (Common Hovea)*			
149.	12859	*Hovea trisperma var. trisperma*			
150.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
151.	20462	*Jacksonia gracillima*		P3	
152.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
153.	4044	*Kennedia prostrata (Scarlet Runner)*			
154.	8564	*Lotus subbiflorus*	Y		
155.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
156.	4079	*Medicago polymorpha (Burr Medic)*	Y		
157.	4085	*Melilotus indicus*	Y		
158.	4113	*Ornithopus compressus (Yellow Serradella)*	Y		
159.	4141	*Phyllota gracilis*			
160.	4181	*Pultenaea reticulata*			
161.	4211	*Sphaerolobium vimineum (Leafless Globe Pea)*			
162.	17145	*Trifolium angustifolium var. angustifolium*	Y		
163.	14738	*Trifolium resupinatum var. resupinatum*	Y		
164.	4320	*Vicia hirsuta (Hairy Vetch)*	Y		
165.	11474	*Vicia sativa subsp. nigra*	Y		
166.	4325	*Viminaria juncea (Swishbush, Koweda)*			
Gentianaceae					
167.	6542	*Centaurium tenuiflorum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
			Y		
Geraniaceae					
168.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
Goodeniaceae					
169.	12724	*Anthotium junciforme*			
170.	7454	*Dampiera linearis (Common Dampiera)*			
171.	7572	*Lechenaultia expansa*			
172.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
Haemodoraceae					
173.	11434	*Anigozanthos humilis subsp. humilis*			
174.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
175.	1418	*Conostylis aculeata (Prickly Conostylis)*			
176.	11826	*Conostylis aculeata subsp. aculeata*			
177.	1436	*Conostylis juncea*			
178.	1454	*Conostylis setigera (Bristly Cottonhead)*			
179.	11597	*Conostylis setigera subsp. setigera*			
180.	1475	*Haemodorum spicatum (Mardja)*			
181.	1478	*Phlebocarya ciliata*			
Haloragaceae					
182.	6161	*Gonocarpus pithyoides*			
183.	34676	*Meionectes brownii (Swamp Raspwort)*			
184.	6189	*Myriophyllum crispatum*			
185.	6199	*Myriophyllum tillaeoides*			
Hemerocallidaceae					
186.	1264	*Arnocrinum preissii*			
187.	1277	*Caesia occidentalis*			
188.	1285	*Corynotheca micrantha (Sand Lily)*			
189.	1259	*Dianella revoluta (Blueberry Lily)*			
190.	1260	*Stypandra glauca (Blind Grass)*			
191.	1363	*Tricoryne tenella*			
Iridaceae					
192.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
193.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
194.	30471	*Patersonia occidentalis var. angustifolia*			
195.	14485	*Romulea flava var. minor*	Y		
196.	1556	*Romulea rosea (Guildford Grass)*	Y		
197.	14924	*Romulea rosea var. communis*	Y		
Juncaceae					
198.	1178	*Juncus bufonius (Toad Rush)*	Y		
199.	1186	*Juncus microcephalus*	Y		
200.	1188	*Juncus pallidus (Pale Rush)*			
201.	1190	*Juncus planifolius (Broadleaf Rush)*			
Juncaginaceae					
202.	40660	*Cycnogeton huegelii*			
Lamiaceae					
203.	6839	*Hemiandra pungens (Snakebush)*			
204.	38320	*Hemiandra sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)*			
205.	6777	*Lachnostachys albicans*			
Lauraceae					
206.	2951	*Cassytha flava (Dodder Laurel)*			
207.	2957	*Cassytha racemosa (Dodder Laurel)*			
Loganiaceae					
208.	6515	*Logania vaginalis (White Spray)*			
Lythraceae					
209.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
Menyanthaceae					
210.	36177	*Ornduffia albiflora*			
Molluginaceae					
211.	2839	*Macarthuria australis*			
Moraceae					
212.	1747	*Ficus carica (Common Fig)*	Y		
Myrtaceae					

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
213.	17202	*Agonis flexuosa var. flexuosa*			
214.	20283	*Astartea scoparia*			
215.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
216.	5382	*Beaufortia elegans*			
217.	5411	*Calothamnus hirsutus*			
218.	5415	*Calothamnus lateralis*			
219.	5439	*Calytrix angulata (Yellow Starflower)*			
220.	5458	*Calytrix flavescens (Summer Starflower)*			
221.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
222.	35618	*Darwinia sp. Karonie (K. Newbey 8503)*			
223.	14097	*Eremaea asterocarpa subsp. brachyclada*		P1	
224.	5541	*Eremaea pauciflora*			
225.	14104	*Eremaea pauciflora var. pauciflora*			
226.	13536	*Eucalyptus decipiens subsp. decipiens*			
227.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
228.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
229.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
230.	13511	*Eucalyptus rudis subsp. rudis*			
231.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			
232.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
233.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
234.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
235.	15498	*Kunzea glabrescens (Spearwood)*			
236.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
237.	5900	*Melaleuca cuticularis (Saltwater Paperbark)*			
238.	13271	*Melaleuca huegelii subsp. huegelii*			
239.	13273	*Melaleuca incana subsp. incana*			
240.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
241.	5946	*Melaleuca pauciflora*			
242.	5952	*Melaleuca preissiana (Moonah)*			
243.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
244.	18598	*Melaleuca systena*			
245.	5978	*Melaleuca teretifolia (Banbar)*			
246.	5980	*Melaleuca thymoides*			
247.	5987	*Melaleuca viminea (Mohan)*			
248.	6006	*Pericalymma ellipticum (Swamp Teatree)*			
249.	16477	*Pericalymma ellipticum var. ellipticum*			
250.	6012	*Regelia ciliata*			
251.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
252.	15432	*Verticordia densiflora var. densiflora*			
253.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
Onagraceae					
254.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
255.	14293	*Oenothera indecora subsp. bonariensis*	Y		
256.	16347	*Oenothera laciniata*	Y		
257.	6140	*Oenothera mollissima*	Y		
Orchidaceae					
258.	1592	*Caladenia flava (Cowslip Orchid)*			
259.	15352	*Caladenia georgei*			
260.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
261.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			
262.	12938	*Diuris micrantha*		T	
263.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
264.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
265.	15419	*Microtis media subsp. media*			
266.	1716	*Thelymitra tigrina (Tiger Orchid)*			
Orobanchaceae					
267.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
Papaveraceae					
268.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
Phyllanthaceae					
269.	4675	*Phyllanthus calycinus (False Boronia)*			
270.	4691	*Poranthera microphylla (Small Poranthera)*			
Phytolaccaceae					
271.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
Plantaginaceae					
272.	34942	*Callitriche brutia subsp. brutia*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
			Y		
273.	19625	*Cymbalaria muralis subsp. muralis*	Y		
274.	14282	*Gratiola pubescens*			
Poaceae					
275.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
276.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
277.	198	*Amphipogon laguroides*			
278.	20184	*Amphipogon laguroides subsp. laguroides*			
279.	200	*Amphipogon turbinatus*			
280.	17234	*Austrostipa compressa*			
281.	17245	*Austrostipa mollis*			
282.	17253	*Austrostipa semibarbata*			
283.	37421	*Austrostipa sp. Marchagee (B.R. Maslin 1407)*			
284.	8661	*Brachypodium distachyon (False Brome)*	Y		
285.	244	*Briza maxima (Blowfly Grass)*	Y		
286.	245	*Briza minor (Shivery Grass)*	Y		
287.	249	*Bromus diandrus (Great Brome)*	Y		
288.	41568	*Cenchrus setaceus (Fountain Grass)*	Y		
289.	277	*Cortaderia selloana (Pampas Grass)*	Y		
290.	299	*Deyeuxia quadriseta (Reed Bentgrass)*			
291.	11105	*Echinochloa crus-galli*	Y		
292.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
293.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
294.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
295.	20019	*Lachnagrostis filiformis*			
296.	478	*Lolium rigidum (Wimmera Ryegrass)*	Y		
297.	485	*Microlaena stipoides (Weeping Grass)*			
298.	527	*Paspalum dilatatum*	Y		
299.	578	*Poa porphyroclados*			
300.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
301.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
Polygalaceae					
302.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
Portulacaceae					
303.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
304.	2856	*Calandrinia liniflora (Parakeelya)*			
Primulaceae					
305.	11647	*Samolus repens var. repens*			
Proteaceae					
306.	1775	*Adenanthos cygnorum (Common Woollybush)*			
307.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
308.	1791	*Adenanthos obovatus (Basket Flower)*			
309.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
310.	32580	*Banksia dallanneyi var. dallanneyi*			
311.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
312.	1830	*Banksia littoralis (Swamp Banksia, Pungura)*			
313.	1834	*Banksia menziesii (Firewood Banksia)*			
314.	32077	*Banksia sessilis var. cygnorum*			
315.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
316.	1858	*Conospermum amoenum (Blue Smokebush)*			
317.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
318.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
319.	2197	*Hakea prostrata (Harsh Hakea)*			
320.	2216	*Hakea varia (Variable-leaved Hakea)*			
321.	2273	*Persoonia saccata (Snottygobble)*			
322.	2299	*Petrophile linearis (Pixie Mops)*			
323.	2301	*Petrophile macrostachya*			
324.	2312	*Petrophile striata*			
325.	2316	*Stirlingia latifolia (Blueboy)*			
326.	15532	*Synaphea spinulosa subsp. spinulosa*			
Restionaceae					
327.	16595	*Desmocladus flexuosus*			
328.	17838	*Dielsia stenostachya*			
329.	1070	*Hypolaena exsulca*			
330.	17841	*Hypolaena pubescens*			
331.	17683	*Meeboldina cana*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rhamnaceae					
332.	4822	*Rhamnus alaternus (Buckthorn)*	Y		
Rutaceae					
333.	4413	*Boronia crenulata (Aniseed Boronia)*			
334.	16636	*Boronia crenulata subsp. viminea*			
335.	11503	*Boronia crenulata var. crenulata*			
336.	4417	*Boronia dichotoma*			
Salviniaceae					
337.	17737	*Azolla pinnata*			
Santalaceae					
338.	2342	*Leptomeria cunninghamii*			
339.	2344	*Leptomeria empetriformis*			
340.	2350	*Leptomeria pauciflora (Sparse-flowered Currant Bush)*			
Sapindaceae					
341.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
Solanaceae					
342.	6974	*Nicotiana glauca (Tree Tobacco)*	Y		
343.	7020	*Solanum linnaeanum (Apple of Sodom)*	Y		
Stylidiaceae					
344.	7676	*Levenhookia pusilla (Midget Stylewort)*			
345.	7677	*Levenhookia stipitata (Common Stylewort)*			
346.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
347.	7696	*Stylidium calcaratum (Book Triggerplant)*			
348.	25801	*Stylidium hesperium*			
349.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
350.	7785	*Stylidium repens (Matted Triggerplant)*			
351.	25806	*Stylidium scariosum*			
352.	7798	*Stylidium schoenoides (Cow Kicks)*			
Thymelaeaceae					
353.	5237	*Pimelea calcicola*		P3	
354.	5243	*Pimelea ferruginea*			
355.	18117	*Pimelea rosea subsp. rosea*			
Tropaeolaceae					
356.	4360	*Tropaeolum majus (Garden Nasturtium)*	Y		
Violaceae					
357.	5216	*Hybanthus calycinus (Wild Violet)*			
Xanthorrhoeaceae					
358.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
Zamiaceae					
359.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
Zygophyllaceae					
360.	4383	*Tribulus terrestris (Caltrop)*	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Fauna Hammond 11_09_2013

Created By Guest user on 11/09/2013

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°51' 02" E,32°09' 34" S
Buffer 5km
Group By Family

Family	Species	Records
Acanthizidae	6	315
Accipitridae	6	244
Agamidae	3	45
Anatidae	13	753
Araneidae	3	4
Ardeidae	3	96
Artamidae	2	8
Barychelidae	1	1
Campephagidae	1	79
Castniidae	1	2
Charadriidae	4	48
Cheluidae	1	3
Columbidae	5	167
Corvidae	1	197
Cracticidae	3	290
Cuculidae	2	24
Dicaeidae	1	2
Dicruridae	2	296
Elapidae	9	18
Estrildidae	1	1
Falconidae	4	77
Gekkonidae	1	4
Halcyonidae	2	109
Hirundinidae	1	128
Hylidae	2	27
Leporidae	1	1
Limnodynastidae	2	114
Lycosidae	4	4
Macropodidae	1	1
Maluridae	2	151
Meliphagidae	8	404
Meropidae	1	51
Micropholcommatidae	1	1
Muridae	4	7
Myobatrachidae	3	66
Myrmecobiidae	1	2
Neosittidae	1	8
Pachycephalidae	3	136
Paradoxosomatidae	1	1
Pardalotidae	2	123
Pelecanidae	1	73
Peramelidae	3	27
Petroicidae	1	1
Phalacrocoracidae	3	24
Phalangeridae	1	4
Phasianidae	2	2
Podargidae	1	3
Podicipedidae	3	86
Psittacidae	10	125
Pygopodidae	4	53
Rallidae	7	316
Recurvirostridae	3	103
Scincidae	12	533
Scolopacidae	10	103
Scolopendridae	1	2
Sparassidae	1	6
Strigidae	1	1
Sylviidae	2	145
Tachyglossidae	1	1
Tarsipedidae	1	1
Tetragnathidae	1	1
Tettigoniidae	1	3
Theridiidae	1	1
Threskiornithidae	4	306
Typhlopidae	1	2
Urodacidae	1	1
Vespertilionidae	3	5
Zosteropidae	1	137
TOTAL	**194**	**6073**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Acanthizidae					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	25530	*Gerygone fusca (Western Gerygone)*			
5.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
6.	30948	*Smicrornis brevirostris (Weebill)*			
Accipitridae					
7.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
8.	25536	*Accipiter fasciatus (Brown Goshawk)*			
9.	24285	*Aquila audax (Wedge-tailed Eagle)*			
10.	24288	*Circus approximans (Swamp Harrier)*			
11.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*		IA	
12.	24295	*Haliastur sphenurus (Whistling Kite)*			
Agamidae					
13.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
14.	24905	*Pogona minor subsp. minima (Dwarf Bearded Dragon (Houtman Abrolhos Is.), Dwarf Bearded Dragon)*		T	
15.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
Anatidae					
16.	24310	*Anas castanea (Chestnut Teal)*			
17.	24312	*Anas gracilis (Grey Teal)*			
18.	24313	*Anas platyrhynchos (Mallard)*			
19.	24315	*Anas rhynchotis (Australasian Shoveler)*			
20.	24316	*Anas superciliosa (Pacific Black Duck)*			
21.	24318	*Aythya australis (Hardhead)*			
22.	24319	*Biziura lobata (Musk Duck)*			
23.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
24.	24322	*Cygnus atratus (Black Swan)*			
25.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
26.	24328	*Oxyura australis (Blue-billed Duck)*			
27.	24329	*Stictonetta naevosa (Freckled Duck)*			
28.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
Araneidae					
29.	-11836	*Austracantha minax*			
30.	-11830	*Cyrtophora parnasia*			
31.	-12821	*Eriophora biapicata*			
Ardeidae					
32.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
33.	24341	*Ardea pacifica (White-necked Heron)*			
34.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
Artamidae					
35.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
36.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
Barychelidae					
37.	-13273	*Idiommata blackwalli*			
Campephagidae					
38.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
Castniidae					
39.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
Charadriidae					
40.	25574	*Charadrius dubius (Little Ringed Plover)*		IA	
41.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
42.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
43.	24386	*Vanellus tricolor (Banded Lapwing)*			
Cheluidae					
44.	25337	*Chelodina oblonga (Oblong Turtle)*			
Columbidae					
45.	24399	*Columba livia (Domestic Pigeon)*	Y		
46.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
47.	24409	*Phaps chalcoptera (Common Bronzewing)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
48.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
49.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
Corvidae					
50.	25592	*Corvus coronoides (Australian Raven)*			
Cracticidae					
51.	25595	*Cracticus tibicen (Australian Magpie)*			
52.	25596	*Cracticus torquatus (Grey Butcherbird)*			
53.	25597	*Strepera versicolor (Grey Currawong)*			
Cuculidae					
54.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
55.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
Dicaeidae					
56.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
Dicruridae					
57.	24443	*Grallina cyanoleuca (Magpie-lark)*			
58.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
Elapidae					
59.	42381	*Brachyurophis semifasciatus*			
60.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
61.	25250	*Elapognathus coronatus (Crowned Snake)*			
62.	25249	*Neelaps calonotos (Black-striped Snake)*		P3	
63.	25252	*Notechis scutatus (Tiger Snake)*			
64.	25253	*Parasuta gouldii*			
65.	25511	*Pseudonaja affinis (Dugite)*			
66.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
67.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
Estrildidae					
68.	25683	*Lonchura castaneothorax (Chestnut-breasted Mannikin)*			
Falconidae					
69.	25621	*Falco berigora (Brown Falcon)*			
70.	25622	*Falco cenchroides (Australian Kestrel)*			
71.	25623	*Falco longipennis (Australian Hobby)*			
72.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
Gekkonidae					
73.	24980	*Christinus marmoratus (Marbled Gecko)*			
Halcyonidae					
74.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
75.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
Hirundinidae					
76.	24491	*Hirundo neoxena (Welcome Swallow)*			
Hylidae					
77.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
78.	25388	*Litoria moorei (Motorbike Frog)*			
Leporidae					
79.	24085	*Oryctolagus cuniculus (Rabbit)*	Y		
Limnodynastidae					
80.	25410	*Heleioporus eyrei (Moaning Frog)*			
81.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
Lycosidae					
82.	-11630	*Artoria flavimana*			
83.	-12841	*Kangarosa properipes*			
84.	-12809	*Lycosa ariadnae*			
85.	-11721	*Venator immansueta*			
Macropodidae					
86.	24131	*Macropus eugenii subsp. derbianus (Tammar Wallaby (WA subsp))*		P5	
Maluridae					
87.	25651	*Malurus lamberti (Variegated Fairy-wren)*			
88.	25654	*Malurus splendens (Splendid Fairy-wren)*			
Meliphagidae					
89.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
90.	24561	*Anthochaera carunculata (Red Wattlebird)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
91.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
92.	24567	*Epthianura albifrons (White-fronted Chat)*			
93.	25661	*Lichmera indistincta (Brown Honeyeater)*			
94.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
95.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
96.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
Meropidae					
97.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
Micropholcommatidae					
98.	-11693	*Raveniella peckorum*			
Muridae					
99.	24215	*Hydromys chrysogaster (Water-rat)*		P4	
100.	24223	*Mus musculus (House Mouse)*	Y		
101.	24243	*Rattus fuscipes (Western Bush Rat)*			
102.	24245	*Rattus rattus (Black Rat)*	Y		
Myobatrachidae					
103.	25399	*Crinia glauerti (Clicking Frog)*			
104.	25400	*Crinia insignifera (Squelching Froglet)*			
105.	25420	*Myobatrachus gouldii (Turtle Frog)*			
Myrmecobiidae					
106.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
Neosittidae					
107.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
Pachycephalidae					
108.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
109.	25679	*Pachycephala pectoralis (Golden Whistler)*			
110.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
Paradoxosomatidae					
111.	-12101	*Antichiropus variabilis*			
Pardalotidae					
112.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
113.	25682	*Pardalotus striatus (Striated Pardalote)*			
Pelecanidae					
114.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
Peramelidae					
115.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
116.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
117.	25504	*Perameles bougainville (Western Barred Bandicoot, Marl)*		T	
Petroicidae					
118.	24659	*Petroica goodenovii (Red-capped Robin)*			
Phalacrocoracidae					
119.	25697	*Phalacrocorax carbo (Great Cormorant)*			
120.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
121.	25699	*Phalacrocorax varius (Pied Cormorant)*			
Phalangeridae					
122.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
Phasianidae					
123.	24671	*Coturnix pectoralis (Stubble Quail)*			
124.	25701	*Coturnix ypsilophora (Brown Quail)*			
Podargidae					
125.	25703	*Podargus strigoides (Tawny Frogmouth)*			
Podicipedidae					
126.	25704	*Podiceps cristatus (Great Crested Grebe)*			
127.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
128.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
Psittacidae					
129.	25716	*Cacatua sanguinea (Little Corella)*			
130.	24729	*Cacatua tenuirostris (Eastern Long-billed Corella)*	Y		
131.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
132.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
133.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo),*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
		Carnaby's Cockatoo)		T	
134.	24735	*Glossopsitta porphyrocephala (Purple-crowned Lorikeet)*			
135.	24738	*Neophema elegans (Elegant Parrot)*			
136.	25720	*Platycercus icterotis (Western Rosella)*			
137.	25722	*Polytelis anthopeplus (Regent Parrot)*			
138.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
Pygopodidae					
139.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
140.	25005	*Lialis burtonis*			
141.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
142.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
Rallidae					
143.	25727	*Fulica atra (Eurasian Coot)*			
144.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
145.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
146.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
147.	24769	*Porzana fluminea (Australian Spotted Crake)*			
148.	25732	*Porzana pusilla (Baillon's Crake)*			
149.	24771	*Porzana tabuensis (Spotless Crake)*			
Recurvirostridae					
150.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
151.	25734	*Himantopus himantopus (Black-winged Stilt)*			
152.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
Scincidae					
153.	42368	*Acritoscincus trilineatus*			
154.	30893	*Cryptoblepharus buchananii*			
155.	25020	*Cryptoblepharus plagiocephalus*			
156.	25027	*Ctenotus australis*			
157.	25100	*Egernia napoleonis*			
158.	25119	*Hemiergis quadrilineata*			
159.	25133	*Lerista elegans*			
160.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
161.	25184	*Menetia greyii*			
162.	25191	*Morethia lineoocellata*			
163.	25519	*Tiliqua rugosa*			
164.	25207	*Tiliqua rugosa subsp. rugosa*			
Scolopacidae					
165.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
166.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
167.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
168.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
169.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
170.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
171.	25741	*Limosa limosa (Black-tailed Godwit)*		IA	
172.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
173.	24808	*Tringa nebularia (Common Greenshank)*		IA	
174.	24809	*Tringa stagnatilis (Marsh Sandpiper)*		IA	
Scolopendridae					
175.	-11860	*Cormocephalus novaehollandiae*			
Sparassidae					
176.	-12192	*Isopeda leishmanni*			
Strigidae					
177.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
Sylviidae					
178.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
179.	25758	*Megalurus gramineus (Little Grassbird)*			
Tachyglossidae					
180.	24207	*Tachyglossus aculeatus (Short-beaked Echidna)*			
Tarsipedidae					
181.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
Tetragnathidae					
182.	-13100	*Nanometa gentilis*			
Tettigoniidae					
183.	33994	*Throscodectes xiphos (cricket)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
				P1	
Theridiidae					
184.	-11913	*Crustulina bicruciata*			
Threskiornithidae					
185.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
186.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
187.	24844	*Threskiornis molucca (Australian White Ibis)*			
188.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
Typhlopidae					
189.	25271	*Ramphotyphlops australis*			
Urodacidae					
190.	-12778	*Urodacus novaehollandiae*			
Vespertilionidae					
191.	24186	*Chalinolobus gouldii (Gould's Wattled Bat)*			
192.	24189	*Falsistrellus mackenziei (Western False Pipistrelle)*		P4	
193.	24194	*Nyctophilus geoffroyi (Lesser Long-eared Bat)*			
Zosteropidae					
194.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Appendix D – Flora results

Flora species list recorded within the Study Area during the survey

Likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the Study Area

Quadrat data & photographs

Flora species identified within the Study Area during the survey

Family	Taxon	EPBC ACT	WC Act	DPaW	Introduced
Aizoaceae	*Carpobrotus edulis*				*
Anarthriaceae	*Lyginia barbata*				
Anarthriaceae	*Lyginia imberbis*				
Araliaceae	*Trachymene pilosa*				
Asparagaceae	*Asparagus asparagoides*				* DP, WoNS
Asparagaceae	*Laxmannia squarrosa*				
Asparagaceae	*Lomandra caespitosa*				
Asparagaceae	*Lomandra preissii*				
Asparagaceae	*Thysanotus sp.*				
Asteraceae	*Arctotheca calendula*				*
Asteraceae	*Hypochaeris sp.*				*
Asteraceae	*Podolepis gracilis*				
Asteraceae	*Podotheca gnaphalioides*				
Asteraceae	*Ursinia anthemoides*				*
Casuarinaceae	*Allocasuarina fraseriana*				
Colchicaceae	*Burchardia congesta*				
Cyperaceae	*Baumea juncea*				
Cyperaceae	*Lepidosperma pubisquameum*				
Cyperaceae	*Mesomelaena pseudostygia*				
Cyperaceae	*Schoenus curvifolius*				
Dasypogonaceae	*Dasypogon bromeliifolius*				
Dilleniaceae	*Hibbertia hypericoides*				
Dilleniaceae	*Hibbertia racemosa*				
Droseraceae	*Drosera erythrorhiza*				
Droseraceae	*Drosera menziesii*				
Ericaceae	*Conostephium pendulum*				
Ericaceae	*Leucopogon polymorphus*				
Ericaceae	*Leucopogon sp.*				
Euphorbiaceae	*Euphorbia terracina*				*
Fabaceae	*Acacia alata*				
Fabaceae	*Acacia pulchella*				
Fabaceae	*Acacia saligna*				
Fabaceae	*Acacia sp.*				
Fabaceae	*Bossiaea eriocarpa*				
Fabaceae	*Daviesia triflora*				
Fabaceae	*Gompholobium tomentosum*				
Fabaceae	*Hovea pungens*				
Fabaceae	*Hovea trisperma*				
Fabaceae	*Jacksonia floribundum*				
Goodeniaceae	*Dampiera linearis*				
Goodeniaceae	*Scaevola sp.*				
Haemodoraceae	*Conostylis aculeata*				
Haemodoraceae	*Conostylis setigera*				
Haemodoraceae	*Phlebocarya ciliata*				
Haloragaceae	*Gonocarpus paniculatus*				
Hemerocallidaceae	*Agrostocrinum hirsutum*				
Hemerocallidaceae	*Caesia micrantha*				
Hemerocallidaceae	*Dianella revoluta*				
Hemerocallidaceae	*Tricoryne elatior*				
Iridaceae	*Gladiolus caryophyllaceus*				*
Iridaceae	*Patersonia occidentalis*				

Family	Taxon	EPBC ACT	WC Act	DPaW	Introduced
Lamiaceae	*Hemiandra pungens*				
Loranthaceae	*Nuytsia floribunda*				
Molluginaceae	*Macarthuria australis*				
Myrtaceae	*Astartea scoparia*				
Myrtaceae	*Calytrix fraseri*				
Myrtaceae	*Calytrix sp.*				
Myrtaceae	*Eremaea asterocarpa*				
Myrtaceae	*Eremaea pauciflora var. pauciflora*				
Myrtaceae	*Eucalyptus marginata*				
Myrtaceae	*Hypocalymma angustifolium*				
Myrtaceae	*Hypocalymma robustum*				
Myrtaceae	*Kennedia sp.*				
Myrtaceae	*Kunzea glabrescens*				
Myrtaceae	*Melaleuca rhaphiophylla*				
Myrtaceae	*Melaleuca thymoides*				
Myrtaceae	*Scholtzia involucrata*				
Orchidaceae	*Caladenia flava*				
Orchidaceae	*Caladenia paludosa*				
Orchidaceae	*Caladenia sp.*				
Orchidaceae	*Elythranthera brunonis*				
Orchidaceae	*Leptoceras menziesii*				
Orchidaceae	*Microtis media*				
Orchidaceae	*Pyrorchis nigricans*				
Orchidaceae	*Thelymitra crinita*				
Orchidaceae	*Thelymitra sp.*				
Orobanchaceae	*Orobanche minor*				*
Papaveraceae	*Fumaria sp.*				*
Poaceae	*Amphipogon turbinatus*				
Poaceae	*Austrostipa sp.*				
Poaceae	*Avena barbata*				*
Poaceae	*Briza maxima*				*
Poaceae	*Bromus diandrus*				*
Poaceae	*Bromus hordeaceus*				*
Poaceae	*Ehrharta calycina*				*
Poaceae	*Ehrharta sp.*				*
Poaceae	*Eragrostis curvula*				*
Poaceae	*Lolium sp.*				*
Poaceae	*Vulpia bromoides*				*
Proteaceae	*Adenanthos cygnorum*				
Proteaceae	*Banksia attenuata*				
Proteaceae	*Banksia illicifolia*				
Proteaceae	*Banksia litoralis*				
Proteaceae	*Banksia menziesii*				
Proteaceae	*Persoonia saccata*				
Proteaceae	*Petrophile linearis*				
Proteaceae	*Stirlingia latifolia*				
Restionaceae	*Desmocladus flexuosus*				
Restionaceae	*Hypolaena exsulca*				
Rubiaceae	*Opercularia vaginata*				
Rutaceae	*Boronia crenulata*				

Flora species identified within the Study Area during the survey

Family	Taxon	EPBC ACT	WC Act	DPaW	Introduced
Rutaceae	*Philotheca spicata*				
Solanaceae	*Solanum nigrum*				*
Stylidiaceae	*Stylidium piliferum*				
Stylidiaceae	*Stylidium repens*				
Stylidiaceae	*Stylidium schoenoides*				
Stylidiaceae	*Stylidium sp.*				
Stylidiaceae	*Stylidium striatum*				
Thymelaeaceae	*Pimelea lehmanniana*				
Violaceae	*Hybanthus calycinus*				
Xanthorrhoeaceae	*Xanthorrhoea preissii*				
Zamiaceae	*Macrozamia riedlei*				
	* *Introduced species*				

Likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the Study Area

Scientific name	Common name	Status		Source			Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	WAHERB/ TPFL	EPBC search			
Andersonia gracilis	Slender Andersonia	T	E			X	Slender erect or open straggly shrub, 0.1-0.5(-1) m high. Fl. white-pink-purple, Sep to Nov. White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps. Andersonia gracilis is currently known from the Badgingarra, Dandaragan and Kenwick areas where it is found on seasonally damp, black sandy clay flats near or on the margins of swamps, often on duplex soils supporting low open heath vegetation with species such as *Calothamnus hirsutus, Verticordia densiflora* and *Kunzea recurva* over sedges.	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Department of Environment and Conservation (2006). Slender Andersonia (*Andersonia gracilis*) Interim Recovery Plan 2006-2011. Interim Recovery Plan No. 228. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Caladenia huegelii	King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	T	E	X		X	Tuberous, perennial, herb, 0.25-0.6 m high. Fl. green & cream & red, Sep to Oct. Grey or brown sand, clay loam.	Possible	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Centrolepis caespitosa		P4	E			X	Tufted annual, herb (forming a rounded cushion up to 25 mm across). Fl. Oct to Dec. White sand, clay. Salt flats, wet areas. Centrolepis caespitosa occurs in winter-wet clay pans dominated by low shrubs and sedges	Very unlikely as preferred habitat is not present	Department of Conservation and Land Management (2004). Matted centrolepis (*Centrolepis caespitosa*) 2004-2008 Interim Recovery Plan No 159 (Gilfillan, S. & S. Barrett, 2004) Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Cyathochaeta teretifolia		P3		X	X		Rhizomatous, clumped, robust perennial, grass-like or herb (sedge), to 2 m high, to 1.0 m wide. Fl. Brown. Grey sand, sandy clay. Swamps, creek edges.	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Darwinia foetida	Muchea bell	T	CE			X	Erect, or spreading, shrub to 0.7 m high, often using other shrubs for support. Young branches are slender, green-brown with prominent, decurrent leaf bases, becoming grey and woody. Fl. Green, Oct to Nov. Grey or white sand, swampy, seasonally wet sites. The Muchea Bell is known from three populations in swampy, seasonally wet habitat in the Muchea area, approximately 70km north of Perth.	Very unlikely as preferred habitat is not present	Commonwealth Conservation Advice on *Darwinia* sp. *Muchea* (B.J.Keighery 2458) (Muchea Bell) (Threatened Species Scientific Committee (TSSC), 2009ab) [Conservation Advice]. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Diuris micrantha	Dwarf Bee-orchid	T	V	X	X	X	Tuberous, perennial, herb, 0.3-0.6 m high. Fl. yellow & brown, Sep to Oct. Brown loamy clay. Winter-wet swamps, in shallow water. Dwarf Bee-orchid is known from seven populations, from east of Kwinana and south towards the Frankland area, Western Australia. It is found in small populations, on dark, grey to blackish, sandy clay-loam substrates in winter wet depressions or swamps. The bases of the flowering plants are often covered with shallow water	Unlikely as preferred habitat is not present	Commonwealth Conservation Advice on *Diuris micrantha* (Threatened Species Scientific Committee, 2008mo) [Conservation Advice]. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Diuris purdiei	Purdie's Donkey Orchid	T	E			X	Tuberous, perennial, herb, 0.15-0.35 m high. Fl. yellow, Sep to Oct. Grey-black sand, moist. Winter-wet swamps. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath and emergent trees	Very unlikely as preferred habitat is not present	Commonwealth Conservation Advice on Diuris purdiei (Purdie's Donkey-orchid) (Threatened Species Scientific Committee, 2008j) [Conservation Advice]. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Dodonaea hackettiana	Hackett's Hopbush	P4		X	X		Erect shrub or tree, 1-5 m high. Fl. yellow-green/red, mainly Jul to Oct. Sand. Outcroping limestone.	Very unlikely as preferred habitat is not present	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Drakaea elastica	Glossy-leaved Hammer-orchid, Praying Virgin	T	E		X	X	Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red & green & yellow, Oct to Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps. Preferred habitat is low-lying areas of deep sand supporting banksia woodland or spearwood thicket	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Department of Environment and Conservation (2009). National recovery plan for the Glossy-leafed Hammer Orchid (*Drakaea elastica*) (Department of Environment and Conservation, 2009l) Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Drakaea micrantha	Dwarf Hammer-orchid	T	V			X	Tuberous, perennial, herb, 0.15-0.3 m high. Fl. red & yellow, Sep to Oct. White-grey sand. The species is usually found in cleared fire breaks or open sandy patches that have been disturbed, and where competition from other plants has been removed. It occurs in infertile grey sands, in Banksia, Jarrah and Common Sheoak woodl and thickets of Spearwood (*Kunzea ericifolia*)	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Commonwealth Conservation Advice on *Drakaea micrantha* Hopper & A.P.Brown nom. inval. (Dwarf Hammer-orchid) (Threatened Species Scientific Committee, 2008k) [Conservation Advice]. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Eremaea asterocarpa subsp. brachyclada		P1		X	X		Shrub, to 0.7 m high. Fl. orange. Deep grey sand. Local Government Areas (LGAs): Gosnells.	Possible	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Jacksonia gracillima		P3		X	X		Local Government Areas (LGAs): Armadale, Busselton, Capel, Cockburn, Murray, Serpentine-Jarrahdale.	Possible	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.

Scientific name	Common name	Status		Source			Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	WAHERB/ TPFL	EPBC search			
Lepidosperma rostratum	Beaked Lepidosperma	T	E			X	Rhizomatous, tufted perennial, grass-like or herb (sedge), 0.5 m high. Fl. brown. Peaty sand, clay. Beaked Lepidosperma is associated with Marsh Banksia (*Banksia telmatiaea*) and Hairy Clawflower (*Calothamnus hirsutus*), and grows in sandy soil among low heath in a winter-wet swamp	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Commonwealth Conservation Advice on *Lepidosperma rostratum* (Threatened Species Scientific Committee, 2008rh) [Conservation Advice]. Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/.
Pimelea calcicola		P3		X	X		Erect to spreading shrub, 0.2-1 m high. Fl. pink, Sep to Nov. Sand. Coastal limestone ridges.	Very unlikely as preferred habitat is not present	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/
Tripterococcus paniculatus		P4		X	X		Perennial, herb, to 1 m high. Fl. yellow-green, Oct to Nov. Grey, black or peaty sand. Winter-wet flats.	Very unlikely as preferred habitat is not present and possible habitat is very degraded	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/
Verticordia lindleyi subsp. *lindleyi*		P4		X	X		Erect shrub, 0.2-0.75 m high. Fl. pink, May or Nov to Dec or Jan. Sand, sandy clay. Winter-wet depressions.	Unlikely as preferred habitat is not present and possible habitat is very degraded	Western Australian (WA) Herbarium 1998–. FloraBase—the Western Australian Flora, retrieved November, 2013, from http://florabase.dpaw.wa.gov.au/

Quadrat data & photographs

Site	Q01	Project	Hammond Park
Type:	Quadrat	**Size:**	10 × 10 m
Date:	11/10/2013	**Described by:**	CB & LZ
Co-ordinates:	MGA 50	mE 391650	mN 6439732
Location:	Hammond Park		
Landform:	Flat		
Drainage:	Good drainage		
Soil colour & type:	White/grey sand		
Vegetation type:	*Banksia*/*Kunzea* woodland		
Vegetation condition:	Degraded (5)		
Fire age & intensity:	Old (> 5 years), no damage		
Disturbances:	Clearing, exotic weeds, sheep grazing (completely degraded understorey), ?dieback		
Bare ground (%):	10-30	**Logs (%):**	10-30
Twigs (%):	30-70	**Leaves (%):**	30-70
Rocks <2 cm (%):	0	**Rocks 2-30 cm (%):**	0
Rocks >30 cm (%):	0	**Veg. ground layer (%):**	2-10

Species list

Family	Species	Status	Stratum	Cover (%)	Height (m)
Casuarinaceae	*Allocasuarina fraseriana*		U1	10-30	4.5
Proteaceae	*Banksia attenuata*		U1	10-30	3.5
Proteaceae	*Banksia littoralis*		U1	2-10	4.0
Proteaceae	*Banksia menziesii*		U1	2-10	5.5
Myrtaceae	*Kunzea glabrescens*		M1	10-30	3.0
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M2	2-10	1.5
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M3	2-10	0.8
Cyperaceae	*Schoenus curvifolius*		G1	2-10	0.4
Restionaceae	*Desmocladus flexuosus*		G2	2-10	0.2
Dasypogonaceae	*Dasypogon bromeliifolius*		G2	2-10	0.3
Dilleniaceae	*Hibbertia hypericoides*		G2	2-10	0.2
Araliaceae	*Trachymene pilosa*		G2	<2	0.5
Asparagaceae	*Lomandra caespitosa*		G2	<2	0.2
Asteraceae	*Arctotheca calendula*	*	G2	<2	0.1
Droseraceae	*Drosera menziesii*		G2	<2	0.05
Hemerocallidaceae	*Agrostocrinum hirsutum*		G2	<2	0.4
Orchidaceae	*Caladenia flava*		G2	<2	0.1
Orchidaceae	*Leptoceras menziesii*		G2	<2	0.1
Poaceae	*Bromus hordeaceus*	*	G2	<2	0.3
Poaceae	*Vulpia bromoides*	*	G2	<2	0.1

Site	Q02	Project	Hammond Park
Type:	Quadrat	**Size:**	10 × 10 m
Date:	11/10/2013	**Described by:**	CB & LZ
Co-ordinates:	MGA 50	mE 0391583	mN 6439854
Location:	Hammond Park		
Landform:	Flat		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation type:			
Vegetation condition:	Excellent (2) – Very Good (3)		
Fire age & intensity:	Nil		
Disturbances:	Clearing, exotic weeds		
Bare ground (%):	10-30	**Logs (%):**	0
Twigs (%):	10-30	**Leaves (%):**	30-70
Rocks <2 cm (%):	0	**Rocks 2-30 cm (%):**	0
Rocks >30 cm (%):	0	**Veg. ground layer (%):**	30-70

Species list

Family	Species	Status	Stratum	Cover (%)	Height (m)
Proteaceae	*Banksia attenuata*		U1	30-70	5.5
Proteaceae	*Banksia illicifolia*		U1	<2	2.5
Proteaceae	*Banksia menziesii*		U1	<2	2.5
Myrtaceae	*Kunzea glabrescens*		M1	2-10	3.5
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M1	<2	2.5
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M2	30-70	1.5
Myrtaceae	*Kunzea glabrescens*		M2	<2	2.5
Myrtaceae	*Melaleuca thymoides*		M2	<2	2.5
Dilleniaceae	*Hibbertia racemosa*		M3	30-70	0.8
Ericaceae	*Leucopogon sp.*		M3	30-70	0.2
Myrtaceae	*Calytrix sp.*		M3	10-30	0.4
Fabaceae	*Gompholobium tomentosum*		M3	2-10	0.7
Fabaceae	*Bossiaea eriocarpa*		M3	2-10	0.3
Ericaceae	*Leucopogon polymorphus*		M3	<2	0.4
Fabaceae	*Hovea trisperma*		M3	<2	0.5
Proteaceae	*Petrophile linearis*		M3	<2	0.6
Haemodoraceae	*Phlebocarya ciliata*		G1	30-70	0.5
Dasypogonaceae	*Dasypogon bromeliifolius*		G1	10-30	0.6
Asparagaceae	*Lomandra preissii*		G1	2-10	0.25
Hemerocallidaceae	*Caesia micrantha*		G1	2-10	0.20
Araliaceae	*Trachymene pilosa*		G1	<2	0.2
Asparagaceae	*Thysanotus sp.*		G1	<2	Creeper
Asteraceae	*Ursinia anthemoides*	*	G1	<2	0.15
Asteraceae	*Hypochaeris sp.*	*	G1	<2	0.05
Colchicaceae	*Burchardia congesta*		G1	<2	0.4
Droseraceae	*Drosera erythrorhiza*		G1	<2	0.05
Haemodoraceae	*Conostylis aculeata*		G1	<2	0.15
Haloragaceae	*Gonocarpus paniculatus*		G1	<2	0.4
Iridaceae	*Gladiolus caryophyllaceus*	*	G1	<2	0.7
Orchidaceae	*Caladenia sp.*		G1	<2	0.1
Orchidaceae	*Pyrorchis nigricans*		G1	<2	0.05
Orchidaceae	*Thelymitra sp.*		G1	<2	0.15
Orchidaceae	*Leptoceras menziesii*		G1	<2	0.05
Orobanchaceae	*Orobanche minor*	*	G1	<2	0.15
Poaceae	*Ehrharta sp.*	*	G1	<2	0.15
Poaceae	*Briza maxima*	*	G1	<2	0.3
Restionaceae	*Hypolaena exsulca*		G1	<2	0.6
Stylidiaceae	*Stylidium repens*		G1	<2	0.15
Stylidiaceae	*Stylidium schoenoides*		G1	<2	0.15

Site	Q03	Project	Hammond Park
Type:	Quadrat	**Size:**	10 × 10 m
Date:	11/10/2013	**Described by:**	CB & LZ
Co-ordinates:	MGA 50	mE 0393266	mN 6479456
Location:	Hammond Park		
Landform:	Flat		
Drainage:	Good drainage		
Soil colour & type:	Grey sand		
Vegetation type:			
Vegetation condition:	Excellent (2) – Very Good (3)		
Fire age & intensity:	Nil		
Disturbances:	Exotic weeds		
Bare ground (%):	10-30	**Logs (%):**	0
Twigs (%):	2-10	**Leaves (%):**	30-70
Rocks <2 cm (%):	0	**Rocks 2-30 cm (%):**	0
Rocks >30 cm (%):	0	**Veg. ground layer (%):**	30-70

Species list

Family	Species	Status	Stratum	Cover (%)	Height (m)
Proteaceae	*Banksia menziesii*		U1	10-30	5.0
Proteaceae	*Banksia illicifolia*		U1	2-10	5.0
Proteaceae	*Banksia litoralis*		U1	<2	5.0
Myrtaceae	*Kunzea glabrescens*		M1	2-10	4.0
Fabaceae	*Jacksonia floribundum*		M1	<2	2.0
Myrtaceae	*Kunzea glabrescens*		M2	2-10	1.5
Myrtaceae	*Scholtzia involucrata*		M3	30-70	0.3
Ericaceae	*Conostephium pendulum*		M3	30-70	0.3
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M3	10-30	1.0
Myrtaceae	*Calytrix fraseri*		M3	10-30	0.4
Dilleniaceae	*Hibbertia racemosa*		M3	<2	0.25
Proteaceae	*Petrophile linearis*		M3	<2	0.15
Fabaceae	*Gompholobium tomentosum*		M3	<2	0.3
Fabaceae	*Bossiaea eriocarpa*		M3	<2	0.2
Anarthriaceae	*Lyginia imberbis*		G1	<2	0.5
Cyperaceae	*Schoenus curvifolius*		G1	<2	0.2
Cyperaceae	*Lepidosperma pubisquameum*		G1	<2	0.4
Dasypogonaceae	*Dasypogon bromeliifolius*		G2	10-30	0.6
Haemodoraceae	*Phlebocarya ciliata*		G2	10-30	0.5
Restionaceae	*Desmocladus flexuosus*		G2	2-10	0.2
Araliaceae	*Trachymene pilosa*		G2	<2	0.05
Asparagaceae	*Lomandra preissii*		G2	<2	0.15
Asteraceae	*Hypochaeris sp.*	*	G2	<2	0.05
Asteraceae	*Ursinia anthemoides*	*	G2	<2	0.05
Asteraceae	*Podotheca gnaphalioides*		G2	<2	0.2
Colchicaceae	*Burchardia congesta*		G2	<2	0.25
Goodeniaceae	*Dampiera linearis*		G2	<2	0.1
Iridaceae	*Gladiolus caryophyllaceus*	*	G2	<2	0.4
Iridaceae	*Patersonia occidentalis*		G2	<2	0.4
Orchidaceae	*Pyrorchis nigricans*		G2	<2	0.05
Poaceae	*Briza maxima*	*	G2	<2	0.15
Poaceae	*Ehrharta calycina*	*	G2	<2	0.4
Poaceae	*Vulpia bromoides*	*	G2	<2	0.15
Poaceae	*Austrostipa compressa*		G2	<2	0.20
Stylidiaceae	*Stylidium striatum*		G2	<2	0.3

Site	Q04	Project	Hammond Park
Type:	Quadrat	**Size:**	10 × 10 m
Date:	11/10/2013	**Described by:**	CB & LZ
Co-ordinates:	MGA 50	mE 0391703	mN 6439980
Location:	Hammond Park		
Landform:	Plain		
Drainage:	Good drainage		
Soil colour & type:	Brown silty sand		
Vegetation type:			
Vegetation condition:	Excellent (2)		
Fire age & intensity:	Old (>5 years)		
Disturbances:	Exotic weeds		
Bare ground (%):	0	**Logs (%):**	10-30
Twigs (%):	10-30	**Leaves (%):**	30-70
Rocks <2 cm (%):	0	**Rocks 2-30 cm (%):**	0
Rocks >30 cm (%):	0	**Veg. ground layer (%):**	30-70

Species list

Family	Species	Status	Stratum	Cover (%)	Height (m)
Proteaceae	*Banksia menziesii*		U1	30-70	5
Proteaceae	*Banksia attenuata*		U1	30-70	5
Proteaceae	*Banksia ilicifolia*		U1	10-30	5
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M1	2-10	2
Myrtaceae	*Eremaea pauciflora var. pauciflora*		M1	2-10	1.5
Xanthorrhoeaceae	*Xanthorrhoea preissii*		M2	10-30	1
Fabaceae	*Bossiaea eriocarpa*		M3	<2	0.3
Myrtaceae	*Calytrix fraseri*		M3	<2	0.15
Cyperaceae	*Lepidosperma pubisquameum*		G1	30-70	0.5
Anarthriaceae	*Lyginia imberbis*		G1	10-30	0.4
Cyperaceae	*Schoenus curvifolius*		G1	<2	0.3
Iridaceae	*Patersonia occidentalis*		G2	2-10	0.4
Haemodoraceae	*Phlebocarya ciliata*		G2	30-70	0.2
Restionaceae	*Desmocladus flexuosus*		G2	30-70	0.15
Dasypogonaceae	*Dasypogon bromeliifolius*		G2	30-70	0.4
Araliaceae	*Trachymene pilosa*		G2	<2	0.1
Asparagaceae	*Lomandra caespitosa*		G2	2-10	0.4
Asparagaceae	*Asparagus asparagoides*	* DP, WoNS	G2	<2	0.8
Colchicaceae	*Burchardia congesta*		G2	<2	0.4
Droseraceae	*Drosera erythrorhiza*		G2	<2	0.05
Haemodoraceae	*Conostylis aculeata*		G2	<2	0.2
Hemerocallidaceae	*Caesia micrantha*		G2	<2	0.4
Hemerocallidaceae	*Tricoryne elatior*		G2	2-10	0.2
Iridaceae	*Gladiolus caryophyllaceus*	*	G2	<2	0.8
Iridaceae	*Patersonia occidentalis*		G2	<2	0.3
Orchidaceae	*Thelymitra* sp.		G2	<2	0.3
Orchidaceae	*Microtis media*		G2	<2	0.4
Orchidaceae	*Pyrorchis nigricans*		G2	<2	0.2
Poaceae	*Briza maxima*	*	G2	<2	0.15
Poaceae	*Ehrharta calycina*	*	G2	<2	0.8
Poaceae	*Avena barbata*	*	G2	<2	0.4
Restionaceae	*Hypolaena exsulca*		G2	<2	0.3
Rubiaceae	*Opercularia vaginata*		G2	2-10	0.2
Solanaceae	*Solanum nigrum*	*	G2	<2	0.3
Stylidiaceae	*Stylidium schoenoides*		G2	<2	0.3

Site	Q05	Project	Hammond Park
Type:	Quadrat	**Size:**	10 × 10 m
Date:	11/10/2013	**Described by:**	CB & LZ
Co-ordinates:	MGA 50	mE 0391719	mN 6439914
Location:	Hammond Park		
Landform:	Plain		
Drainage:	Seasonal wet		
Soil colour & type:	Black/grey sand		
Vegetation type:			
Vegetation condition:	Good (4) – Degraded (5)		
Fire age & intensity:	Old (>5 years)		
Disturbances:	Exotic weeds, clearing		
Bare ground (%):	2-10	**Logs (%):**	<2
Twigs (%):	10-30	**Leaves (%):**	30-70
Rocks <2 cm (%):	0	**Rocks 2-30 cm (%):**	0
Rocks >30 cm (%):	0	**Veg. ground layer (%):**	30-70

Species list

Family	Species	Status	Stratum	Cover (%)	Height (m)
Myrtaceae	*Melaleuca rhaphiophylla*		U1	2-10	6
Myrtaceae	*Kunzea glabrescens*		M1	30-70	3
Myrtaceae	*Astartea scoparia*		M1	30-70	1.5
Myrtaceae	*Hypocalymma angustifolium*		M2	30-70	1
Poaceae	*Ehrharta calycina*	*	G1	30-70	1.4
Asteraceae	*Arctotheca calendula*	*	G1	10-30	0.15
Asparagaceae	*Lomandra caespitosa*		G1	<2	0.8
Asteraceae	*Hypochaeris sp.*	*	G1	<2	0.05
Iridaceae	*Gladiolus caryophyllaceus*	*	G1	<2	0.8
Iridaceae	*Patersonia occidentalis*		G1	<2	0.5
Poaceae	*Avena barbata*	*	G1	<2	0.5

Appendix E – Fauna results

Fauna species recorded within the Study Area during the field survey

Fauna likelihood of occurrence assessment of conservation significant fauna identified in the desktop assessment as potentially occurring within the Study Area

Significant habitat trees (diameter at breast height >500 mm) recorded within the Study Area

Fauna species identified within the Study Area during the survey

Family	Taxon	Common name	EPBC ACT	WC Act	DEC	Locally Significant	Introduced
Birds							
Accipitridae	*Haliastur sphenurus*	Whistling Kite				x	
Anatidae	*Tadorna tadornoides*	Australian Shelduck					
Anatidae	*Anas superciliosa*	Pacific Black Duck					
Cacatuidae	*Eolophus roseicapilla*	Galah					
Casuariidae	*Dromaius novaehollandiae*	Emu				x	
Columbidae	*Ocyphaps lophotes*	Crested Pigeon					
Corvidae	*Corvus coronoides perplexus*	Australian Raven					
Cracticidae	*Cracticus tiibicen dorsalis*	Australian Magpie					
Dicruridae	*Grallina cyanoleuca*	Magpie-lark					
Dicruridae	*Rhipidura leucophrys leucophrys*	Willie Wagtail					
Hirundinidae	*Hirundo neoxena*	Welcome Swallow					
Maluridae	*Malurus splendens*	Splendid Fairy-wren				x	
Motacillidae	*Anthus novaeseelandiae*	Richards Pipit					
Psittacidae	*Platycercus zonarius semitorquatus*	Twenty-eight Parrot					
Mammals							
Canidae	*Canis lupus**	Domestic Dog					x
Bovidae	*Bos taurus**	Cow					x
Felidae	*Felis catus**	Cat					x
Leporidae	*Oryctolagus cuniculus**	European Rabbit					x
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo					

* Introduced species

Likelihood of occurrence assessment of conservation significant flora identified in the desktop assessment as potentially occurring within the Study Area

Scientific name	Common name	Status		Source		Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	EPBC search			
Birds								
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	T	V	X	X	Forest Red-tailed Black Cockatoo typically occurs in dense Jarrah (*Eucalyptus marginata*), Karri (*E. diversicolor*) and Marri (*Corymbia calophylla*) forests, however the species also occurs in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (DSEWPaC, 2012). Habitats also tend to have an understorey of *Banksia* spp., *Persoonia* spp., *Allocasuarina* spp.The Forest red-tailed Black Cockatoo generally nests in hollows in live or dead trees of marri, karri, wandoo, bullich, blackbutt, tuart and jarrah (DSEWPaC 2012).	Likely The Forest Red-tailed Black Cockatoo has been recorded within 5 km of the Study Area and there is suitable foraging and potential breeding habitat present.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012).Environmental Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species. Department of Sustainability, Environment, Water, Population and Communities. Australian Government Canberra
Calyptorhynchus baudinii	Baudin's Black Cockatoo	T	V		X	Baudin's Black Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri (*Corymbia calophylla*) and Eucalyptus species, especially Karri (*E. diversicolor*) and Jarrah (*E. marginata*). The species also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), and Yate (*E. cornuta*) . Baudin's Black Cockatoo breeds in the Jarrah, Marri and Karri forests of the deep south-west in areas averaging more than 750 mm of rainfall annually. The range of the species extends from Albany northward to Gidgegannup and Mundaring (east of Perth), and inland to the Stirling Ranges and near Boyup Brook. Preferred roosts are in areas with a dense canopy close to permanent sources of water, that provide the birds with protection from weather conditions (DSEWPaC, 2012).	Possible The Study Area is located outside the modelled distribution of the Baudin's Black Cockatoo, however the species has been known to occur on the southern Swan Coastal Plain. This species typically is restricted to the Darling Range, however, sightings have been recorded within the Perth metropolitan area. There is suitable foraging and potential breeding habitat for the Baudin's Black Cockatoo present within the Study Area.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012).Environmental Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species. Department of Sustainability, Environment, Water, Population and Communities. Australian Government Canberra
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	T	E	X	X	This species mainly occurs in uncleared or remnant native eucalypt woodlands and in shrubland or kwongan heathland dominated by Hakea, Dryandra, Banksia and Grevillea species. The species also occurs in forests containing Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) or Karri (*E. diversicolor*). Breeding usually occurs in the Wheatbelt region of Western Australia, with flocks moving to the higher rainfall coastal areas to forage after the breeding season. Feeds on the seeds of a variety of native plants, including Allocasuarina, Banksia, Dryandra, Eucalyptus, Grevillea and Hakea, and some introduced plants (DSEWPaC, 2012).	Known Carnaby's Black Cockatoo was recorded flying over the Study Area during the field survey. This species has been recorded within 5 km of the Study Area and there is suitable foraging and potential breeding habitat present.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012).Environmental Protection and Biodiversity Conservation Act 1999 referral guidelines for three threatened black cockatoo species. Department of Sustainability, Environment, Water, Population and Communities. Australian Government Canberra
Botaurus poiciloptilus	Australasian Bittern	T	E		X	The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands. The species favours foraging in tall, dense vegetation in shallow permanent or seasonal fresh water. In the southwest of Western Australia the Bittern is now largely confined to coastal areas especially along the south coast where it is found in beds of tall rush mixed with or near short fine sedge or open pools (Burbridge 2004). It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum *Muehlenbeckia*, canegrass *Eragrostis* or other dense vegetation. It occasionally ventures into areas of open water or onto banks.	Unlikely There is no suitable habitat present for this species within the Study Area.	Burbidge, A.A (2004) Threatened Animals of Western Australia. Department of Conservation and Land Management, Perth.
Sternula nereis nereis	Australian Fairy Tern	T	V		X	Within Australia, the Fairy Tern occurs along the coasts of Victoria, Tasmania, South Australia and Western Australia; occurring as far north as the Dampier Archipelago near Karratha. The Fairy Tern (Australian) nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland coastline. The bird roosts on beaches at night (Garnett and Crowley 2000; Nevill, 2008)	Unlikely There is no suitable habitat present for this species within the Study Area.	Nevill S. (2008) Birds of the Greater South West Western Australia. Simon Nevill Publications. Perth Australia. Garnett S.T. and Crowley G.M. (2000). The Action Plan for Australian Birds 2000. Environment Australia, Canberra
Falco peregrinus	Peregrine Falcon	S		X		The Peregrine Falcon is seen occasionally anywhere in the south-west of Western Australia. It is found everywhere from woodlands to open grasslands and coastal cliffs - though less frequently in desert regions. The species nests primarily on ledges of cliffs, shallow tree hollows, and ledges of building in cities. (Morcombe, 2004).	Possible The Peregrine Falcon is known to occurr in the region and may utilise the Study Area opportunistically.	Morcombe M, (2004). Field Guide to Australian Birds. Steve Parish Publishing Archer Field Queensland Australia
Calidris ferruginea	Curlew Sandpiper	T	Mi	X		Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DSEWPaC 2013).	Unlikely There is no suitable habitat present for this species within the Study Area.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Australian Government Canberra.
Migratory Birds								

Scientific name	Common name	Status		Source		Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	EPBC search			
Ardea modesta	Great Egret	IA	Mi	X	X	The eastern Great Egret is widespread in Australia. They have been reported in a wide range of wetland habitats, include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pasture or agricultural lands; reservoirs; sewerage treatment ponds; drainage channels; salt pans; salt marshes; mangrove, and a range of coastal/marine habitats (DSEWPaC 2013).	Unlikely There is no suitable habitat present for this species within the Study Area.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Australian Government Canberra.
Haliaeetus leucogaster	White-bellied Sea-Eagle	IA	Mi	X	X	The White-bellied Sea-Eagle occurs in coastal habitats (especially those close to the sea-shore as well as any habitat characterized by the presence of large areas of open water (larger rivers, swamps, lakes, the sea). It also occurs in the vicinity of estuaries, mangroves, swamps, lagoons and floodplains, often far inland along major rivers (Morcombe, 2004).	Unlikely There is no suitable habitat present for this species within the Study Area.	Morcombe M, (2004). Field Guide to Australian Birds. Steve Parish Publishing Archer Field Queensland Australia.
Merops ornatus	Rainbow Bee-eater	IA	Mi	X	X	Open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. It also inhabits sand dune systems in coastal areas and at inland sites that are in close proximity to water (Morcombe, 2004).	Likely The Study Area contains suitable habitat for this species. The Rainbow Bee-eater has previously been recorded in the area.	Morcombe M, (2004). Field Guide to Australian Birds. Steve Parish Publishing Archer Field Queensland Australia.
Leipoa ocellata	Malleefowl	T	V, Mi		X	The Malleefowl generally occurs in semi-arid areas of Western Australia, from Carnarvon to south east of the Eyre Bird Observatory (south-east Western Australia). It occupies shrublands and low woodlands that are dominated by mallee vegetation, as well as native pine Callitris woodlands, Acacia shrublands, Broombush *Melaleuca uncinata* vegetation or coastal heathlands. The nest is a large mound of sand or soil and organic matter (DSEWPaC 2013).	Unlikely The Malleefowl has never been recorded on the Swan Coastal Plain.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Australian Government Canberra.
Plegadis falcinellus	Glossy Ibis	IA	Mi	X		Within Australia, the Glossy Ibis is generally located east of the Kimberley. The species is also known to be patchily distributed in the rest of Western Australia. Its preferred habitat for foraging and breeding are freshwater marshes at the edges of lakes and rivers, lagoons, floodplains, wet meadows, swamps, reservoirs, sewerage ponds, rice-fields and cultivated areas under irrigation (DSEWPaC 2013). The Glossy Ibis is considered scarce to uncommon on the Swan Coastal Plain (Neville 2008).	Unlikely There is no suitable habitat present for this species within the Study Area.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Australian Government Canberra. Nevill S. (2008) Birds of the Greater South West Western Australia. Simon Nevill Publications. Perth Australia.
Rostratula australis	Australian Painted Snipe	T	E, Mi		X	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. The species rarely occurs in south-western Australia, where it was once more common (DSEWPaC 2013).	Unlikely There is no suitable habitat present for this species within the Study Area.	Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2013, *Species Profile and Threats Database (SPRAT)*, Department of Sustainability, Environment, Water, Population and Communities, Australian Government Canberra.
Mammals								
Dasyurus geoffroii	Chuditch, Western Quoll	T	V		X	The Chuditch inhabits eucalypt forest (especially Jarrah, Eucalyptus marginata), dry woodland and mallee shrublands . In Jarrah forest, Chuditch populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest. Most diurnal resting sites in sclerophyll forest consist of hollow logs or earth burrows (Van Dyke & Strahan, 2008). The species can travel large distances, has a large home range and is sparsely populated through a large portion of its range.	Unlikely Historically the species was known to be wide spread on the Swan Coastal Plain. In recent years some records of individuals have been identified however these are associated with large tracks of remnat vegitation. Due to the fragmented nature of natural vegetation in the area this species is unlikely to occur.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing,Sydney Australia.
Pseudocheirus occidentalis	Western Ringtail Possum	T	V		X	The Western Ringtail Possum occurs in and near coastal Peppermint Tree (*Agonis flexuosa*) forest and Tuart (*Eucalyptus gomphocephala*) dominated forest with a Peppermint Tree understorey from Bunbury to Albany. Also occurs in Jarrah (*Eucalyptus marginata*) forest and Jarrah-Marri (*Corymbia calophylla*) forest associated with Peppermint Tree (Van Dyck and Strahan, 2008).	Unlikely The Western Ringtail Possum is known to occur southern Swan Coastal Plain, however it doesn't not occur as far north as the Study Area.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Isoodon obesulus subsp. *fusciventer*	Quenda, Southern Brown Bandicoot	P5		X		The Quenda prefers dense scrubby, often swampy, vegetation with dense cover up to one metre high. However, it also occurs in woodlands, and may use less ideal habitat where this habitat occurs adjacent to the thicker, more desirable vegetation. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Van Dyck and Strahan, 2008).	Likely There is suitable habitat present within Study Area, and the Quenda has previously been recorded in the Study Area and in surroudning areas of remnant vegetation.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Hydromys chrysogaster	Water-rat	P4		X		Water-rats live primarily in a wide variety of freshwater habitats, from sub-alpine streams and other inland waterways to lakes, swamps, farm dams and irrigation channels and are thought to be one of the few native species to have at least partially benefited from human encroachment (Van Dyck and Strahan, 2008).	Unlikely The Study Area does not contain any permanent water bodies which would provide habitat for the water-rat. The species has previously been recorded within 5 km of the Study Area, near Banganup Lake in 1973.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.

Scientific name	Common name	Status		Source		Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	EPBC search			
Setonix brachyurus	Quokka	T	V		X	Dense forests and thickets, streamside vegetation, heaths and shrublands *Agonis linearifolia*-dominated swamps in the Jarrah (*Eucalyptus marginata*) forest. The northern extent of the current distribution on the mainland is in the Jarrah forest immediately south-east of the Perth metropolitan area, from where it extends southward through the southern Jarrah, Marri and Karri forests to the south coast, but largely confined throughout to areas receiving an annual rainfall of 1,000 millimetres or more (Van Dyck and Strahan, 2008).	Unlikley There is no suitable habitat for the Quokka within the Study Area, and the species has not been recorded within 5 km.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Falsistrellus mackenziei	Western False Pipistrelle	P4		X		The Western False Pipistrelle occurs in wet sclerophyll forest dominated by Karri (Eucalyptus diversicolor), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) forests. The species is restricted to areas in or adjacent to stands of old growth forest. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*E. calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (Churchill 2008).	Unlikely There is no suitable habitat for the Western False Pipistrelle within the Study Area, and the nearest record of the species is from Harry Waring Marsupial Reserve in 1993. This is the only record of the species on the northern Swan Coastal Plain.	Churchill, S (2008). Australian Bats. Second Edition. Allen and Unwin, NSW.
Macropus eugenii subsp. derbianus	Tammar Wallaby (WA subsp)	P5		X		The Tammar Wallaby inhabits dense, low vegetation for daytime shelter and open grassy areas for feeding. Inhabits coastal scrub, heath, dry sclerophyll (leafy) forest and thickets in mallee and woodland The tammar wallaby is currently known to inhabit three islands in the Houtman Abrolhos group, Garden Island near Perth, Middle and North Twin Peak Islands in the Archipelago of the Recherche, and at least nine sites on the mainland including, Dryandra, Boyagin, Tutanning Batalling (reintroduced) Perup, private property near Pingelly, Jaloran Road timber reserve near Wagin, Hopetown, Stirling Range National Park, and Fitzgerald River National Park (Van Dyck and Strahan 2008).	Unlikely The Tammer Wallaby is restricted to known populations on offshore islands and at only nine sites on the mainland.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Myrmecobius fasciatus	Numbat	T	V	X		The numbat's distribution once encompassed a number of habitat types, including eucalypt forest, eucalypt woodland, Acacia woodland and Triodia grasslands. Current populations occupy several different habitat types: upland Jarrah forest, open eucalypt woodland, banksia woodland and tall closed shrubland. There are currently two remnant native populations at Dryandra and Perup, WA and several reintroduced populations including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve.Habitats usually have an abundance of termites in the soil, hollow logs and branches for shelter. This species has been part of a recovery plan since the late 1980's and has been relocated into several areas of the south west (Van Dyck and Strahan, 2008).	Unlikely The Numbat is restricted to known populations at Dryandra and Perup, and several intriduced populations in DPaW managed reserves.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Perameles bougainville	Western Barred Bandicoot	T	Extinct	X		Historically the Western Barred Bandicoot occupied a wide variety of landscapes and vegetation types, including the saltbush covered Nullarbor Plain, sand ridges with woodlands, bluebush plains, desert *Acacia*, shrublands and heath throughout southern Australia (Van Dyck and Strahan, 2008). The western subspecies is now restricted to Bernier and Dorre Islands in Shark Bay.	Unlikely The mainland sub-species of the Western Barred Bandicoot is extinct.	Van Dyke. S & Strahan. R. (2008). The Mammals of Australia. Third Edition. New Holland Publishing, Sydney Australia.
Reptiles								
Neelaps calonotos	Black-striped Burrowing Snake	P3		X		The Black-striped Burrowing Snake is restricted to the sandy coastal strip near Perth, between Mandurah and Lancelin. It occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands, where is shelters in the upper layers of loose soil beneath leaf litter at the base of trees and shrubs. This species is seriously threatened by increasing development within its restricted distribution (Wilson and Swan 2013).	Likely The Black-striped Burrowing Snake has been recorded within 5 km of the Study and there is suitable eucalypt/banksia woodland habitat for the species.	Wilson S and Swan G, (2013) A Complete Guide to Reptiles of Australia. 4th Edition New Holland Press. Sydney Australia.
Lerista lineata	Perth Lined Skink	P3		X		Locally restricted to the Swan Coastal Plain south of the Swan River including Rottnest and Garden Islands, where it inhabits coastal dunes, banksia/eucalypt woodlands and suburban gardens. The Perth lined Lerista shelters in leaf litter and upper layers of loose soil at the bases of shrubs, inside soil heaps and abandoned stick-ant nests.There are also isolated populations on the mid-west coast at Woodleigh Station and in Busselton (Wilson and Swan, 2013).	Likely There is suitable eucalypt/banksia woodland habitat for the Perth Lined Skink within the Study Area and the species has previously been recorded…	Wilson S and Swan G, (2013) A Complete Guide to Reptiles of Australia. 4th Edition New Holland Press. Sydney Australia
Pogona minor subsp. minima	Dwarf Bearded Dragon (Houtman Abrolhos Is.)	T		X		The Houtman Abrolhos Island subspecies of the Dwarf Bearded Dragon is resticted to the Houtman Abrolhos Island off the lower west coast of WA.	Unlikley The Houtman Abrolhos Island subspecies of the Dwarf Bearded Dragon is resticted to the Houtman Abrolhos Island off the lower west coast of WA. There are two NatureMap records in the vicinity of the Perth metropolitan area (both from 2013), and these are most likely mid-identifications.	Wilson S and Swan G, (2013) A Complete Guide to Reptiles of Australia. 4th Edition New Holland Press. Sydney Australia
Invertebrates								

Scientific name	Common name	Status		Source		Description and habitat requirements (Western Australian Herbarium, 1998-)	Likelihood of occurrence	References
		State	Federal	NatureMap search	EPBC search			
Synemon gratiosa	Graceful Sun Moth	P4		X		The Graceful Sun-moth is closely associated with Banksia woodland. The species is also dependent upon L*omandra maritima* and *L. hermaphrodita* being present for breeding. In recent years the species has been found to be wide spread and not restricted to the Perth metropolitan area. In 2012 the species was down graded from Vulnerable both under the EPBC Act and WC Act, but know resides as a Priority 4 species under DPaW.	Possible The Graceful Sun-moth is known to occur in the region, and there is sutiable Banksia woodland habitat is present within the Study Area.	
Throscodectes xiphos	Cricket	P1				There are only four records of *Throscodectes xiphos* from one location at Jandokot between 1981-1999.	Possible This species has been recorded 6.5 km north east of Study Area, and there is potentially suitable habitat available.	

Significant habitat trees (diameter at breast height >500 mm) recorded within the Study Area

Tree species	Location	DBH	Hollows			Foraging	Comments
			S	M	L	Marri nuts	
Jarrah	Easting: 391720 Northing: 6439711	600	0	0	0		
Jarrah	Easting: 391586 Northing: 6439696	550	0	0	0		
Jarrah	Easting: 391583 Northing: 6439696	800	0	0	0		
Jarrah	Easting: 391569 Northing: 6439725	1000	0	0	0		
Jarrah	Easting: 391566 Northing: 6439719	700	0	0	0		
Stag	Easting: 391664 Northing: 6439792	1500	0	0	2		At least 2 suitable (1 with beehive)
Jarrah	Easting: 391596 Northing: 6439795	700	0	0	0		
Jarrah	Easting: 391594 Northing: 6439798	500	0	0	0		
Jarrah	Easting: 391580 Northing: 6439807	700	0	0	0		
Jarrah	Easting: 391600 Northing: 6439780	1000	0	0	0		
Jarrah	Easting: 391534 Northing: 6439895	1000	0	0	0		
Jarrah	Easting: 391611 Northing: 6439994	800	0	0	0		
Jarrah	Easting: 391565 Northing: 6439679	700	0	0	0		

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\2992303\WP\136686.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	C. Best D. Mullan	J. Reid C. Grabham		C. Grabham		
B	C. Best D. Mullan	A. Napier	C. C Napier	A. Napier	C.C. Napier	1/10/2014

www.ghd.com

Appendix D – Preliminary Stormwater Planning Report (October 2014)

Department of Treasury

Hammond Park High School

Preliminary Stormwater Planning

October 2014

Table of contents

Table index

Figure index

Appendices

1. Introduction

GHD has been commissioned by the Department of Treasury to prepare a preliminary Stormwater Management Plan for the Hammond Park High School site.

This report presents a preliminary stormwater drainage plan covering key design aspects of surface water and groundwater management strategies. The principles adopted build on the criteria identified in the Barfield Road District Water Management Strategy (Cardno, 2010), which partially covers the high school site.

This preliminary stormwater management plan covers the general principles of drainage required to achieve the objectives set out in the DWMS. As further details of the site are made available, the principles identified in this report should be used as the basis for a comprehensive drainage design for the site.

1.1 Disclaimer

This report: has been prepared by GHD for Department of Treasury and may only be used and relied on by Department of Treasury for the purpose agreed between GHD and the Department of Treasury as set out in and as defined in the this report, letters of appointment and letters of aggregate liability dated 25 August 2014.

GHD otherwise disclaims responsibility to any person other than Department of Treasury arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible and as defined in the letters of appointment and letters of aggregate liability dated 25 August 2014.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the EOI, RFP, Development Application or other documents beyond this report and has had no contribution to, or review of these documents. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of these other documents.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit, Department of Treasury may incur as a direct or indirect result of the PPP Schools Site Investigations Library, for any reason being inaccurate, incomplete or incapable of being processed on Department of Treasury's equipment or systems or failing to achieve any particular purpose. To the extent permitted by law, GHD excludes any warranty, condition, undertaking or term, whether express or implied, statutory or otherwise, as to the condition, quality, performance, merchantability or fitness for purpose of the PPP Schools Site Investigations Library.

GHD does not guarantee that the PPP Schools Site Investigations Library is free of computer viruses or other conditions that may damage or interfere with data, hardware or software with which it might be used. Department of Treasury absolves GHD from any consequence of Department of Treasury's or other person's use of or reliance on, PPP Schools Site Investigations Library.

2. Pre-development

2.1 Surface water

The existing site is largely undeveloped with no major existing drainage channels present. The relatively high permeability of the underlying sands and natural vegetation coverage has resulted in no natural channels forming over the site. Surface runoff from extreme rainfall events is likely to be seen as sheet flow, directed towards low points across the site by natural grades in the topography.

Pre-development modelling of the site carried out within the DWMS (Cardno, 2010) indicated that the majority of surface runoff is retained in low-lying areas located within the site and therefore discharge from the site is minimal. The permeability of the underlying sand is high, allowing surface water to infiltrate freely across the site.

A site investigation by GHD in 2011 during a feasibility study identified the site being lower than the surrounding land, potentially receiving stormwater runoff from surrounding areas. Future earthworks plans should take this into account when determining the amount of fill required across the site.

2.2 Groundwater

Limited pre-development groundwater conditions have been established to date. The Phase 1 Report recommends conducting a groundwater monitoring study to establish site specific groundwater quality, levels and seasonal variations.

The Perth Groundwater Atlas (Department of Water) indicates that the highest estimated groundwater is situated around RL+22mAHD. This equates to maximum groundwater level situated 1 m to 3 m below surface level.

3. Surface water management strategy

The principles behind the stormwater strategy aim to maintain the existing hydrology by retaining surface flows and to infiltrate the stormwater runoff as close to source as possible. Table 1 summarises the various strategies proposed to achieve the desired objectives consistent with the Barfield Road DWMS (Cardno, 2013). Figure 1 illustrates some of these strategies on a preliminary site layout.

3.1 Site drainage system

The overall site will contain all runoff onsite up to and including the 100 year ARI event. The retention storage will be provided via a treatment train which includes soakwells, rain gardens, vegetated swales, bio-retention areas and infiltration basins within POS.

The stormwater runoff from the 1 year 1 hour ARI event will be retained at source or as close to as practically possible. Interaction with vegetation, and the infiltration process within the soil column, will remove a large portion of contaminants including nutrients, gross pollutants, and suspended sediments within the stormwater runoff.

Rainfall events greater than the 1 year 1 hour ARI will be conveyed by overland flow or the swale network to infiltration basins within POS area. The size of the infiltration basin storage can be minimised through the use of bio retention and soak well storage provided higher up in the catchment.

Table 1 Summary of surface water management strategy

Principle	Strategy
Retain the 100 year ARI rainfall event onsite	Soakwells for each building sized to hold 1 year 1 hour ARI runoff from buildings
	Roadside swales to retain portion of runoff from road and parking reserves
	Bio-retention areas within green-space sized to hold residual 1 year 1 hour ARI event runoff from impervious areas.
	Infiltration basins within downstream POS sized to hold up to the 100 year ARI event runoff
Provide stormwater flowpath for runoff from the 100 year ARI event	Earthworks designed such that finished surface levels graded to allow surface runoff to flow towards retention areas within POS in a 100 year ARI event
Finished floor levels of building must have a minimum of 300 mm clearance above the 100 year ARI flood level in the onsite detention areas	Detailed earthworks design will detail finished surface levels with sufficient clearance from modelled 100 year ARI flood levels.
Infiltration areas designed to avoid creating mosquito habitat	Infiltration basins will be designed to ensure a maximum inundation time of 72 hours. Due to the high infiltration rate this will likely be considerably less.
Base of infiltration basins must be at	Detailed earthworks plan will specify inverts of infiltration basins with a minimum clearance to MGL of

least 500 mm above MGL.	0.5 m.
Retain the 1 year 1 hour duration ARI rainfall event at or close to source.	Soakwells for building runoff, swale network for road and parking reserves and bio-retention pits for other impervious areas will be sized to retain the 1 year 1 hour ARI rainfall event.
The surface area of bio-retention areas is to be at least 2% of the connected impervious area.	Detailed landscape design will ensure provision of at least 2% of connected impervious area is allocated to bio-retention areas. Based on current master plans of the site this represents an area of 0.1 ha.
Apply appropriate structural and non-structural measures to reduce nutrient loads.	Minimise use of fertilisers within POS and road verges.
	Maintenance of POS and drainage areas

3.1.1 Storage requirement

Based on a site area of 10.6 ha of which approximately 4 ha will consist of impervious area, a storage volume of 2315 m^3 is required to retain and infiltrate the 100 year ARI event on site.

The basin size may be reduced depending on the volume of bio-retention area storage provided within the school site, as well as the size of soak wells provided for retention of roof runoff.

Based on the assumption that 2% of impervious area or 0.1 ha of land will be allocated to bio-retention, a depth of 0.5 m creates an additional 500 m^3 of storage upslope of the basin.

Details of the modelling calculations and assumptions adopted are presented in Appendix A.

3.2 Buildings

Roof runoff from buildings will be retained within subsurface soak wells. Specific size requirements will be determined at latter design stages. Preliminary modelling indicated the following storage requirements:

Table 2 Indicative soakwell storage requirements

Design ARI	Storage requirement per m^2 of roof area (m^3)
1 year 1 hour	0.016
10 year 1 hour	0.029
100 year 1 hour	0.047

3.3 Roads and parking

Runoff from road reserves and parking areas will be conveyed by a swale network into an infiltration basin situated at a natural low point within the site near the edge of the impervious area. The infiltration basin will be utilised to retain major flow events up to the 100 year ARI event within the school site. The basin will be designed with a maximum depth of 1.2 m and 1 in 6 side slopes. The basin will not be designed to be permanently wet, draining from completely full within 12-24 hours. To achieve this the basin invert will need to be have a minimum clearance of 0.5 m from MGL.

3.4 Paved areas

Residual surface runoff from paved areas within the school site will be retained in vegetated bio-retention areas within allocated garden beds. These will be sized to contain at least the 1 year 1 hour ARI runoff for the modelled catchment area. The bio-retention areas will have a maximum depth of 0.5 m, will have 1 in 3 side slopes and will be underlain with a layer of soil with a high Phosphorus Retention Index (PRI). Vegetation within the bio-retention areas will be selected for their nutrient removal capability.

To achieve the objective of providing bio-retention for at least 2% of connect impervious areas, 0.1 ha of bio-retention area should be incorporated into the landscape design for the school site.

Figure 1 Preliminary drainage plan

4. Groundwater management strategy

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology and to ensure sufficient separation between maximum groundwater level and proposed infrastructure. This can be achieved by:

- Treating stormwater runoff before infiltration to groundwater
- Using water sensitive design approaches to recharge the superficial aquifer
- Maintaining or improving groundwater quality onsite.
- Provision of engineering fill in areas where maximum groundwater is close to the natural surface

Earthworks plans should ensure sufficient separation between MGL and finished surface levels. In cases where groundwater is close to the surface, additional fill should be utilised to achieve the desired separation.

Preliminary site investigations and desktop research has revealed groundwater varies between 1 m to 3 m BGL being situated around RL+22 mAHD. Depending on the natural ground surface level, groundwater could potentially be intersected during construction, depending on the proposed design levels and timing of the works.

5. Future work

5.1 Urban Water Management Plan

The local authority may request preparation of a more detailed water management plan, such as an Urban Water Management Plan (UWMP), prior to construction activities. If this is required, it should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008).

While strategies have been provided within this stormwater plan for water management within the site, it is a logical progression that future designs and the supportive UWMP will clarify details not provided within this document.

The main areas that may need to be addressed within a UWMP include:

- Modelling of the drainage network
- Infiltration basin area configurations
- Imported fill specifications and requirements
- Implementation of water conservation strategies
- Structural and non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management plan
- Monitoring and evaluation program

6. References

Cardno, 2010. Barfield Road District Water Management Strategy. Report for City of Cockburn.

Department of Water, 2004. Perth Groundwater Atlas.

Department of Water, 2008. Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions.

Emerge Associates, 2013. Barfield Road Local Water Management Strategy. Report for Gold Estate Holdings and Department of Housing.

GHD, 2011. Stage 1 Report for School Site Inspection and Feasibility Study Hammond Park High School. Report for Building Management and Works.

GHD, 2013. Phase 1 Report for Hammond Park High School PPP Schools Investigation. Report for Department of Treasury.

Western Australian Planning Commission, 2008. Better Urban Water Management, Perth.

Appendices

Appendix A – Modelling

Preliminary basin storage requirements were calculated using the software DRAINS (v 2013.08).

An ILSAX hydrological model was adopted with the following depression storages:

- Paved area: 16 mm
- Supplementary area: 2 mm
- Grassed area: 5 mm

The 16mm depression storage for impervious areas takes into account that the first 16 mm or 1 year 1 hour runoff volume will be retained at source and not be conveyed down catchment into the basin. A soil type 2 was adopted for the site which represents moderate infiltration rates and moderately well-drained.

The basin was assumed to be square in shape with an infiltration rate of 1 m/day. The catchment was assumed to be 5.7 ha in size of which 70% consists of impervious surfaces.

Rainfall data was obtained from BoM's IFD program, based on the principles of AR&R 1987, and has been reproduced in the figure below.

Intensity-Frequency-Duration Table

Location: 32.175S 115.850E NEAR.. Hammond Park Issued: 1/10/2014

Rainfall intensity in mm/h for various durations and Average Recurrence Interval

	Average Recurrence Interval						
Duration	1 YEAR	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5Mins	59.2	78.2	103	121	146	183	215
6Mins	55.1	72.9	96.1	113	136	170	199
10Mins	44.0	57.9	75.5	88.0	105	131	153
20Mins	30.7	40.1	51.2	59.0	69.9	85.8	99.3
30Mins	24.3	31.6	40.0	45.8	53.9	65.8	75.7
1Hr	16.0	20.6	25.7	29.1	34.0	41.1	47.0
2Hrs	10.3	13.2	16.2	18.3	21.2	25.4	28.9
3Hrs	7.93	10.2	12.4	13.9	16.1	19.2	21.7
6Hrs	5.09	6.49	7.84	8.75	10.1	11.9	13.4
12Hrs	3.27	4.17	5.02	5.59	6.41	7.58	8.54
24Hrs	2.09	2.67	3.24	3.63	4.18	4.98	5.62
48Hrs	1.30	1.67	2.07	2.34	2.72	3.28	3.73
72Hrs	.952	1.23	1.54	1.76	2.06	2.49	2.85

(Raw data: 21.19, 4.29, 1.28, 36.28, 6.8, 2.23, skew=0.66, F2=4.86, F50=17.18)

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

\\ghdnet.internal\ghd\AU\Perth\Projects\61\31027\WP\145125.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	O Saare	N Deeks		N Deeks		2/10/14

www.ghd.com

Appendix E – Preliminary Transport Assessment (October 2014)

Department of Treasury - Strategic Projects

Hammond Park High School

Preliminary Transport Assessment

October 2014

Table of contents

Table index

Figure index

1. Introduction

GHD has been commissioned by the Department of Treasury- Strategic Projects to prepare a preliminary transport assessment for the Hammond Park High School site.

The scope of this report is limited to the following:

- Review traffic generation by the school site.
- Review car parking and access locations to the school. Confirm the number of parking bays required with City of Cockburn/Department of Education.
- Review likely operation of access points
- Review likely road cross- section requirements adjacent to the school.
- Consider any pedestrian/cycling requirements
- Consider any public transport requirements.
- Liaison with City of Cockburn regarding any further issues or concerns.
- Prepare a technical summary of the findings and recommendations following review of the Masterplan.

The site location is shown in Map 1.

Map 1 Hammond Park high school locality

1.1 Standard disclaimer

This report: has been prepared by GHD for Department of Treasury - Strategic Projects and may only be used and relied on by Department of Treasury - Strategic Projects for the purpose agreed between GHD and the Department of Treasury - Strategic Projects as set out in section 1 of this report.

GHD otherwise disclaims responsibility to any person other than Department of Treasury - Strategic Projects arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.2 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury - Strategic Projects and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

1.2 Assumptions

The following assumptions are made.

- The private Primary School adjacent to the High School will have 450 students.
- The Access Street on the east side of the school will carry <1000vpd.

2. Stakeholder liaison

2.1 City of Cockburn

Contact was made with the City of Cockburn in June 2014 regarding their likely requirements for a transport assessment of the High School site. The Council's response is summarised as follows:

1. What are Council's requirements for car parking for a senior high school?

The City's Town Planning Scheme No. 3 requirements for onsite High School parking is;

- 1 bay per Classroom plus 1 bay per 25 x Year 12 students;
- 1 delivery bay; and
- 1 bicycle rack per 2 students

2. Are any traffic reports available for the District Structure Plan?

There is no specific traffic study for the Southern Suburbs DSP. The DSP text contains some discussion on traffic issues.

The only Local Structure Plan adopted which covers (part of) the high school site is the Barfield Road LSP. The City has provided a copy of the LSP report.

3. Do you have specific requirements for the traffic study to address?

The City requires any study to discuss the provision and management of any on-street parking adjacent to the school, considering such issues as the need to balance supply/demand issues, discouraging car use (particularly by senior students who create a demand for all-day parking)

The study should include pedestrian and cyclist access to/from the site, considering such issues as connectivity to the surrounding path network; the need for any further paths in the area; the need for guard controlled children's crossings and any recommended locations; and, the provision of high quality, secure, weatherproof bicycle parking facilities

The study should consider servicing of the school by public and/or school buses

The study should develop a Green Travel Plan and a Traffic Management Plan for the school.

Any traffic study should be cognisant of the WA Planning Commissions' Transport Assessment draft Guidelines.

Correspondence received from the City of Cockburn on 28 August included the following comments:

The planning for the school will need to consider the timing of individual subdivisions in that area and any impact that might have on access to/from the site. Ideally the entire new road network around the site will have been completed before the school is developed.

Another small issue is the traffic generated by the Hammond Park Catholic Primary School (on Woodrow Ave/Frankland Ave) which will also have a road frontage and access to the continuation of Irvine Parade. A certain level of competing demand is expected for on-street parking created by the two schools.

2.2 Department of Treasury – Strategic Projects

The Department of Treasury have provided the following information in relation to student numbers and car parking:

- Hammond Park High School will accommodate 1450 students.

- The Department of Education formula for secondary school car parking provision is 1 bay for every 10 students (ie 145 bays on site) and street embayments of 7 bays per 100 students ie 102 bays (some of which may have to be located onsite). Therefore the total requirement is **247** car parking bays.
- The recommended bike parking provision in the Secondary School Planning Guide (SSPG) is 1 bike rack for every 15 -20 students (**73-97** racks).
- Staff will be provided 1 rack or bay for every 25 to 35 staff (3% - 5%).

3. Hammond Park High School, Masterplan

In September 2011 a Business Case Development was prepared for the Hammond Park High School for the Department of Education.

Two Masterplans were developed to allow for the option of a two stage and three stage construction, (see Figure 1 and Figure 2 below).

Key features are identified as:

- The High School site is bounded by four roads. A Private Primary School is also proposed opposite the site on the western boundary road.
- The High School is located within walking distance of the proposed Mandogalup Train Station on Kwinana Freeway
- A future train station and the town centre are located within a 400m walking distance to the south boundary of the school site.
- The southern boundary street is favoured as the potential school entrance as it has the potential to support school hour traffic feeding off the future arterial Barfield Road and Kwinana Freeway.
- A school oval is proposed alongside the primary school site to create a buffer between the two schools.

The Department of Education confirm Hammond Park High School will accommodate 1450 students.

Figure 1 Hammond Park High School Two Stage Masterplan

Figure 2 Hammond Park High School Three Stage Masterplan

4. Transport assessment

Various transport elements of the Masterplan have been considered in the following sections to assess the likely impacts and requirements to support two collocated schools.

4.1 Traffic generation from the school site.

WA Planning Commission Transport Assessment Guidelines for Development (2006) indicate the following trip rates to be used for both primary and secondary schools.

- 0.5 trips per child to school and 0.5 trips per child from school in each of the am and pm peak hours.

The trips generated from the High School and Primary School are summarised in Table 1.

Table 1 Traffic generation

Landuse	No of Students	Trip rate (vph)	Two way trips (vph)
High School	1450	1 per child	1450
Primary School	450	1 per child	450
Total School Trips			1900vph

The total trips on the north-south road adjacent to the west side of the school are likely to be in the order of 4,000vpd assuming the primary school has access to this road.

The total trips on the east-west road adjacent to the south side of the school are likely to be in the order of 1500vpd (assuming 50% of High School traffic access from this road).

Traffic volumes are also anticipated to impact on the eastern road accessing and circulating the school.

4.2 Proposed road hierarchy

The City of Cockburn have provided the Local Structure Plan Report for Lots 114, 123, and 125 Frankland Ave, Hammond Park (December 2013). This site is located to the south of the High School site, however the structure plan shows the functionality of roads that will service the school. Details are shown in Figure 3.

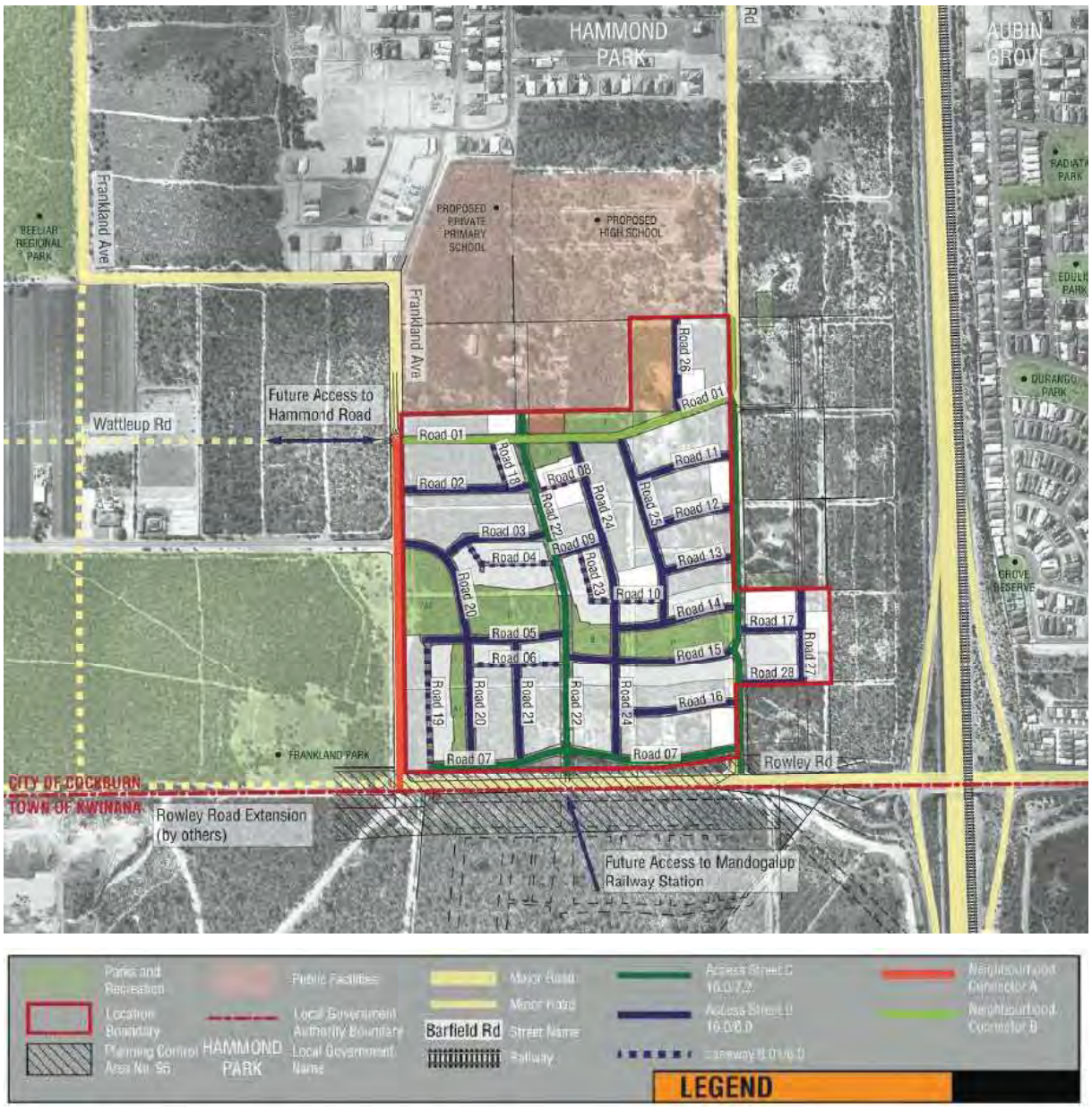


Figure 3 Structure Plan Lots 114, 123, 125 Frankland Ave, Hammond Park – road hierarchy

The road hierarchy plan from the structure plan indicates the following classification (from Liveable Neighbourhoods) for roads servicing the school:

- Western road is classified as an Access Street C (yield or give way street)
- Eastern road is classified as an Access Street D (narrow yield or give way street)
- Southern road is classified as a Neighbourhood Connector B

The following plan, Figure 4 identifies forecast traffic volumes on roads in the vicinity for 2031.

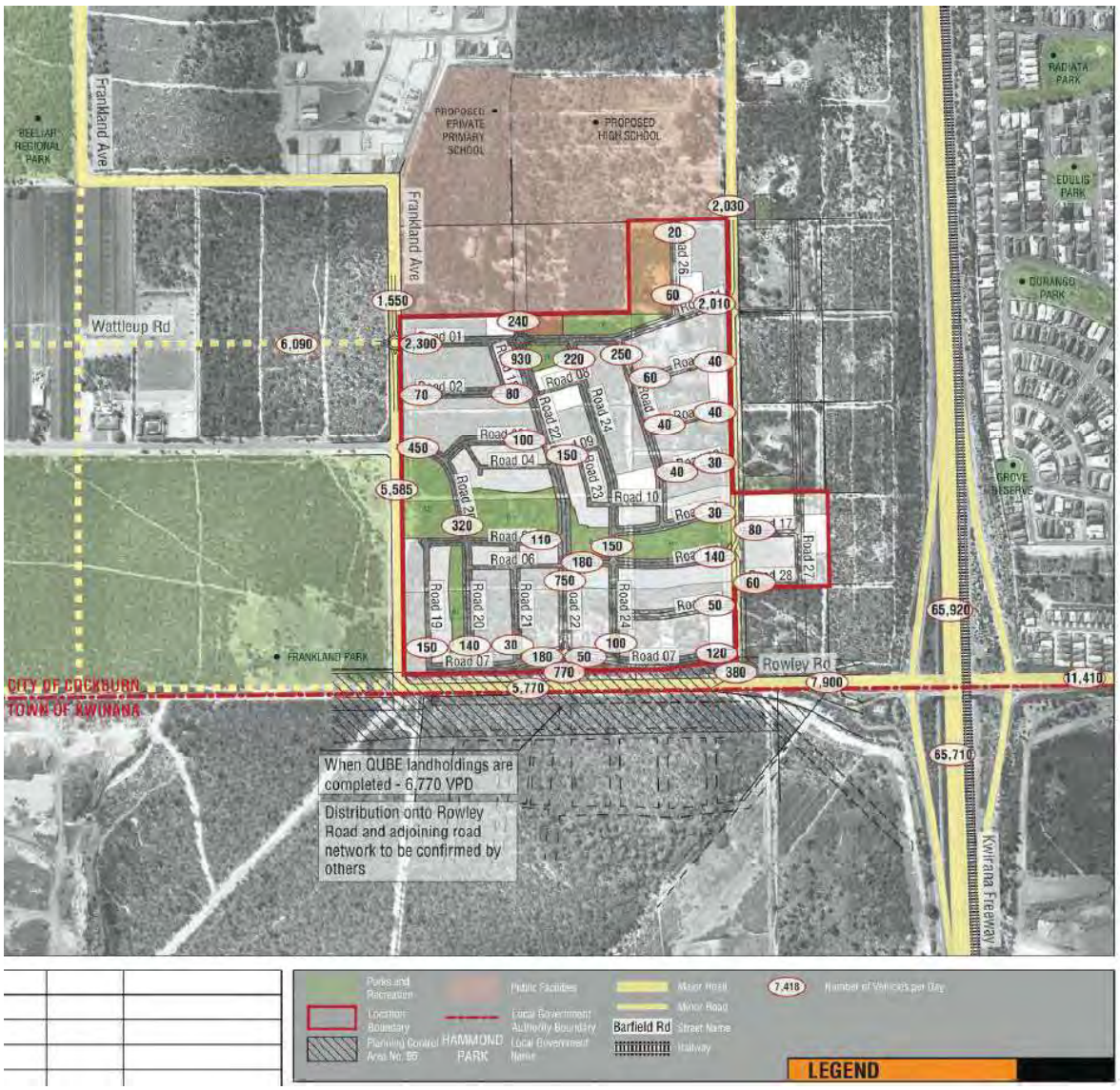


Figure 4 Forecast traffic volumes 2031 (Lot 114, 123, 125 Structure Plan)

4.3 Recommended road hierarchy and cross-sections

4.3.1 Western access road

This road will serve both the proposed Primary School to the west and the High School to the east. A major shared path is proposed as part of the District Structure Plan. The road will need to accommodate embayed car parking on both sides. The safe crossing of pedestrians will also need to be accommodated by the design of this road.

The Local Structure Plan Report for Lots 114, 123, and 125 Frankland Ave, Hammond Park (December 2013) indicates the common north – south road between the two schools as an Access Street C. Contact has been made with the developer who has provided precal details, this road reserve will be 20m wide. The road reservation would need to accommodate a shared path and parking embayment's adjacent to the High School.

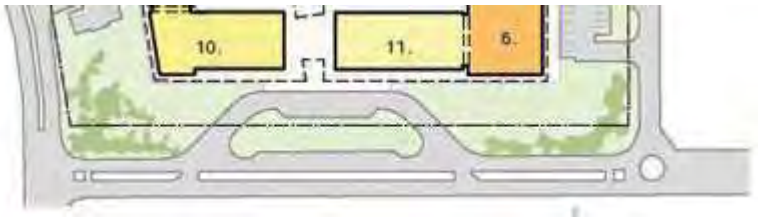
The planned road reservation will be able to accommodate the trips generated by the school.

Liveable Neighbourhoods indicates that where a road abuts a school, the street environment should be designed to slow vehicle speeds and accentuate a pedestrian oriented development alongside the school. Measures include:

- Threshold paving
- Median Island
- Vertical elements such as trees
- On-street parking
- Bus bays
- Formal and informal pedestrian crossings.

Car parking should not be provided opposite car park access points.

4.3.2 Southern access road



The southern access road will provide the main access into the school. The road cross section should include a shared path 2.5m wide adjacent to the school.

Access into the school should operate one way east bound with parking on the school side rather than opposite the school as shown to reduce crossing activity.

The planned road reservation will be able to accommodate the trips generated by the school.

The Local Structure Plan Report for Lots 114, 123, and 125 Frankland Ave, Hammond Park (December 2013) indicates the southern road as a Neighbourhood Connector B.

Contact has been made with the developer who has provided precal details, this road reserve will vary between 19m and 20.7m wide.

4.3.3 Eastern access road

The Local Structure Plan Report for Lots 114, 123, and 125 Frankland Ave, Hammond Park (December 2013) indicates the eastern road as an Access Street D (narrow yield or give way street).

The eastern access road will provide secondary access to the High School. The road cross section should include a shared path 2.5m wide adjacent to the school, and should facilitate on-street parking.

Contact has been made with the developer who has provided precal details, this road reserve will be 16m wide.

The planned road reservation will be able to accommodate the trips generated by the school.

4.4 Car parking and access locations

The Department of Treasury has confirmed the car parking requirement to be adopted for Hammond Park High School.

1 bay for every 10 students (i.e. 145 bays on site) and street embayments of 7 bays per 100 students ie 102 bays (some of which may have to be located onsite). The total requirement is therefore **247** car parking bays.

The design of the road to the west of the school should also include car parking provision on the west side of the road to accommodate car parking demand for the proposed private Primary School. Designated parking embayments will need to be provided adjacent to the Primary School to minimise the need for young children to cross the road. Adequate onsite car parking will also need to be provided on site for the Primary School based on DoE requirements.

The City of Cockburn has raised the issue of Senior High School students driving to school and thus requiring all day parking. It is recommended that a designated onsite parking area is provided for senior students, this should be based on known demand elsewhere. Other public bays could be managed by time restrictions eg 4 hours maximum to maintain their availability for drop off/pick up use.

4.5 Operation of access points

As identified in Table 1, the High School is likely to generate in the order of 1450vph during the am/pm school peak hour. ie 725vph in and 725vph out.

The forecast traffic volumes for the surrounding road network have not been estimated as part of the current surrounding structure plans; however broad daily volumes are likely to be in the order of:

- North-South Road 4000vpd
- Southern East-West Road 1500vpd
- Eastern Access Road <1000vpd.

The planned road reservations will be able to accommodate the trips generated by the school.

Sight distance at each access point will be provided based on the design speed of 60km/h i.e. 2.5m x 83m. On-street car parking bays will be sited outside of the sight requirement.

4.6 Pedestrian/cycling requirements

A shared path is required on the western and southern boundary road adjacent to the High School to facilitate safe cycling /pedestrian routes to the school. The path should be 2.5m wide.

Safe access to cycle racks should be provided through the proposed car park by way of a designated crossing facility within the car park.

Raised plateaus and designated crossing facilities should be provided within the off street car parking areas to facilitate pedestrian activity.

The future implementation of a guard controlled crossing is also likely to be required to improve the safe crossing of pedestrians and cyclists as the surrounding development occurs. It would be desirable to locate the facility in the Access Street between the two schools. This should be located clear of access points and parking embayments.

Shared paths 2.5m wide should be provided on each side of the north-south road with connectivity into the school.

As discussed earlier in Section 2.2, the DoE advise the recommended bike parking provision in the Secondary School Planning Guide (SSPG) is 1 bike rack for every 15 -20 students (73-97 racks).

Staff will be provided 1 rack or bay for every 25 to 35 staff (3% - 5%).

4.7 Public transport requirements

Contact was made with the Public Transport Authority seeking advice regarding the current and planned bus services around the schools.

Figure 5 indicates the short and long term bus route planning before and after the opening of the Aubin Grove Station.

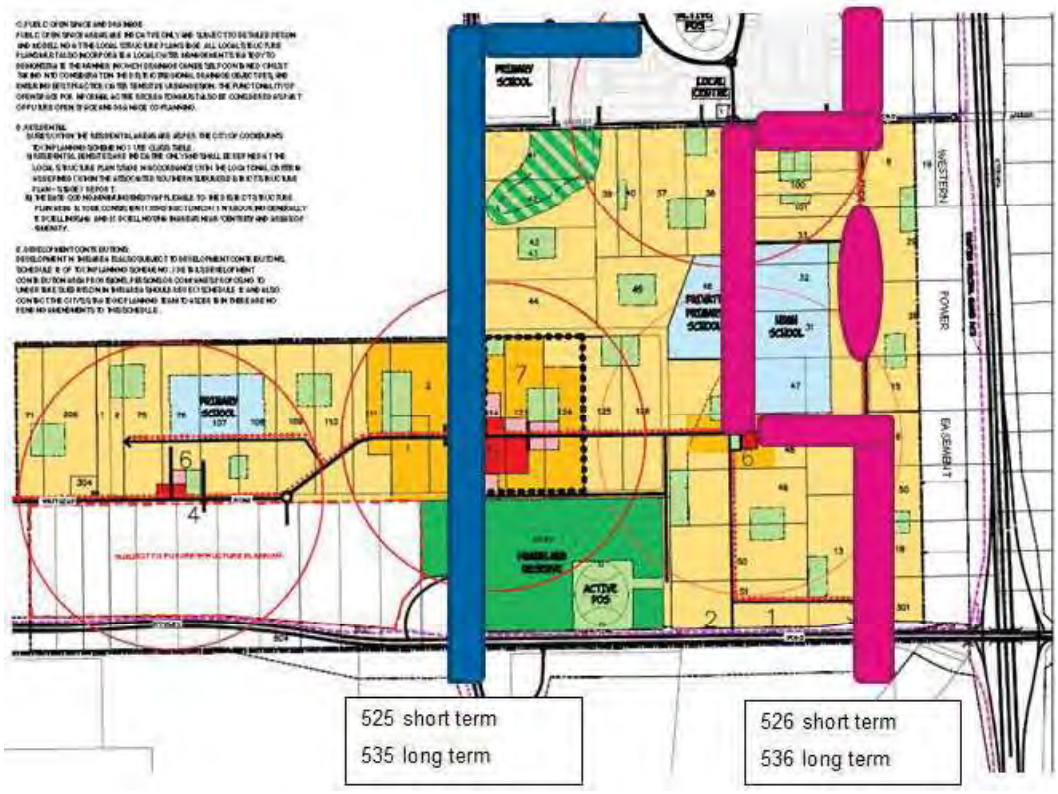


Figure 5 Bus Route Plan

Prior to Aubin Grove Station opening:

- Route 525 will operate Hammond Park to Cockburn Central Station via Macquarie / Eucalyptus / Frankland (shown as Hammond)
- Route 526 will operate Hammond Park to Cockburn Central Station via EITHER
- Barfield / Ironbark / Botany / south past Hammond Park High School / East-West to Barfield / Barfield (most likely) OR
- Barfield only

Once Aubin Grove Station opens:

- Route 535 will operate Hammond Park to Aubin Grove Station via Macquarie / Eucalyptus / Frankland (shown on map as Hammond Road)
- Route 536 will operate Hammond Park to Aubin Grove Station via EITHER
- Barfield / Ironbark / Botany / south past Hammond Park High School / East-West to Barfield / Barfield (most likely) OR
- Barfield only

PTA's plan is to operate both routes every 10 minutes in the peak periods, every 30 minutes in the off- peak periods, weekdays and hourly on weekends. This is subject to the resources available when Aubin Grove Station opens.

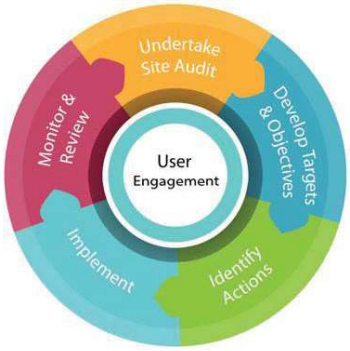
A bus embayment should be included in close proximity to the schools on the north-south road on each side, to the west of the High School.

The planning indicates good public transport access to serve the schools.

4.8 Green Travel Plan

It is recommended that a Green Travel Plan is developed for the school to minimise excessive car trips. Key elements of a Green Travel Plan include:

- Reduced use of parking space
- Improved access to public transport
- Incentives to use a bicycle
- Public transport promotion
- Cycle prioritisation and provision of facilities eg secure parking,
- Encourage walking and provision of route information
- Set targets and monitoring of those targets.



5. Technical summary of the findings and recommendations following review of the Masterplan

Following a review of the transport requirements for the Hammond Park High School, the following summary and recommendations are provided:

Anticipated trip generation:

- The total trips on the north-south road adjacent to the west side of the school are likely to be in the order of 4,000vpd.
- The total trips on the east-west road adjacent to the south side of the school are likely to be in the order of 1500vpd (assuming 50% of High School traffic access from this road).
- The total trips on the north-south road to the east of the school are likely to be in the order of 1000vpd.
- The planned road reservations will be able to accommodate the trips generated by the school.

Access arrangements:

- Access into the school from the southern Access Street should operate one way east bound with parking on the school side rather than opposite the school as shown, to reduce crossing activity.

Pedestrian access:

- Shared paths 2.5m wide should be provided on each side of the north-south road to the west of the High School with connectivity into the school.
- The future provision of a guard controlled crossing on the north-south road to the west of the school should be considered.
- A 2.5m shared path should be provided on the southern Access Street and preferably on the eastern Access Street adjacent to the School.

Bicycle parking:

- As discussed in Section 2.2 the DoE advise the recommended bike parking provision in the Secondary School Planning Guide (SSPG) is 1 bike rack for every 15 -20 students (73-97 racks).
- Staff will be provided 1 rack or bay for every 25 to 35 staff (3% - 5%).

Public transport accessibility:

- A bus embayment should be included in close proximity to the schools on the north-south road to the west of the High School for each direction.

Parking

- It is recommended that a designated parking onsite area is provided for senior students on site, this should be based on known demand elsewhere in similar established sites. Other public bays could be managed by time restrictions ie 4 hours maximum to maintain their availability for drop off/pick up use.

- The DoE formula for secondary school car parking provision is 1 bay for every 10 students (i.e. 145 bays on site) and street embayments of 7 bays per 100 students (i.e. 102 bays some may have to be located onsite). Therefore the total requirement is 247 car parking bays.

Further planning:

- It is recommended that a Green Travel Plan is developed for the school to minimise excessive car trips and promote other modes of travel.
- The City of Cockburn have advised that planning for the school will need to consider the timing of individual subdivisions in that area and any impact that might have on access to or/from the site.

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\31027\WP\144175Rev Oct 2014.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	S McDermott	C Murphy	C Murphy	P Fisher	P Fisher	1/10//2014

www.ghd.com

Appendix F – Site Servicing Report (October 2014)

Department of Education

Hammond Park High School- Servicing Report

June 2014

Table of contents

Appendices

1. Introduction

1.1 Location

The following servicing report for the future Hammond Park High School site has been prepared for the Department of Education by GHD Pty Ltd.

The proposed school site is located in Hammond Park, a suburb within the City of Cockburn. The site is shown on the Southern Suburbs District Structure Plan (SSDSP) as per Appendix A.

The school site straddles a number of private landowners:

- Lot 33
- Lot 32
- Lot 31
- Lot 14
- Lot 47

1.2 Topography and Features

The site is largely undeveloped bush land, with a small number of rural residential dwellings. There are several access tracks throughout the site, surrounded by dense vegetation.

There are two low-lying areas on the site which are shown to be filled in Water Corporation sewer planning to enable the area to be serviced with gravity sewers discharging northwards.

No geotechnical investigations have been carried out on site as part of this preliminary investigation. A review of the Regional Geology Map indicates that the site is predominantly underlain by well drained Bassendean sand.

A review of the South Metropolitan Region Scheme Acid Sulphate Soils map indicates that the site is in an area of moderate to low risk of actual and potential acid sulphate soils occurring at depths generally greater than 3m from the surface.

It is currently assumed that the site is free from any contamination.

Appropriate geotechnical / environmental investigations should be under taken in the future to further evaluate the ground conditions to make more accurate assessments of the need for Acid Sulphate Soils treatment, dewatering, and rock excavation.

2. Servicing

2.1 Clearing, Earthworks and Retaining Walls

Site clearing and bulk earthworks will be required over the majority of the school site to fill low lying areas so that sewerage infrastructure from the south can be accommodated and to facilitate the development of the school and playing fields.

Clearing of the site would need further investigation to determine the condition of the bushland and any requirements for retention of vegetation.

2.2 Roads

The north–south road shown in the SSDSP is intended to be the primary access for traffic from the north and runs between Gaebler Road and Rowley Road. This 20m road reserve separates the private school and Hammond Park High school.

Road frontage will be planned for the entire school boundary. Parking embayments and paving between the kerb and the school site boundary will need to be provided. The structure plan for Vivente, south of the school site shows a strip of public open space between the school boundary and the road reserve. The other roads surrounding the school site have direct frontage.

The current City of Cockburn Developer Contribution Area 9 (DCA9) includes an upgrade of Frankland Avenue and is currently expected to be $30,000 per ha. The proposed DCA9 area is shown in Appendix D

2.3 Stormwater Drainage

The school site will need to contain all run-off within the boundaries of the site. Developers surrounding the school site will be required to provide for their own run-off in basins located in public open space.

2.4 Sewer

Currently there is no Water Corporation sewer infrastructure fronting the school site with the closest sewer located in Irvine Parade (Hammond Rise development) north of the proposed school site.

To provide a sewer connection for the school, a DN300 gravity sewer will need to be extended from the existing manhole AC7596 located in Irvine Parade southwards at a minimum grade. This sewer would be located on a 3.5m alignment in the future road reserve on the western boundary of the school site. Further negotiations with the Water Corporation will be required to determine whether this sewer would be prefunded by the developers and subsequently reimbursed by the Water Corporation.

The Water Corporation sewer planning is shown in Appendix C.

2.5 Water

The current Water Corporation planning indicates that the area will ultimately be serviced by large diameter distribution mains connecting to the existing 600mm main at the Hammond Road / Russel Road intersection and extending down the future Hammond Road reserve, Frankland Avenue, Wattleup Road and Rowley Road. These mains are required to facilitate residential development in the area. The planning is shown in Appendix D.

To service the school site, it is likely that the Water Corporation would require the extension of a DN200 water reticulation main from Irvine Parade in Hammond Rise. This main will be located within the road reserve on the western boundary of the school site.

2.6 Power

There is an existing 22kV power line along the western side of Barfield Road from which power supply for the development of the school site can most likely be provided.

Access for high voltage cable between Barfield Road and the school site would need to be negotiated with the landowners and cables would need to be located within easements in the future road reserves.

Allowance should be made for location a transformer and switchgear on the school site.

2.7 Gas

The area will most likely have three potential connection points from which a gas supply can be provided:

1. A 160PE at the Lyon Road / Rowley Road intersection, east of the freeway
2. A 160PE at the Frankland Avenue / Woodrow Avenue intersection
3. A 110PE at the Gaebler Road / Barfield Road intersection.

A single connection for the school, however, can most likely be provided off existing gas infrastructure in Irvine Parade, Hammond Rise. This gas main can be installed in a common trench with the water main.

2.8 Telecommunications

Telstra has existing services in the area. It is anticipated that a connection can be supplied from Barfield Road and the conduits between Barfield Road and the school site can be installed in a common trench with the power.

3. Timing of infrastructure

We understand that the intention is to have the Hammond Park High School site serviced by January 2018 to facilitate construction to meet the intended occupation in 2020. Development is anticipated to commence in the area from early 2015, however if this does not occur and the school need to be developed prior to the residential development, the following target dates would need to be considered to achieve the deadline of January 2018:

Preliminary negotiations with the servicing authorities: June 2016 to September 2016

Development application approval: June 2016 to December 2016

Design of infrastructure and approvals: January 2017 to April 2017

Tender and construction: May 2017 to November 2017

Should the school proceed with development prior to any residential development in surrounding area, the following infrastructure would need to be fully funded by the developer of the school site:

- Roads, drainage, parking and pathways for the roads surrounding the school site. The southern road has strip of POS between the road and the school site boundary. The road reserve and POS are both located on Lots 14 and 48. If the school requires this road, permission to construct will need to be discussed with Gold Estates.
- Road connection between the school and Barfield Road.
- Extension of sewer from Irvine parade to the southern boundary of the school site. (possible prefunding arrangement with Water Corporation)
- Extension of a water reticulation main from Irvine Parade to the southern boundary of the school site.
- Extension of a gas main from Irvine Parade in a common trench with the water main.
- High voltage power cables from Barfield Road to the school site.

- Telecommunication conduits in a common trench with power cables.

Section 159 of the Planning and development Act makes provision for developers to claim a proportion of the costs of roads and drainage from a subsequent developer who benefits directly from the road access. Based on this, it is anticipated that the developer of the school would be able to claim fifty percent of the roads and drainage surrounding the school site that provide frontage to residential lots.

The majority of the landowners in the area are in the process of preparing structure plans for approvals with the intention of submitting subdivision applications in the near future.

If development occurs prior to the school, which is most likely, a large proportion of the above infrastructure would need to be funded by the relevant developers of which fifty percent on average would most likely be claimed from the developer of the school site.

Gold Estates who own Lot 14 and the land between the school site and Rowley Road will most likely proceed with construction of Stage 1 of Vivente early in 2015. This will require the extension of the sewer and water mains from Irvine Parade.

Based on structure plans that are in the process of being finalised with City of Cockburn, it is anticipated that the developers of Lots 47, 14 and 31 will be in a position to commence development ahead of the school site.

4. Probable costs of infrastructure

4.1 Infrastructure provided by the Department of Education

If development of the school proceeds ahead of the residential development, the school site developer will need to contribute to the following infrastructure:

Item	Estimated cost for school developer	Possible reimbursement
Western Road & drainage on Lots 31 to 33	$100k	$0k
Western Road & drainage on Lot 47	$50k	$25k
Northern road & drainage on Lot 33	$70k	$35k
Eastern Road & drainage on Lots 14 and 31-33	$135k	$65k
Southern Road & drainage	$40k	$20k
Parking bays	$80k	$0k
Footpaths on school side	$120k	$0k
Sewer extension	$80k	$0k
Water extension	$35k	$0k
Power	$20k	$0k
Gas	$15k	$0k
Telecomms	$15k	$0k

TOTAL (excluding GST)	$760k	$145k
NETT Cost to school developer		$614k

4.2 Infrastructure provided by the developers

If residential development proceeds ahead of the school, the school site developer will need to contribute to or construct the following infrastructure:

Item	Estimated cost for developers	Possible school contribution or cost
Western Road & drainage on Lots 31 to 33	$0k	$100k
Western Road & drainage on Lot 47	$50k	$25k
Northern road & drainage on Lot 33	$70k	$35k
Eastern Road & drainage on Lots 14 and 31-33	$135k	$65k
Southern Road & drainage	$40k	$0k
Parking bays on developer funded roads	$60k	$60k
Parking bays on western road	$0k	$20k
Footpaths on western road	$0k	$48k
Footpaths on developer funded roads	$72k	$72k
Sewer extension	$80k	$0k
Water extension	$35k	$0k
Power	$20k	$0k
Gas	$15k	$0k
Telecomms	$15k	$0k
TOTALS (excluding GST)	$592k	$425k
NETT cost to school developer		$425k

In summary, there is a benefit of approximately $200k if the residential development proceeds ahead of the development of the school site.

5. Risk

This section documents the associated financial risks to the development of the Hammond park Primary School.

These risks are a function of the alternative scenarios discussed above and are related to whether the development front proceeds ahead of the school or not.

5.1 Roads and drainage infrastructure

All road infrastructures surrounding the proposed site will most likely be constructed by developers by the time the lot for the school is created. However, the western road will be dependent on the conditions for subdivision approval for lots 31 to 33 and whether this road needs to be constructed as part of the subdivision approval as there are no lots fronting it.

Risk Rating: Medium

5.2 Sewer

The gravity sewer will most likely be constructed by the developers south of the school site prior to the development of the school.

Risk Rating: Low

5.3 Water

The water reticulation main will most likely be extended by the developer south of the school prior to development of the school.

Risk Rating: Low

5.4 Power

Power can be provided to the school site off existing aerial lines in Barfield Road and a supply is therefore not entirely dependant on development in the area.

It is assumed that the existing WPC network has sufficient capacity to supply the school site.

Risk Rating: Low

5.5 Gas

Gas will most likely be extended to supply the development south of the school, site prior to development of the school.

Risk Rating: Low

5.6 Telecommunications

The developer south of the school will most likely install NBN compliant infrastructure prior to the school development. If this does not happen, a connection off existing infrastructure in Barfield Road would be a possibility.

Risk Rating: Low

5.7 Multiple landowners

The school site is located in an area of multiple land ownership. If development of the school proceeds ahead of the adjacent developments, the required land for the school and surrounding road reserves will need to be acquired before any work on the infrastructure can proceed.

If the residential development proceeds ahead of the school, the developers will, be required to give up the land required for the school plus the road reserves as part of their subdivision approval conditions.

Risk Rating: Medium

Disclaimer

This report: has been prepared by GHD for the Department of Education and may only be used and relied on by the Department of Education for the purpose agreed between GHD and the Department of Education. The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

GHD has prepared this report on the basis of information provided by the Department of Education and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Appendices

Appendix A – District Structure Plan

Stage 3, Hammond Park / Wattleup Figure 7

PLAN NOTES

1. FUTURE RESIDENTIAL DEVELOPMENT SHALL NOT DIRECTLY ABUT ROWLEY ROAD. FUTURE LOCAL STRUCTURE PLANNING IS TO DEMONSTRATE A SUITABLE INTERFACE TREATMENT (E.G. LINEAR PUBLIC OPEN SPACE, SERVICE ROAD DESIGN WITH FRONTING RESIDENTIAL DEVELOPMENT), BEING PROVIDED TO THE FUTURE ROWLEY ROAD FREIGHT ACCESS ROUTE.

2. FUTURE ACCESS ROAD TO BE PROVIDED AS A FULL INTERSECTION UNTIL ROWLEY ROAD IS UPGRADED AND CONSTRUCTED TO A REGIONAL ROAD AT WHICH TIME THE INTERSECTION WILL BE CONVERTED AND MAINTAINED AS LEFT IN/LEFT OUT ACCESS ONLY.

3. AS PART OF THE UPGRADING OF ROWLEY ROAD, GRADE SEPARATED PEDESTRIAN AND VEHICULAR ACCESS IS TO BE PROVIDED AS A CONTINUATION OF BARFIELD ROAD, IN ORDER TO MAINTAIN CONNECTIVITY BETWEEN FUTURE DEVELOPMENT TO THE SOUTH OF ROWLEY ROAD.

4. FUTURE STRUCTURE PLANNING OF THE CELL SOUTH OF WATTLEUP ROAD MUST PROVIDE AN APPROPRIATE INTERFACE WITH RESIDENTIAL DEVELOPMENT NORTH OF WATTLEUP ROAD. THIS IS TO HAVE PARTICULAR REGARD TO THE POSITION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION IN RESPECT OF ITS POSITION ON THE ACCEPTABILITY (OR OTHERWISE) OF RESIDENTIAL DEVELOPMENT SOUTH OF WATTLEUP ROAD, AND ALTERNATIVE (NON-RESIDENTIAL) LAND USES THAT MAY BE REQUIRED. ANY IMPACTS ASSOCIATED WITH THE FUTURE DEVELOPMENT OF NON-RESIDENTIAL LAND USES IN THE CELL SOUTH OF WATTLEUP ROAD MUST BE FULLY CONTAINED WITHIN THE CELL BOUNDARIES.

5. NEIGHBOURHOOD CENTRE – THE DESIGN AND FUNCTION OF THE PROPOSED NEIGHBOURHOOD CENTRE SHALL BE BASED ON 'MAIN STREET' PRINCIPLES AND RELEVANT PROVISIONS OF LIVEABLE NEIGHBOURHOODS. ANY ASSOCIATED LOCAL STRUCTURE PLAN MUST ADEQUATELY DEMONSTRATE THROUGH CONCEPT PLANS AND/OR DETAILED AREA PLANS THE MANNER IN WHICH THE CENTRE ADDRESSES THE REQUIREMENTS OF THE RELEVANT SECTIONS OF THE SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN – STAGE 3 REPORT, AND PARTICULARLY THE NEIGHBOURHOOD CENTRE CONCEPT PLAN PROVIDED WITHIN THE REPORT DOCUMENT.

6. NEIGHBOURHOOD NODES – THE DESIGN AND FUNCTIONALITY OF THE NEIGHBOURHOOD NODES SHALL BE DISTINCTLY DIFFERENT TO THE PRIMACY OF THE NEIGHBOURHOOD CENTRE. THESE LOCATIONS ARE TO PROVIDE FOR A RANGE OF MORE LOCALLY FOCUSSED ACTIVITIES AND FUNCTIONS. WHERE RETAIL IS PROPOSED, THESE ARE TO NOT EXCEED A MAXIMUM RETAIL FUNCTION OF 300SQM, WITH SUCH FUNCTION BASED UPON A 'CONVENIENCE STORE' TYPE USE.

7. CENTRAL PRECINCT – A COMPREHENSIVE LOCAL STRUCTURE PLAN WILL BE REQUIRED FOR THE CENTRAL NEIGHBOURHOOD CENTRE AND ADJACENT DEVELOPMENT. THE CITY WILL NOT CONSIDER INDIVIDUAL STRUCTURE PLANS IN THIS LOCATION DUE TO THE NEED TO ENSURE THE SUITABLE INTEGRATION OF DEVELOPMENT.

GENERAL NOTES

A. ALL LOCAL STRUCTURE PLANS MUST INCLUDE AND BE INFORMED BY:
- I) DETAILED LWMS BASED UPON REGIONAL DRAINAGE STUDY;
- II) DETAILED NOISE MANAGEMENT STRATEGY WHERE LSP ADJOINS ROWLEY ROAD;
- III) FIRE MANAGEMENT PLAN WHERE LSP IS LOCATED NEAR RDS OR SIGNIFICANT POS;
- IV) FLORA AND FAUNA MANAGEMENT PLAN;
- V) TRAFFIC MANAGEMENT PLAN;
- VI) CONTAMINATED SITES & ACID SULPHATE SOILS MANAGEMENT PLAN WHERE REQUIRED;
- VII) HERITAGE STUDY WHERE LSP INCLUDES FORMER HISTORIC TRAMWAY;
- VIII) TRANSITION AND/OR INTERFACE STRATEGY IN RESPECT OF EXISTING RURAL USES;
- IX) NEIGHBOURHOOD CENTRE CONCEPT PLAN AND DETAILED AREA PLAN WHERE INCLUDED WITHIN LSP AREA;
- X) NEIGHBOURHOOD NODE CONCEPT PLAN AND DETAILED AREA PLAN.

B. LOCAL STRUCTURE PLANS
SUBDIVISION AND DEVELOPMENT OF THE SUBJECT AREA IS TO BE IN ACCORDANCE WITH AN ENDORSED APPLICABLE LOCAL STRUCTURE PLAN.

C. PUBLIC OPEN SPACE AND DRAINAGE
PUBLIC OPEN SPACE AREAS ARE INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN AND MODELLING AT THE LOCAL STRUCTURE PLAN STAGE. ALL LOCAL STRUCTURE PLANS MUST ALSO INCORPORATE A LOCAL WATER MANAGEMENT STRATEGY TO DEMONSTRATE THE MANNER IN WHICH DRAINAGE CAN BE SELF CONTAINED WHILST TAKING INTO CONSIDERATION THE DISTRICT/REGIONAL DRAINAGE OBJECTIVES AND ENSURING BEST PRACTICE WATER SENSITIVE URBAN DESIGN. THE FUNCTIONALITY OF OPEN SPACE FOR INFORMAL ACTIVE RECREATION MUST ALSO BE CONSIDERED AS PART OF FUTURE OPEN SPACE AND DRAINAGE CO-PLANNING.

D. RESIDENTIAL
- I) USES WITHIN THE RESIDENTIAL AREAS ARE AS PER THE CITY OF COCKBURN'S TOWN PLANNING SCHEME NO 3 USE CLASS TABLE.
- II) RESIDENTIAL DENSITIES ARE INDICATIVE ONLY AND SHALL BE REFINED AT THE LOCAL STRUCTURE PLAN STAGE IN ACCORDANCE WITH THE LOCATIONAL CRITERIA AS DEFINED WITHIN THE ASSOCIATED SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN - STAGE 3 REPORT.
- III) THE BASE CODING/MINIMUM DENSITY APPLICABLE TO THE DISTRICT STRUCTURE PLAN AREA IS TO BE CONSISTENT WITH DIRECTIONS 2031 IN REQUIRING 15 DWELLINGS/HA GENERALLY AND 25 DWELLINGS/HA IN AREAS NEAR 'CENTRES' AND AREAS OF 'AMENITY'.

E. DEVELOPMENT CONTRIBUTIONS
DEVELOPMENT IN THIS AREA IS ALSO SUBJECT TO DEVELOPMENT CONTRIBUTIONS SCHEDULE 12 OF TOWN PLANNING SCHEME NO. 3 DETAILS DEVELOPMENT CONTRIBUTION AREA PROVISIONS. PERSONS OR COMPANIES PROPOSING TO UNDERTAKE SUBDIVISION IN THIS AREA SHOULD REVIEW SCHEDULE 12 AND ALSO CONTACT THE CITY'S STRATEGIC PLANNING TEAM TO ASCERTAIN THERE ARE NO PENDING AMENDMENTS TO THIS SCHEDULE.

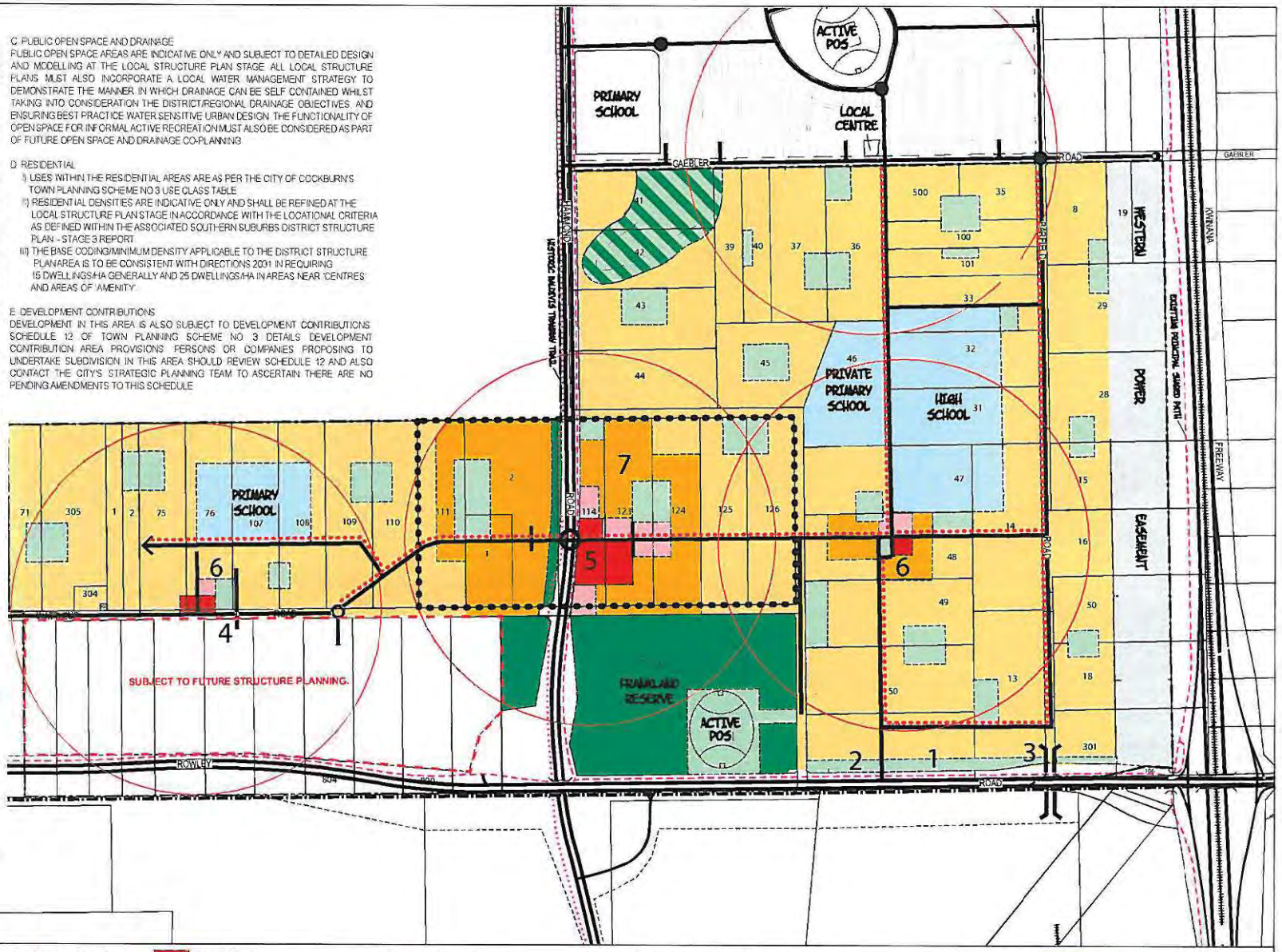


FIGURE 7

City of Cockburn

GNA 2/05

0 250m

SCALE 1:12,500

Residential Density
- High
- Medium

- Local Centre (Pedestrian Based Retail)
- Mixed Business / Commercial / Home Based Business
- Community Facilities / Schools etc
- Western Power Easement
- Conservation Category Wetland (In accordance with DEC Geomorphic Wetlands Swan Coastal Plain dataset)

Key Open Space Areas:
- Public Open Space
- Regional Open Space

- Key Road Structure (Existing and Proposed)
- Major Shared Path
- Historic Baldivis Tramway Trail
- 400m Walkable Catchment
- Central Precinct

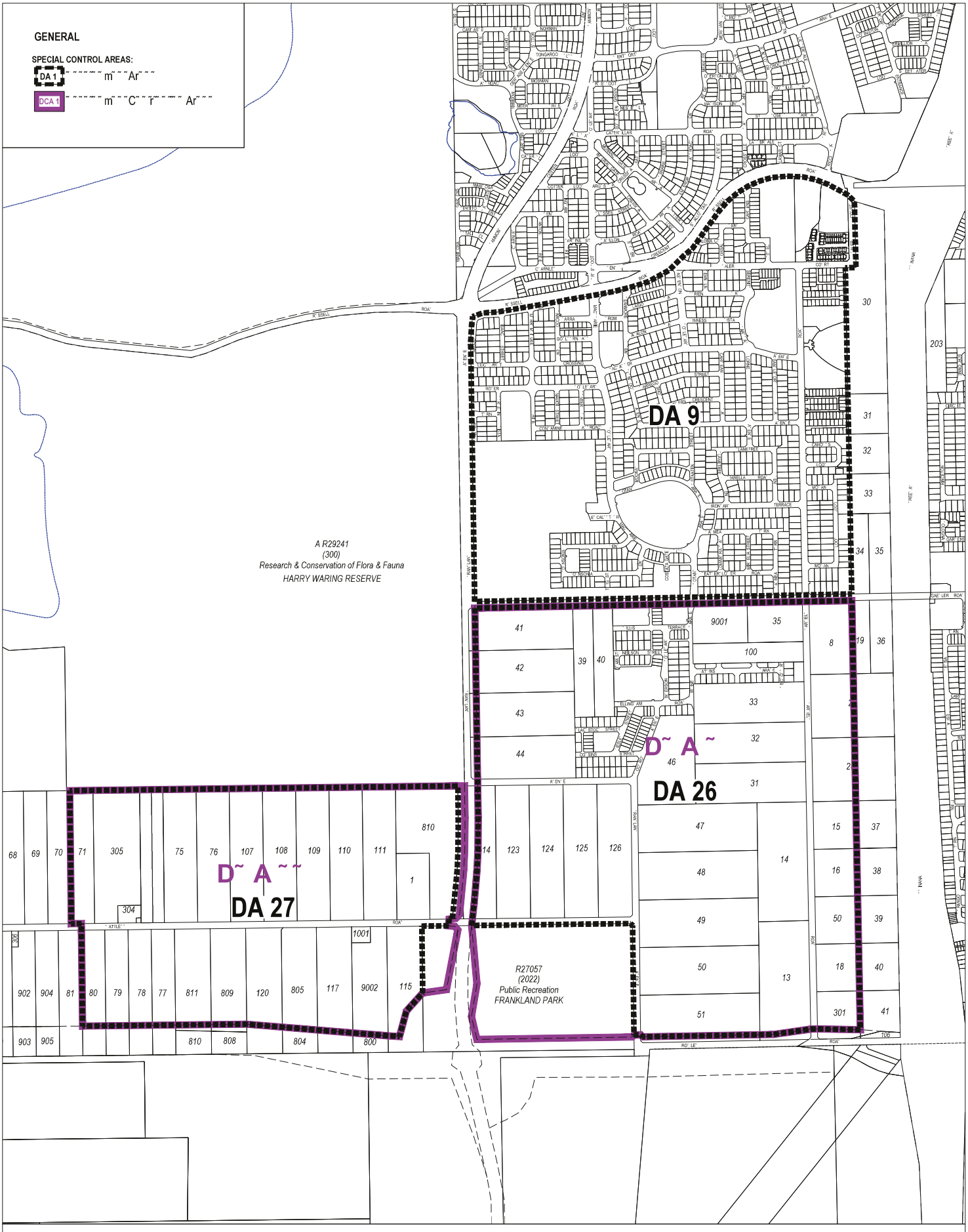
DRAFT

SOUTHERN SUBURBS DISTRICT STRUCTURE PLAN

- STAGE 3, HAMMOND PARK / WATTLEUP

Figure 7

Appendix B – City of Cockburn DCA9 map



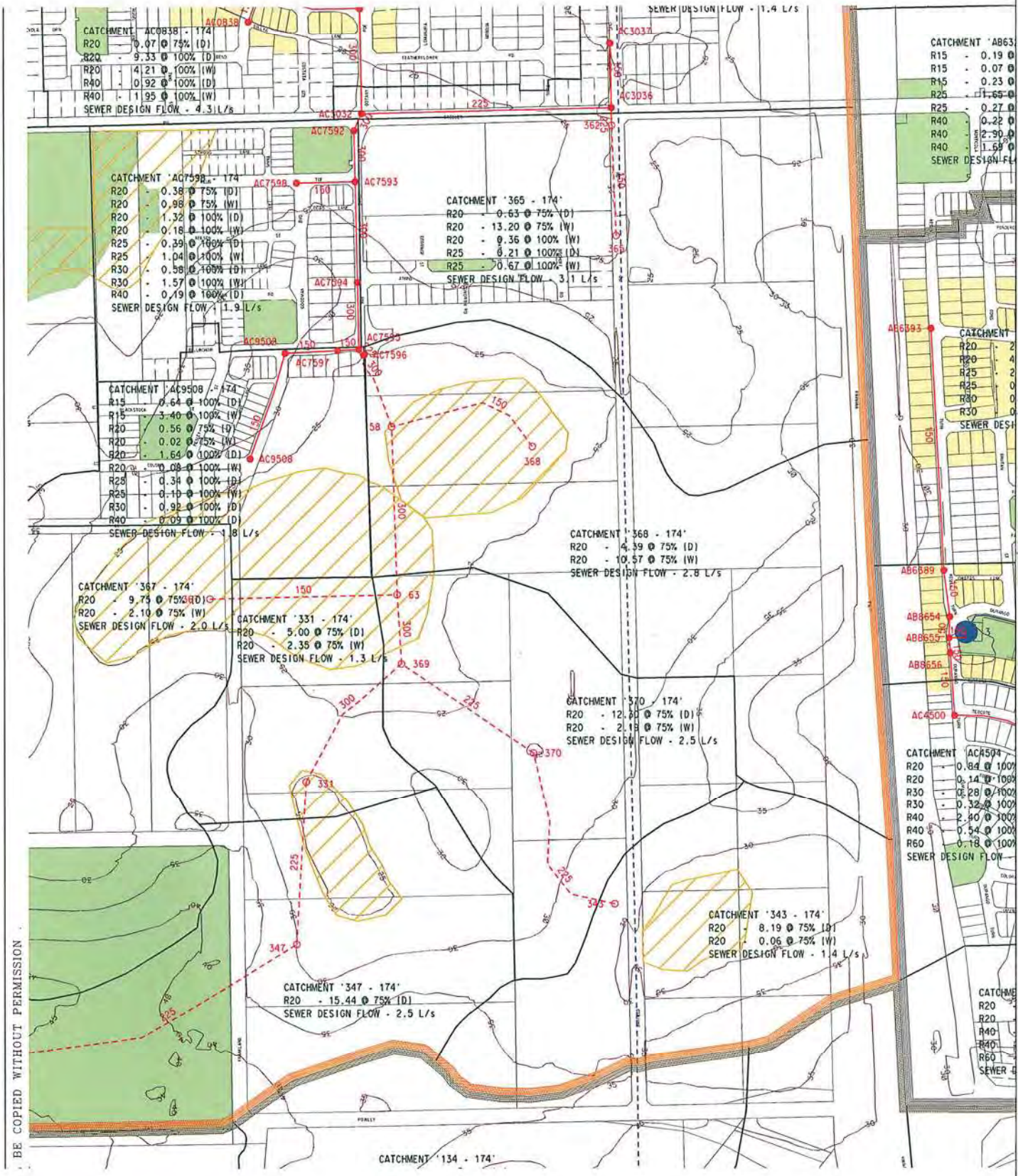
City of Cockburn
wetlands to waves

GNA 4/12

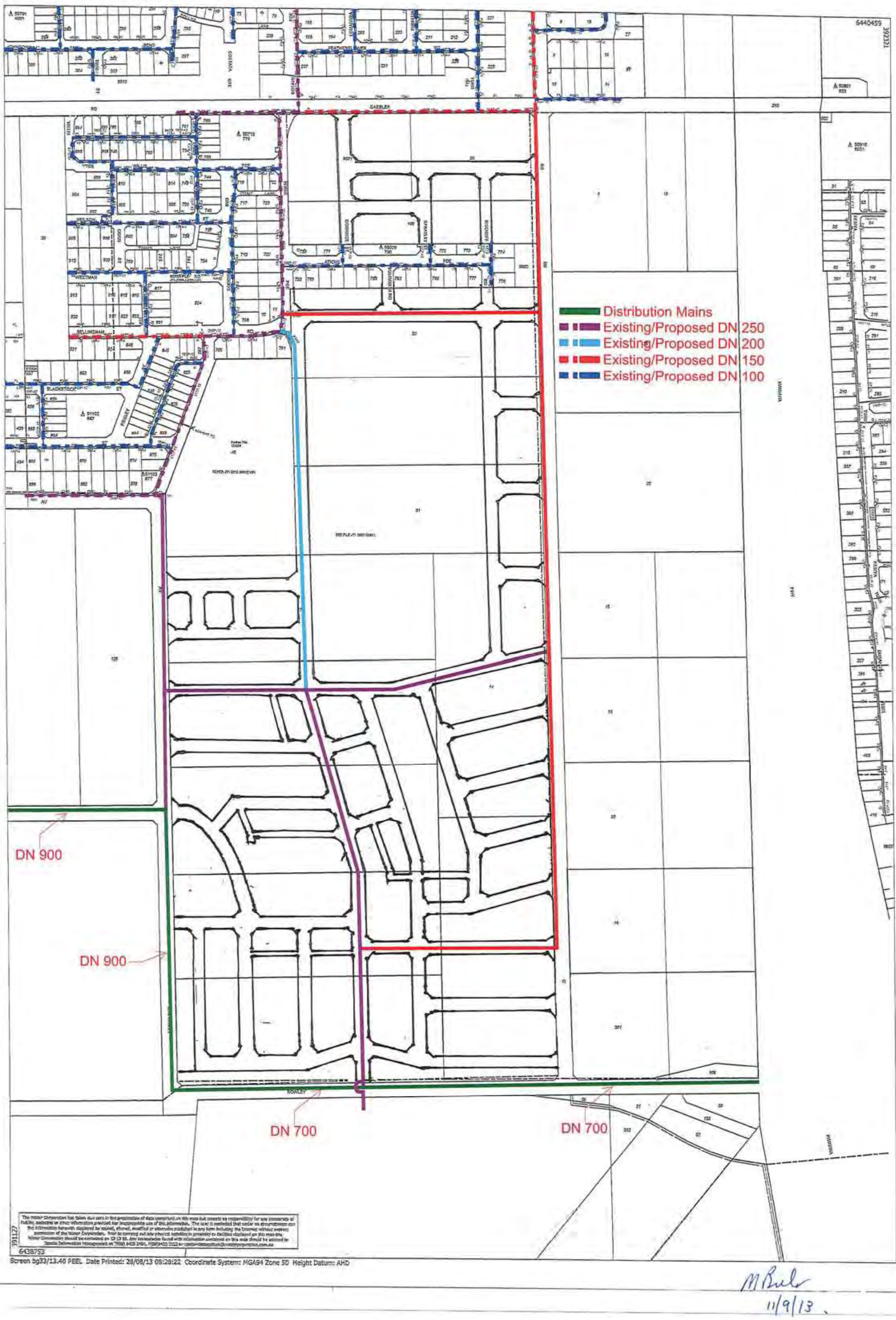
0 300m
SCALE 1:15,000

PROPOSED ZONING
TOWN PLANNING SCHEME No.3
AMENDMENT No.28

Appendix C – Water Corporation sewer planning


CATCHMENT 'AC0838 - 174'
R20 - 0.07 @ 75% (D)
R20 - 9.33 @ 100% (D)
R20 - 4.21 @ 100% (W)
R40 - 0.92 @ 100% (D)
R40 - 1.95 @ 100% (W)
SEWER DESIGN FLOW - 4.3 L/s
SEWER DESIGN FLOW - 1.4 L/s
CATCHMENT 'AC7598 - 174'
R20 - 0.38 @ 75% (D)
R20 - 0.98 @ 75% (W)
R20 - 1.32 @ 100% (D)
R20 - 0.18 @ 100% (W)
R25 - 0.39 @ 100% (D)
R25 - 1.04 @ 100% (W)
R30 - 0.58 @ 100% (D)
R30 - 1.57 @ 100% (W)
R40 - 0.19 @ 100% (D)
SEWER DESIGN FLOW - 1.9 L/s
CATCHMENT '365 - 174'
R20 - 0.63 @ 75% (D)
R20 - 13.20 @ 75% (W)
R20 - 9.36 @ 100% (W)
R25 - 6.21 @ 100% (D)
R25 - 10.67 @ 100% (W)
SEWER DESIGN FLOW - 3.1 L/s
CATCHMENT 'AC9508 - 174'
R15 - 0.64 @ 100% (D)
R15 - 3.40 @ 100% (W)
R20 - 0.56 @ 75% (D)
R20 - 0.02 @ 75% (W)
R20 - 1.64 @ 100% (D)
R20 - 0.08 @ 100% (W)
R25 - 0.34 @ 100% (D)
R25 - 0.10 @ 100% (W)
R30 - 0.92 @ 100% (D)
R40 - 0.09 @ 100% (D)
SEWER DESIGN FLOW - 1.8 L/s
CATCHMENT '368 - 174'
R20 - 4.39 @ 75% (D)
R20 - 10.57 @ 75% (W)
SEWER DESIGN FLOW - 2.8 L/s
CATCHMENT '367 - 174'
R20 - 9.75 @ 75% (D)
R20 - 2.10 @ 75% (W)
SEWER DESIGN FLOW - 2.0 L/s
CATCHMENT '331 - 174'
R20 - 5.00 @ 75% (D)
R20 - 2.35 @ 75% (W)
SEWER DESIGN FLOW - 1.3 L/s
CATCHMENT '370 - 174'
R20 - 12.80 @ 75% (D)
R20 - 2.18 @ 75% (W)
SEWER DESIGN FLOW - 2.5 L/s
CATCHMENT '343 - 174'
R20 - 8.19 @ 75% (D)
R20 - 0.06 @ 75% (W)
SEWER DESIGN FLOW - 1.4 L/s
CATCHMENT '347 - 174'
R20 - 15.44 @ 75% (D)
SEWER DESIGN FLOW - 2.5 L/s
CATCHMENT '134 - 174'
CATCHMENT 'AB63
R15 - 0.19 @
R15 - 0.07 @
R15 - 0.23 @
R25 - 1.65 @
R25 - 0.27 @
R40 - 0.22 @
R40 - 2.90 @
R40 - 1.69 @
SEWER DESIGN FL
CATCHMENT
R20 - 2
R20 - 4
R25 - 2
R25 - 0
R30 - 0
R30 - 0
SEWER DESI
CATCHMENT 'AC4504
R20 - 0.84 @ 100%
R20 - 0.14 @ 100%
R30 - 0.28 @ 100%
R30 - 0.32 @ 100%
R40 - 2.40 @ 100%
R40 - 0.54 @ 100%
R60 - 0.18 @ 100%
SEWER DESIGN FLOW
AC0838
AC3037
AC3036
AC3032
AC7592
AC7598
AC7593
AC7594
AC9508
AC7597
AC7596
AB6393
AB6389
AB8654
AB8655
AB8656
AC4500
AC4504
225
300
150
375
450
525
600
Ø 331
Ø 343
Ø 347
Ø 368
Ø 369
Ø 370
58
63
BE COPIED WITHOUT PERMISSION

Appendix D – Water Corporation water planning



Screen 5g33/13.40 PEEL Date Printed: 28/08/13 08:28:22 Coordinate System: MGA94 Zone 50 Height Datum: AHD

11/9/13

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\27869\WP\135356.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	J Grierson	S Li		J Grierson		6/6/14

www.ghd.com

Appendix G – Site Contamination, Acid Sulfate Soil and Groundwater Assessment (October 2014)

Department of Treasury - Strategic Projects

Hammond Park High School

Site Contamination, Acid Sulphate Soil and Groundwater Assessment

October 2014

Acronyms and Abbreviations

ABC	Ambient Background Concentration
ACL	Added Contaminant Limit
ACM	Asbestos Containing Material
AF	Asbestos Fines
AHD	Australian Height Datum
BSR	Basic Summary of Records
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CEC	Cation Exchange Capacity
CSM	Conceptual Site Model
DER	Department of Environment Regulation
DGS	Dangerous Goods Storage
DMP	Department of Mines and Petroleum
DO	Dissolved Oxygen
DoH	Department of Health
DoW	Department of Water
DQI	Data Quality Indicators
DQO	Data Quality Objectives
DSI	Detailed Site Investigation
EC	Electrical Conductivity
EIL	Ecological Investigation Level
ESL	Ecological Screening Levels
FA	Fibrous Asbestos
GIL	Groundwater Investigation Levels
GSWA	Geological Survey of Western Australia
HIL	Health Investigation Level
HSEMP	Health, Safety and Environmental Management Plan
HSL	Health Screening Level
LOR	Limit of Reporting
MRS	Metropolitan Region Scheme
MWG	Marine Waters Guideline
NATA	National Association of Testing Authorities
NEPM	National Environment Protection Measure
OCP	Organochlorine Pesticides
OPP	Organophosphorus Pesticides

ORP	Oxidation-Reduction Potential
PAH	Polycyclic Aromatic Hydrocarbons
PID	Photoionisation Detector
POS	Public Open Space
PSI	Preliminary Site Investigation
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RPD	Relative Percentage Difference
SAP	Sampling and Analysis Plan
SVOC	Semi-Volatile Organic Compounds
TRH	Total Recoverable Hydrocarbons
UCL	Upper Confidence Limit
VOC	Volatile Organic Compounds
WAPC	Western Australian Planning Commission
WIR	Water Information Reporting

Executive summary

The Department of Treasury – Strategic Projects commissioned GHD to undertake an assessment of contamination, ASS and groundwater for the proposed Hammond Park High School on Barfield Road (the Site). The Site is composed of a 10.71 ha area, consisting of sections of Lots 14, 31, 32 and 33 Barfield Road and Lot 47 Frankland Avenue. The northern half of this area (on Lots 32 and 33 Barfield Road) is proposed for use as public open space adjoining the school. This area of 10.71 ha is referred to as 'the site' throughout this report. The site location is shown in Map 1.

In general accordance with applicable DER guidelines, the assessment included a desktop investigation of historical and current land uses and site condition, along with intrusive soil and groundwater investigation. A total of nine locations were investigated for potential soil contamination and ASS, via soil bores. Four groundwater wells were installed and monitored. The assessment works were completed in September and October 2014.

The findings of the assessment included:

- The site has a history of agricultural uses, with a potential for contamination associated with agricultural chemical use;
- The ASS regional risk mapping indicates the soil is at moderate to low risk of acid sulphate soils occurring within 3 m of the ground surface;
- Based on pH screening and quantitative ASS analysis conducted it is considered that an ASS Management Plan is likely to be required for the site. A review of the available information will be required once construction information such as site layout and final design levels is available to identify depth and volume of any soil disturbance;
- The assessment of potential contamination at the 9 locations included in this investigation did not indicate the presence of contamination due to heavy metals or pesticide above applicable guidelines or at levels considered to pose a significant risk to human health considering the propose future land use; and
- The assessment of shallow groundwater quality in the 4 monitoring wells included in this investigation showed groundwater quality below the site is variable, with one well (MB04) showing signs of acidification with low pH, high salinity and high dissolved iron and aluminium (above irrigation guidelines). If shallow groundwater was to be used for irrigation purposes, it is likely water treatment would be required.

The following recommendations are made:

- If any dewatering is required for works associated with the proposed onsite development an Acid Sulphate Soils and Dewatering Management Plan will be required and may require treatment of dewatering effluent; and
- The groundwater results presented as part of this investigation are considered to be an initial groundwater geochemistry assessment at this time. It must be noted however that groundwater geochemistry within the wells sampled will likely change between the time this report is written and the commencement of construction. As such, it is recommended an additional groundwater sampling event be undertaken just prior to construction with both sets of results be considered baseline groundwater quality against which results collected during and post-construction should be assessed. The additional sampling event should include the wells that currently exist and any future wells determined necessary during the review of the construction programme.

- Following clearing and removal of dumped rubbish but prior to construction commencing, a gridded site walkover assessment should be conducted to look for any hazardous materials (e.g. asbestos cement fragments) or localised visible soil contamination not evident in this initial assessment.

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 Background

The Department of Treasury – Strategic Projects commissioned GHD to undertake an assessment of contamination, ASS and groundwater for the proposed Hammond Park Senior High School site on Barfield Road (the site). This Site is 10.71 ha, and is composed of portions of five properties in Hammond Park:

- 194 (Lot 14) Barfield Road, Hammond Park 6164
- 156 (Lot 31) Barfield Road, Hammond Park 6164
- 144 (Lot 32) Barfield Road, Hammond Park 6164
- Lot 33 Barfield Road, Hammond Park 6164
- 213 (Lot 47) Frankland Ave, Hammond Park 6164

These properties are collectively referred to as 'the Site' throughout this report. The site location is shown in Map 1. The Site Summary Form and Certificates of Title are presented in Appendix A.

The Department of Treasury – Strategic Projects has requested the site be investigated to determine if there is ASS or contamination present which may pose a potential restriction to the proposed development.

This assessment has been prepared with reference to the Department of Environment Regulation (DER[1]) *Contaminated Sites Management Series* Guidelines, *National Environmental Protection (Assessment of Contamination) Measure* 1999 (as amended and in force on 16 May 2013) and the DER *Acid Sulphate Soils Guideline Series*.

1.2 Objectives

The primary objective of this assessment is to identify if there is likely to be either soil or groundwater contamination or acid sulphate soil risk which presents a potential restriction to the proposed development. Tasks undertaken included:

- investigation of the land use history of the site in order to identify existing or past practices that have the potential to cause contamination of soil and/or groundwater.
- soils sampling and analysis
- groundwater sampling analysis

The assessment also aimed to establish the possible locations of contamination and nature of probable contaminants for the purpose of identifying areas that require further investigation and/or remediation.

1.3 Limitations

This report: has been prepared by GHD for Department of Treasury - Strategic Projects and may only be used and relied on by Department of Treasury - Strategic Projects for the purpose agreed between GHD and the Department of Treasury - Strategic Projects as set out and defined in this report.

[1] Formerly Department of Environment and Conservation (DEC). Reference is made in this report to DER for both entities.

GHD otherwise disclaims responsibility to any person other than Department of Treasury - Strategic Projects arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

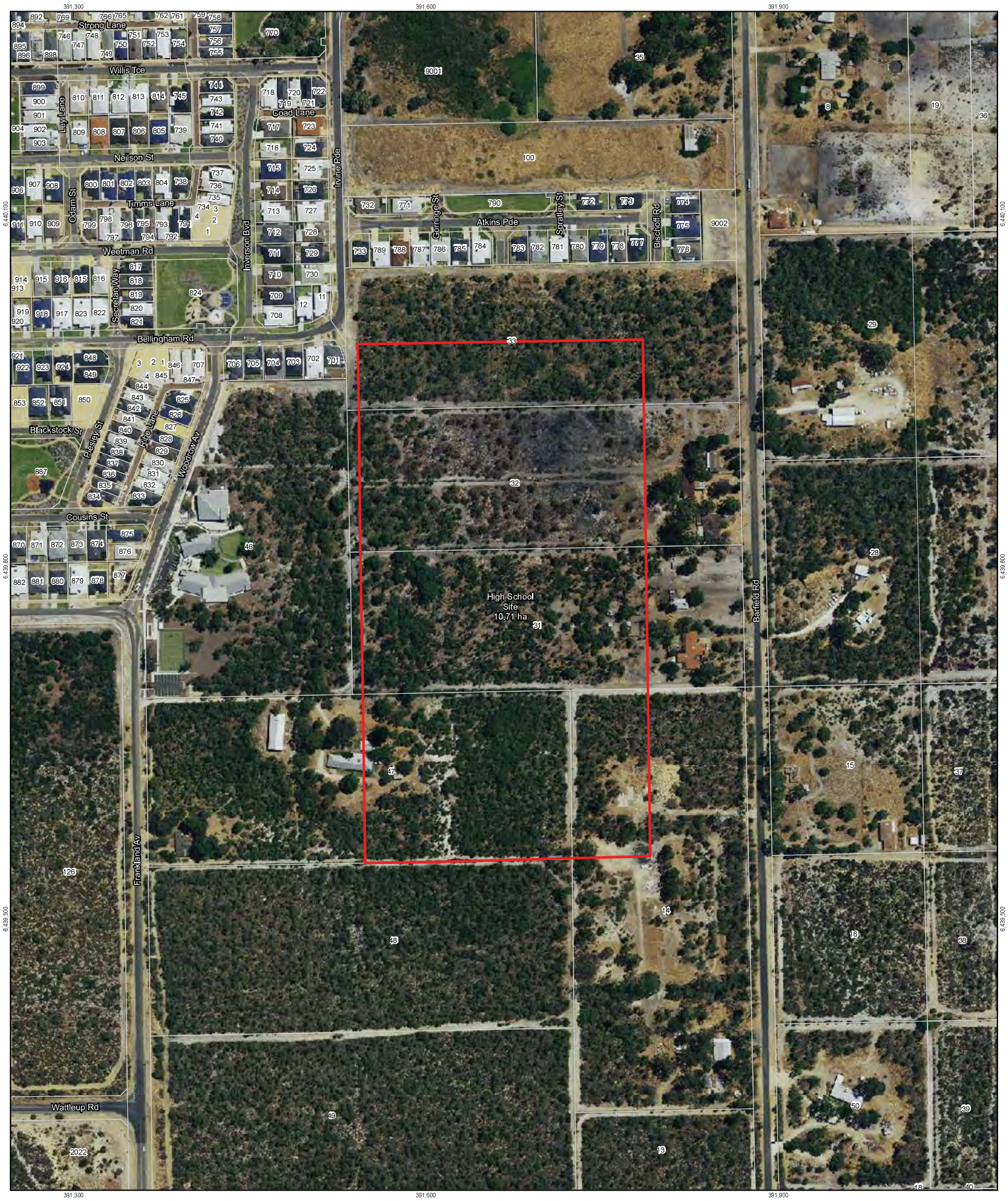
The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury - Strategic Projects and others who provided information to GHD (including Government authorities)], which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.



LEGEND

- School Site
- Cadastre

Paper size : A3

0 15 30 60 90 120 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

SLIP ENABLER

Department of Finance
Schools PPP - Desktop Study

Hammond Park High School
Locality

Job Number	61-31027
Revision	0
Date	17 Sep 2014

Map 1

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G001_HammondParkHS_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central 2014 Mosaic - 20140526, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jomonteignes

2. Scope of Work

2.1 Desktop Assessment

A review of available information was undertaken to provide evidence of past or present contamination issues at the site. The desktop assessment included a review of the following:

- Current and historic Certificate of Title to determine past owners of the site and likely associated uses.
- Current and historic aerial photographs, on an approximate ten year basis, showing the site to determine the development over time.
- Surrounding land uses to assess potentially sensitive environmental and human health receptors to possible contamination and to assess surrounding land uses that have the potential to impact the site.
- Local and regional geology and hydrogeology to determine the likely soil type and groundwater regime at the site.
- Department of Water (DoW) bore information to ascertain the use and available groundwater quality information in the vicinity of the site.
- Local topography and any surface water information to determine possible surface water flows and potential contaminant receptors.
- DER *Contaminated Site Database* information to ascertain whether the site or any surrounding properties have been identified as contaminated sites.

The following references were also available for the site:

- Local Water Management Strategy Barfield Road Local Structure Plan – Landscape Master Plans (2013)
- Southern Suburbs District Structure Planning Area Russell Road Arterial Drain Scheme
- Shawmac Consulting Civil and Traffic Engineers, Risk Managers (Year unknown)
- Taylor Robinson 2011, Hammond Park High School DoE Business Case Development, Report for Department of Education
- GHD 2014, Hammond Park High School Flora, Fauna and Vegetation Assessment, Report for Department of Education
- GHD 2013, Hammond Park High School Flora, Fauna and Vegetation Assessment, Report for Department of Education
- Inherit, Heritage Council, State Heritage office, http://inherit.stateheritage.wa.gov.au/public accessed 11 June 2014 and 26 June 2014
- GHD, 2011. Stage 1 Report for School Site Inspection and Feasibility Study Hammond Park High School. Report for Building Management & Works

Regional data (public data sources) also reviewed included:

- SRTM Digital Elevation Model;
- Perth Groundwater Atlas (Department of Water, http://www.water.wa.gov.au/idelve/gwa/)
- Boreholes registered in Department of Water WIN database at the distances between 100 and 350 m from the site boundaries

- Department of Water - WIN Database - provides details on existing bores that may or may not be related to the active abstraction licences.
- Landgate Shared Land Information Platform, https://www2.landgate.wa.gov.au/bmvf/app/waatlas/, accessed 11 June 2014

2.2 Soil Investigation

Soil investigations comprised soil bore investigations at nine locations across the site. Soil samples were collected and analysed for a broad range of contamination and ASS indicators, as described in Section 7.

2.3 Groundwater Investigation

Groundwater investigations included installation, sampling and analysis of four groundwater monitoring wells at the site, as described in Section 8.

2.4 Reporting

This assessment has been prepared with reference to DER guidelines. The report presents the information obtained through the desktop assessment, summarises the findings of site monitoring and identifies any areas that require further investigation and/or remediation under current Western Australian legislation.

Where other parties have supplied information or data, the data is included and used in the form provided by other parties. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD. Attention is drawn to Section 1.3, which outlines the limitations of this report.

3. Site Identification

The site is located approximately 25km south of the Perth CBD, in the suburb of Hammond Park, within the City of Cockburn. The site location is shown in Map 1. The coordinates of the site boundaries and the legal identification details for the site are presented in Table 1. Copies of the Certificate of Title can be found in Appendix A.

Table 1 Site Identification Summary

Common Title/Name	Hammond Park High School Proposed Site		
Address	**Street Address**	**Lot number**	**Certificate of Title (Volume/Folio)**
	194 Barfield Rd, Hammond Park 6164	14	1667/69
	156 Barfield Rd, Hammond Park 6164	31	1749/64
	144 Barfield Rd, Hammond Park 6164	32	13/61A
	Barfield Rd, Hammond Park 6164	33	22/201A
	213 Frankland Ave, Hammond Park 6164	47	1698/219
Local Government Authority	City of Cockburn		
Current Zoning	Urban		
Area and elevation	10.2 ha		
Locality Map	Map 1		
Site and Surrounding Land Use Plan	The site is currently composed of residential acreages on bushland blocks. The area to the north and west has already been subdivided into residential lots.		
Regional Setting	The site is located approximately 300 m west of the Kwinana Freeway. Banganup Lake and Thompsons Lake is located over 2 km to the west and north of the site respectively. Alcoa Tailing Ponds are located approximately 4-5 km to the south west.		
Coordinates of the Site Boundary	Corner	Northing	Easting
	North West:	391542	6439989.19
	North East:	391784.89	6439993.16
	South West:	391548.48	6439547.52
	South East:	391791.24	6439553.42

4. Site History

4.1 Site Ownership

Certificates of Title were reviewed to identify possible uses of the sites. These lots are currently privately owned by individuals. Details of site ownership are summarised here in Table 2 and the Certificates of Title are presented in Appendix A.

A review of the Certificates of Title indicates that all properties have been registered as privately owned for several decades. A review of the aerial photographs for these properties has indicated that they contain a mix of uncleared bushland and agricultural land.

Table 2 Summary of Site Ownership

Volume/Folio	Date	Registered Proprietor
Lot 14, 194 Barfield Rd, Hammond Park 6164		
1575/356	17 May 1984	George William Morgan and Rosemary Morgan
1575/357	Unknown	Unknown
1667/69	6 October 2004	Gold Estates Holdings Pty Ltd
Lot 31, 156 Barfield Rd, Hammond Park 6164		
1749/64	19 March 1997	Jade Falls Pty Ltd (1/5 share) Peter Lori Sumich (1/5 share) Louvre Nominees Pty Ltd (3/5 share)
Lot 32, 144 Barfield Rd, Hammond Park 6164		
13/59A	23 December 1966	Lavinio Panizza and Loredana Panizza
13/59A	14 May 1976	Victor Soltoggio and Barbara Soltoggio
13/59A	13 January 2000	Victor Soltoggio and Barbara Soltoggio
13/61A	13 January 2000	Ching His Liao and Mei Li Tsao
Lot 33, Barfield Rd, Hammond Park 6164		
22/201A	15 July 1969	Vincenzo Passione
Lot 47, 213 Frankland Ave, Hammond Park 6164		
14188/842	Unknown	Unknown
1698/219	21 June 1985	Edward John Phillip Neesham and Kerry Anne Neesham

		(276/1000 share) Catherine Therese Clark (181/1000 share) David Lindsay Clark (181/1000 share) Laurie Stuart Clark (362/1000 share)

4.2 Zoning

Under the historic Metropolitan Region Scheme 1963, the Site was zoned "Rural" (WAPC 1963). According to the Western Australian Planning Commission's Metropolitan Region Scheme 2014, the Site and surrounding area are a mix of "Urban" and "Urban deferred" zones (WAPC 2014).

4.3 Land Use

The Site is surrounded by semi-rural properties, with a residential subdivision to the north and northwest of the Site (GHD 2011). There is some evidence to suggest the site has been used for livestock rearing. Remnant bushland of varying condition is located throughout the site. The site is located approximately 300 m west of the Kwinana Freeway and Banganup Lake and Thompsons Lake is located over 2 km to the west and north of the site respectively. Barfield Road is located approximately 100m east of the site.

Subdivision works and construction of residential houses is in progress beyond the boundary of Lot 33, to the north and northwest of the site. The Business Case Development (BCD) shows future residential distributor roads along the north, west and south boundaries of the site (Taylor Robinson 2011). A minor residential road also appears to be planned along the eastern boundary. The BCD indicates residential development is to occur to all areas surrounding the site except for a Private Primary School which is to be located on the opposite side of the future road on the western boundary. It is noted that there may be potential for shared facilities between the high school and adjacent Private Primary School (Taylor Robinson 2011).

4.3.1 Surrounding Land Use

The surrounding land uses are summarised in Table 3 below.

Table 3 Description of land use surrounding the Site

Direction	Description
North	The east of the Site is zoned as 'Urban Development' and as 'Rural'.
South	The east of the Site is zoned as 'Urban Development'.
East	The east of the Site is zoned as 'Urban Development'.
West	The west of the Site is zoned as 'Primary Regional Roads' and 'Rural'.

4.4 Heritage

4.4.1 Indigenous Heritage

There is no evidence of heritage issues on the site. A search conducted by the Heritage Council of WA confirms that there is no registered heritage agreement or conservation order for the site.

The Department of Indigenous Affairs has indicated that there are no registered Aboriginal Heritage Sites in the vicinity of the school site (accessed 26 June 2014). The closest registered sites are to the east and north-east (DoIA 2014). Results of a search conducted by Landgate indicate that the site is within the external extents of one registered and two unregistered Native Title Claims (O'Connor 2014).

4.4.2 Non-Indigenous Heritage

No heritage sites were found on the Site or in the surrounding area (inHerit, accessed 11 June 2014).

4.5 Aerial Photographs and Historic Site Layout

Aerial photography/aerial imagery of the area available from 1953 to 2014 from Landgate was used to identify former land uses of the site and to identify regional trends and changes in that period. Images are presented in Appendix B. A summary of information available from the imagery is provided below and was recorded when there was a visible change to the site from the previous recorded image.

Table 4 Review of Aerial Photographs

Date	Observations
1953	Site is composed of sparse scrub. Some areas may be marshy including an area present in Lots 32 and 33 and centred on: 6439900N, 391933E. A north-south track is apparent approximately 700m to the east, and an east-west track appears to be visible to the south of the Site.
1965	The Site is still covered by spares scrub. A track has been cleared in the current location of Barfield Road and a track has also been cleared from Barfield road to the east, where Rowley Road now lies. A boundary around 194 Barfield Road is visible. Land has been cleared on the eastern side of Barfield Road, to the north east of the Site.
1974	A number of acreage blocks have been subdivided, bushland cleared and tracks constructed in the area. Rowley Road now runs further west, and a large number of the lots have clear boundaries. Lot 32 has been substantially cleared. The bush still appears quite sparse and scrubby. Trees were apparent on 156 Barfield Road, in the south west corner of 144 Barfield Road and across 213 Frankland Ave. The vegetation across 194 Barfield Road appears denser than the surrounding lots.
1977	Vegetation across all the lots other than 144 Barfield Rd appears denser. The area of 144 Barfield Rd has retained trees in the south west corner, but appears sparse and cleared across most of it. A few houses have been constructed on Lots to the north of the Site, and these properties appear to be used as market gardens. A house has been built on Lot 32 outside of the site envelope.
1979	Clearing appears to have occurred across the south east section of 194 Barfield Rd.

	The vegetation at 156 Barfield Road also appears to be sparser.
1981	More structures have been constructed on Lot 32, adjoining the previous building. A house and shed have been constructed on Lot 31 outside of the site envelope. Tracks have been constructed around Lots 31 and 32. Firebreaks are also clearly visible around these two Lots. Eight structures, possibly sheds or greenhouses have been constructed on Lot 31 within the co-ordinates: • 6439769N, 391717E, • 6439771N, 391781E • 6439742N, 391781E • 6439739N, 391718E Lot 47 has been cleared on the south west corner and on the eastern half. Trees remain on the northeast corner, through the centre and across the northwest corner. As this aerial is in colour, both Rowley Road and Barfield Road can be seen to be bituminised by this point.
1985	Lot 47 has been cleared further, and a small house has been constructed outside the site envelope. A hardstand appears to have been constructed in the centre of the lot. There are now ten small sheds or greenhouses on Lot 31 where there were eight before. A pool has been constructed next to the house. The oval track around this lot appears to be covered with gravel. The middle third of Lot 14 has been cleared and a structure has been constructed within the co-ordinates: • 6439612N, 391761E • 6439611N, 391771E • 6439592N, 391773E • 6439592N, 391761E
1995	Several new structures have been constructed in the northern centre third of Lot 47, that appear to be large sheds. The eastern quarter is now bushland. Some of the shed or greenhouse structures on Lot 31 are now obscured by trees. Lot 33 remains undeveloped. Lot 14 contains new structures outside the Site in the south east corner. A new structure is on the northwest corner of the cleared area in the centre of the lot, within the Site boundary.
2000	The Site and all lots appear to have more mature trees and bush on them than previously. The centre third of Lot 47 is being used for some sort of commercial activities largely outside of the site envelope. Lot 47 has a new track, possibly limestone hardstand, running from Frankland Ave to the sheds in the centre of the lot. A small bright blue area, which could be a pool or water storage, has been constructed directly north of one of the large sheds in the centre of the lot. Lot 14 also appears to be used for commercial purposes in the centre third. Soil appears to be stockpiled in the centre of the Lot, outside the Site boundary. Eight structures on Lot 31 have been removed and replaced with four greenhouse-like structures in north east corner of site. Lot 32 has a new track running down the centre.

2003	The vegetation on Lot 33 appears sparser and with more grasses along the northern border. Lot 32 appears to be mostly cleared, with some trees around the buildings and towards the western edge. Lot 14 has some trees growing on the cleared centre third, where stockpiles appeared to be previously.
2006	The structures in the centre of Lot 14 have been removed, with only hardstand areas remaining. A house and shed appear to remain in the south east corner of the lot. The greenhouses on Lot 31 also appear to have been partially demolished or removed, although this may just be the roofs of the structures having been temporarily removed. All other lots appear to have remained the same.
2010	The Site area appears unchanged; however clearing has occurred to the north and northwest of the site indicative of housing developments.
2010	Significant residential development has occurred to the north and northwest of the Site. Numerous houses have been constructed or are in the process of being constructed. Green open public spaces have also been built. No changes appear to have occurred on the Site.
2014	The area to the north and northwest of the Site has been significantly developed, with several new roads and housing. Structures within site boundary on Lot 47 have been removed. No evidence of structures within site boundary. A fire appears to have occurred through the centre of Lot 32, with dark grey ash throughout the lot.

4.6 Potential Contamination

4.6.1 Land Use

The majority of the site area consists of undeveloped native bushland, however there are some sheds located within the site boundary on Lots 31 and 47. The portion of the site on Lot 31 also contains animal pens for sheep and goats, which were in use at the time of the inspection. Part of the site on Lot 47 also includes a section of the household's backyard. Lot 14 contains concrete and limestone hard stand areas and part of an old feature entry wall.

Firebreaks and fences separate the existing lots. There is scattered refuse across the site including car bodies, car parts, rusted metal drums, spools of wire, old containers, building rubble, domestic waste and random felled trees. Sheets and fragments of potential asbestos containing fibre cement materials were also present across the site.

An old windmill frame was found resting on the ground at the eastern end of the site on Lot 31. A dilapidated shade structure was also present in this area. Numerous bags of absorbent material, similar to kitty litter, are present near the western end of Lot 31. These are likely to be waste from the animal pens on this lot. Further refuse was present on the Lot 14 part of the site, which contained a discarded fibreglass swimming pool and a small stack of overflowing waste oil drums.

of the uncontrolled dumpingAppendix H (Plate 1 and Plate 2). Refuse included:

- General dumped rubbish - car bodies, car parts, rusted metal drums, spools of wire, old containers, building rubble
- Domestic waste

- Felled trees
- Fibre cement materials, which may contain asbestos
- Windmill frame
- Bags of absorbent material, similar to cat litter, likely for animals kept on the site (goats and sheep)
- Lot 14 contained a discarded fibreglass swimming pool and a small stack of overflowing waste oil drums
- Animals have been kept on Lot 31 and in the surrounding area, in particular sheep and goats. While not observed at the time of inspection, a sheep dip would increase the likelihood of contamination (GHD 2011)
- Sheep were observed wandering on Lot 31 and Lot 32 during drilling on 30 September 2014.

The Site is low lying, and may have received contamination through previous runoff from the surrounding areas (GHD 2011).

Some livestock, goats and sheep were being farmed on one of the lots. The impact from this activity needs to be investigated for any residual pesticides and effluent build-up that may require remediation. The underlying groundwater should also be tested for any contamination.

Various collections of dumped rubbish were noted across the site. Pieces of fibre cement material were noted in a number of locations and there is a strong likelihood that they contain asbestos fibre. Testing is recommended with a strong potential for soil remediation being required prior to any earthworks occurring. There were scattered metal drums dumped across the site including a stockpile of 9 x 20L drums filled with used engine oil in one location. This raises the potential for contamination and the need for soil remediation prior to any earthworks.

Fragments and sheets of fibre cement material are scattered around the site and may contain asbestos. Further site contamination is possible due to general dumping of waste on the site and the presence of sheep and goats on Lot 31, particularly if a 'sheep dip' was present. Hard stand areas of unknown use are present on Lot 14 and a small stack of waste oil drums, also present in this location, may indicate some former industrial activity.

4.6.2 DER Contaminated Sites Information

Lot 8001 On Plan 53298 Aubin Grove WA 6164

This site (a former piggery) is located approximately 1 km north east of the site boundary and is composed of 85 lots. There are microbiological indicators of possible pathogens in groundwater across the site as well as elevated levels of hydrocarbons and zinc. Remediation of affected soils has been conducted and the site is classed as "remediated for restricted use". There are a number of restrictions on the use of groundwater at the site.

4.7 Acid Sulphate Soils

A search of recorded risk of ASS was conducted using the landgate search tool. The entire site is classified as of low to moderate risk for ASS (Landgate SLIP viewer, accessed 2014).

4.8 Previous Soil and Groundwater Assessments

No previous soil or groundwater assessments were available for this site.

4.9 Integrity Assessment

The information presented in this report was obtained from a variety of sources including government agencies and various reference documents. The information provided by these sources has a varying degree of accuracy and therefore GHD has sought to consult several sources, wherever possible, to confirm the accuracy of the information.

4.9.1 Government Agencies

The information provided by government agencies or obtained from government databases is generally accurate and is sourced from reputable reference documents. Therefore this data has been used as a primary line of evidence wherever available.

4.9.2 Aerial Photographs

Aerial photographs are considered to be an accurate and reliable source of information about the site as the information provided is independent of memory of bias. Aerial photographs were available for the site, however many data gaps were present in this source, with aerial photographs only being available from 1953 onwards. Photographs are also open to interpretation and so have been considered in conjunction with other information sources.

5. Site Conditions and Surrounding Environment

5.1 Site Description

As per a site walkover in 2013, the site walkover in September 2014 showed Lot 33 contains some dumped rubbish and wood cutting, but appears to be otherwise undisturbed. Lot 31 is partially cleared, with the remainder affected by grazing. Large trees are still present. Photographs from the site walkover show a minor amount of rubbish and old farm infrastructure is scattered throughout the lot. Lot 32 is cleared in the northern section, with some dumped rubbish. Lot 47 was partially cleared, with weeds dominating the understory, however the remainder of the site is generally clear of weeds. Lot 14 was not accessed during this site walkover, however the site contains vegetated areas that seemed relatively undisturbed, and cleared areas. Lot 31 contained animal pens for sheep and goats, which were in use during the 2014 site walkover.

5.2 Topography

The topography of the site varies by over 6 m from the highest point (29 mAHD in the south east corner) to the lowest (23 mAHD in a depression in the centre of Lot 32). There is a built up area on the south east corner of the site. There is also a depression approximately 0.5 m deep in the centre of the northern half of the site (Lot 32).

There is a development to the northwest of the site, which has been built up and is well above the level of the site. The low lying nature of the site leave it at risk of receiving water from street drainage and runoff, from this development and the surrounding area, with the potential for flooding during significant storm events.

5.3 Climate

The Study Area experiences a Mediterranean climate, with mild, wet winters and hot, dry summers. The closest Bureau of Meteorology (BoM) weather station to the Study Area is located approximately 6.9 km from the Study Area at the Medina weather station (station number 9194). A summary of the climatic data (BoM, 2013) for this weather station (1994–2013) is below:

- Mean maximum temperature: 18.3 °C (July) to 31.5 °C (February)
- Mean minimum temperature: 8.0 °C (July) to 17.6 °C (February)
- Mean annual rainfall: 763.9 mm
- Mean number of days of rain >1 mm: 90.1

5.4 Surrounding Environment

5.4.1 Environmentally Sensitive Areas

There are no Environmentally Sensitive Areas (ESAs) within the Study Area, there are however, four ESAs are within 2 km of the Study Area (Map 2).

5.4.2 Reserves & conservation areas

There is no State or Federally managed reserves within the Study Area. There are, however, a number of reserves and conservation areas within the general area. These reserves and conservation areas are described below and mapped in Map 2.

A search of the EPBC Protected Matters Search Tool (DotE, 2013a) identified five state and territory reserves as occurring within 5 km of the Study Area:

- Harry Waring Marsupial Reserve
- Thomsons Lake
- Unnamed WA48291
- Unnamed WA49561
- Wandi Nature Reserve

Four Bush Forever sites are present within approximately 2 km of the Study Area (Government of Western Australia, 2012):

- Bush Forever site (number 268). Located south west of the Study Area
- Bush Forever site (number 392). Located west of the Study Area
- Bush Forever site (number 391). Located north west of the Study Area
- Bush Forever site (number 492). Located north east of the Study Area

5.4.1 Water Information Reporting Bore Search

The Study Area is in a P3 Public Drinking Water Source Area and less than 500 meters from a P1 Public Drinking Water Source Area (GHD 2013a).

A groundwater bore search was undertaken using Water Information Reporting provided by the Department of Water on the 11th June 2014. The following AWRC Bore references (Table 5) are within approximately 500 m of the site.

Table 5 WIR Groundwater Bore Search

AWRC Ref	Context	Name	WIN Site ID
61411056	Wattleup Private Wells	L 113 Wattleup Rd	11166976
61404004	Murray River Catchment 614	Ellement Bore	20023110
61404009	Murray River Catchment 614	Ellement Bore	20023115
61410087	Jandakot Monitoring	JM37	3049
61403659	Murray River Catchment 614	Bore	20022741
61403703	Murray River Catchment 614	Bore	20022786
61403164	Murray River Catchment 614	145	20022151
61410211	Jandakot Monitoring	JM33	3173
61403082	Murray River Catchment 614	50	20022068
61406521	Murray River Catchment 614	Bore	20022750

61403628	Murray River Catchment 614	Bore	20022708
61419635	Jandakot Private Wells	Wilkins	10022891
61403741	Murray River Catchment 614	Bore	20022826
61403438	Murray River Catchment 614	Bore	20022503
61410104	Jandakot Observation	J220	3066
61403737	Murray River Catchment 614	Bore	20022822
61403704	Murray River Catchment 614	Bore	20022787
61403670	Murray River Catchment 614	Bore	20022753
61410100	Lake Thomson	T100 (I)	3062
61410103	Jandakot Aquifer Eval	JE12C	3065
61410102	Jandakot Aquifer Eval	JE12B	3064
61410101	Jandakot Aquifer Eval	JE12A	3063
61415024	Artesian Monitoring	AM49A	3424
61415023	Artesian Monitoring	AM49	3423
61410098	Lake Thomson	T100 (O)	3060

5.5 Wetlands

5.5.1 Ramsar wetlands

A search of the EPBC Protected Matters Search Tool (DotE, 2013a) identified two Wetlands of International Importance (Ramsar) within 5 km of the Study Area (Map 2).

- Forrestdale & Thomsons lakes (within Ramsar site).

5.5.2 Lakes covered under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992

No Lakes covered under the Environmental Protection (Swan Coastal Plain Lakes) Policy 1992 (EPP) occur within the Study Area. Thirty six EPP Lakes occur within 5 km of the Study Area (Map 2).

5.5.3 Geomorphic wetlands

No geomorphic wetlands occur within the Study Area. Twenty three geomorphic wetlands occur within approximately 2 km of the Study Area (Table 5 and Map 2).

Table 6 Geomorphic wetlands occurring within approximately 2 km of the Study Area

UFI	Conservation Category	Classification	Name
1638	Resource Enhancement	Sumpland	Unknown
6529	Conservation	Lake	Thomson Lake
6530	Multiple Use	Dampland	Mandogalup Swamp North
6533	Resource Enhancement	Sumpland	Copulup Lake
6534	Conservation	Dampland	Unknown
6611	Conservation	Sumpland	Banganup Swamp
6665	Resource Enhancement	Dampland	Unknown
6719	Resource Enhancement	Sumpland	Mandogalup Swamp North
6724	Resource Enhancement	Sumpland	Mandogalup Swamp North
6725	Conservation	Sumpland	Mandogalup Swamp North
6726	Resource Enhancement	Sumpland	Mandogalup Swamp North
6886	Resource Enhancement	Dampland	Unknown
6888	Resource Enhancement	Dampland	Unknown
6889	Resource Enhancement	Dampland	Unknown
6893	Conservation	Sumpland	Unknown
14104	Conservation	Dampland	Unknown
14662	Multiple Use	Sumpland	Mandogalup Swamp North
15406	Multiple Use	Sumpland	Unknown
15408	Multiple Use	Sumpland	Unknown
15412	Conservation	Sumpland	Unknown
15520	Resource Enhancement	Dampland	Baler Court
15521	Multiple Use	Dampland	Baler Court
15886	Multiple Use	Dampland	Unknown

6. Geology and Hydrogeology

6.1 Geology

The 1:50,000 Environmental Series map (Fremantle Sheet) indicates the predominant near surface geology to comprise Bassendean Sand.

The Bassendean Sand is described as very light grey at surface to yellow at depth, fine to medium grained, moderately sorted, sub-rounded to rounded quartz sand of eolian origin. A layer of friable, limonite-cemented sand, colloquially known as “coffee rock” commonly occurs near the groundwater table.

6.2 Hydrogeology

6.2.1 Site Groundwater Levels

The Perth Groundwater Atlas (PGA) indicates that the highest estimated groundwater is approximately 2 m below the natural surface level of the site, or RL +22 m AHD. The topography ranges from RL +23 to +29 m AHD across the site, indicating the highest estimated groundwater level may be between 1m and 7m below the natural ground surface level.

6.3 Hydrology

There was no surface water on site, but vegetation in the low lying areas indicates there is a high water table. The site is lower than the surrounding land, so there is the potential for stormwater runoff to collect at the site. There is no standing surface water on the site.

6.4 Historical Acid Sulfate Soil Information

The site contains pale sandy soil, which is dark and loamy just below the surface (GHD 2011). Fines and organic matter (vegetation) were observed to be mixed into the soil in lower areas, indicating that ASS may be present. Vegetation in the lower lying areas was also indicative of a high water table (GHD 2011).

A review of the WA Atlas (SLIP viewer) found that the area has a moderate to low risk of ASS beyond 3 m of the ground level. As the topography is variable, it is possible that there is ASS closer to the surface than this.

7. Soil Investigation

7.1 Soil sampling rationale

The soil sampling frequency was undertaken with consideration to the DER ASS Guideline Series: *Identification and investigation of acid sulfate soils and acidic landscapes* (DEC, 2013). The DER recommends that for larger scale projects (i.e. >4 ha) a minimum of two (2) soil investigation locations per hectare should be applied to the site. For this site of 10.71 ha a total of nine locations were sampled. This was thought appropriate due to the preliminary nature of the investigation. For all sample locations a surface sample was obtained for heavy metals and OCP/OPP pesticides.

7.2 Soil sampling

7.2.1 Soil bores

Drilling was undertaken on the 30/09/2014 using a direct push probe rig to obtain un-disturbed soil cores beneath the site. When push probing was not possible a solid auger drill method was used to obtain samples. Bore locations are included in Map 4.

7.2.2 Methodology

Following logging of the soil profile, samples were collected at 0.5m intervals to the base of the test pit or soil bore. Allowances were made to collect samples at discrete soil strata (if encountered between the sampling intervals). Field measurements were undertaken where appropriate.

Samples were placed in clearly labelled air tight bags with the air excluded, and placed in an esky™ with ice while on-site before being couriered directly to Eurofins MGT Environmental Laboratory in Kewdale. Quality control sampling comprised the collection of duplicate samples at an approximate rate of one (1) per twenty (20) samples.

7.3 Acid Sulfate Soil assessment criteria

7.3.1 ASS action criteria

The acid based accounting equation, as outlined in the DER ASS Guideline Series: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2013) is:

Net Acidity[2] = Potential Acidity + Existing Acidity – Acid Neutralising Capacity[3]

The trigger levels based on net acidity and soil texture are outlined in the DER ASS Guidelines Series: *Identification and investigation of acid sulfate soils and acidic landscapes* and are presented in Table 7.

Generally materials (excluding topsoil) containing net acidity in excess of the values presented in Table 7 are deemed to be soils that require treatment. Based on the current design, the

[2] Net Acidity equation has been extracted from the DER ASS Guideline Series*: Identification and investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2013).

[3] Due to particular characteristics of the soil and groundwater regime in Western Australia, DER does not recognise the validity of ANC values without confirmatory kinetic testing or modified laboratory methods to provide a more accurate estimate of the actual amount of neutralising capacity that would be available under real field conditions.

proposed volume to be disturbed for this project is significantly greater than 1,000 tonnes. Due to the large volume of material that will be disturbed, an action criterion of 18.7 mol H+/tonne or 0.03%S has been adopted regardless of the soil texture range and in consideration to the origin of the sand.

Table 7 Acid Sulfate Soil Action Criteria

Type of material		Net acidity action criteria			
Soil texture range	Approx. clay content (%)	< 1,000 ton of material disturbed		> 1,000 ton of material disturbed	
		Equivalent Sulfur % S	Equivalent Acidity mol H+/tonne	Equivalent Sulfur % S	Equivalent Acidity mol H+/tonne
Coarse Texture Sands to Loamy sands	< 5	0.03	18.7	0.03	18.7
Medium Texture Sandy Loams to Light Clays	5 – 40	0.06	37.4	0.03	18.7
Fine Texture Medium to Heavy Clays and Silty Clays	> 40	0.1	64.8	0.03	18.7

Adopted from Table 10: Texture based ASS 'action criteria' (DEC 2013)

7.3.2 Bassendean sand criteria

Bassendean sands may contain singe crystal and framboidal aggregates of sub-micron-sized pyrites. Bassendan sands generally have a poor acid buffering capacity and the revised DER guidedance recommend that Bassendean sands with a combination of pH_{FOX} less than 3.0 and a S_{CR} value greater than 0.01%S are indicators of ASS.

7.4 pH screening analysis

The preliminary pH screening tests provide important information in regards to the existing acidity of the soil profile (pH_F) and the stored (potential) acidity of the soil. The soil pH trigger values in accordance with the DER ASS Guideline Series*: Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC 2013) were used as a preliminary screening tool to identify AASS and PASS.

The pH field screening method is indicative only and cannot determine the presence or absence of ASS. The pH field screen may provide '*false positives*' and '*false negatives*' therefore overestimating and under estimating the true acidity potential of a soil.

7.4.1 pH screening results

A total of one hundred and five (105) soil samples were submitted to Eurofins for pH_F and pH_{FOX} rapid screening. Samples were collected at 0.5 m intervals to a maximum depth of 5.0 m below ground level (bgl), after which they were collected at 1.0 m intervals to a maximum depth of 10.0 m bgl. The results of the ASS pH screening are presented in Table 1 in Appendix D, while the laboratory Certificates of Analysis are presented in Appendix E.

Values for pH_F ranged from 4.4 to 8.4 (average of 6.0) with values for pH_{FOX} ranging from 2.3 to 5.9 (average of 3.8). The ΔpH, defined as pH_F minus pH_{FOX}, ranged from 1.0 to 3.5 (average 2.1). Approximately 13% of samples had ΔpH value of greater than 2 indicating that the initial potential of acidity upon oxidation is significant within soil profiles anticipated to be excavated and/or dewatered. The screening results indicate that most of the soils sampled are generally slightly alkaline to slightly acidic.

Table 8 outlines the number of samples that are likely to be actual and/or potential ASS based on the number of exceedances of the ASS pH screening criteria outlined within the DER ASS Guidelines Series (DEC, 2013). In summary:

- No samples are indicative of AASS, with pH_F greater than 4.0 for all samples analysed.
- 40 samples have pH_F between 4.0 and 5.5 (inclusive), indicating acidic soil.
- 69 samples have ΔpH of greater than or equal to 2, indicating that PASS is likely. Of these 42 also had pH_{FOX} less than or equal to 4.0, further supporting their classification as PASS.

Table 8 pH Analysis Criteria

Criteria	Result	Number of Exceedences (of 248 samples)
$pH_F \leq 4.0$	AASS	0
$4.0 < pH_F \leq 5.5$	Acid Soil (possible ASS link)	40
$pH_{FOX} \leq 4.0$	PASS likely	65
$\Delta pH \geq 2.0$	PASS likely	69

Table adapted from Table A1 and Table A2 (DEC 2013)

Of the 105 samples analysed for the ASS pH screening tests, Chromium Reducible Sulfur (CRS) analyses was scheduled on 33 samples from the soil profile anticipated to be disturbed during construction.

7.5 Quantitative laboratory testing

Chromium Reducible Sulfur (CRS) analysis provides an estimation of the soils potential sulfidic acidity. This is achieved through measuring the reduced inorganic sulfur content within a soil sample. CRS is not subject to interference from organic matter or sulfate minerals (as is the case with SPOCAS) and therefore is considered to provide an accurate estimation of the potential sulfidic acidity potential of a material.

Results of the ASS confirmatory laboratory testing are discussed below.

A total of thirty three (33) primary samples collected were analysed via the CRS method.

Conclusions drawn from the ASS laboratory results (Table 1, Appendix D) include the following.

- None of SCr acidity results were greater than the DER ASS action criteria of 18.7 mol H+/tonne (equivalent 0.03%S).
- A total of seven (7) primary samples (21%) analysed were found to have a net acidity above the DER ASS action criteria of 18.7 mol H+/tonne (equivalent 0.03%S). The Acid Neutralising Capacity (ANC) of the sample has been excluded from the Net Acidity (NA) equation.

- All seven (7) samples had exceedances due to high Total Actual Acidty (TAA). The maximum TAA value presented was 100 mol H+/tonne and was located within indurated sands and weakly cemented coffee rock (MB02 at 2.5m below ground level). All of these samples are at 2 m below ground level or deeper and below the standing groundwater level (which was likely to be close to the maximum groundwater level given the timing of the investigation).
- The maximum net acidity value recorded was 110 mol H+/tonne (0.18%S equivalent) excluding ANC with sample (MB02 at 2.5m bgl), with 90% of the acidity related to actual acidity, rather than potential acidity.

7.6 Contamination Testing

Samples were taken at 0.1m from 6 locations and tested for Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel and Zinc as well as OCP/OPP pesticides. All results for metals and the OCP/OPP pesticides were below the limit of reporting. Results are included in Table 2, Appendix D.

7.7 Summary of investigation

The soil investigation confirmed the soil formations on the site consist of Bassendean sands overlying Guildford Formation across the Site. This includes non continuous lenses of coffee rock in the northern half of the site, and lenses of clay across the site. These soils are historically known to present weak ASS within previously oxidised areas.

It is considered that ASS is present across the site below the groundwater table and where coffee rock is present. . If the in-situ soil below the groundwater table is to be disturbed by digging or dewatering an acid sulphate management plan will be required for construction. If the in situ soil disturbance is of a volume less than 100m^3, it is recommended that trench management strategies only are implemented to provide limited buffering capacity within soils potentially disturbed during the dewatering operations. The trench management strategies aim to assist with the neutralisation of any readily exchangeable acidity present within soil units dewatered or disturbed during construction.

Weakly cemented coffee rock and indurated sand was observed at two locations across the site, and is considered to be below the anticipated depth of excavation; however it is noted that coffee rock has the potential to contain stored potential acidity and therefore is required to be treated and managed accordingly, if excavated during construction.

Further testing and analysis may be advisable once the design levels and site layout is finalised.

7.8 Quality assurance/quality control (QA/QC)

7.8.1 Introduction

Quality Assurance and Quality Control (QA/QC) requirements were undertaken in accordance with Section 8.2 of DE ASS Series Guidelines: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC, 2013). The GHD field duplicate results are presented in Table 1 in Appendix F, and are discussed in Section 7.8.2. The Laboratory QA/QC results are presented in Appendix E, and are discussed in Section 7.8.3.

7.8.2 Field duplicates – Relative Percentage Differences

During the soil investigation, eight (8) field duplicates were collected for the purposes of QA/QC. A further six (6) inter-laboratory duplicates were collected.

A quantitative measure of the precision of the analytical results is made by calculating the Relative Percent Difference (RPD) between primary and duplicate results in accordance with the procedure described in AS4482.1 *Guide to the sampling and investigation of potentially contaminated soil Part 1: Non-volatile and semi-volatile compounds* (2005). According to AS4482.1, typical RPD's range between 30% and 50%, however AS4482.1 recognises that this may be higher for low concentrations of analytes. GHD considers the RPD acceptable if it is less than 50%, and where the concentrations are less than 10 times the Limit of Reporting (LOR). This acceptance criterion is based on the criteria listed in AS4482.1 (2005).

RPDs were calculated for all analysis undertaken on the fifteen (15) field duplicate samples. RPDs of greater than 50% were noted in one of the field duplicates and one of the inter-laboratory duplicates. The field duplicate exceedance was for moisture, which can vary within the soil. The inter-laboratory exceedance was for pH_{FOX}, and the RPD was 51%, so it is not considered significant. It is also noted that samples undertaken for ASS are considered to be heterogeneous in nature and differences in duplicate samples may be due to the organic nature of the soils. ASS parameters with RPD exceedances are typically below the DER Action Criteria and are therefore not considered to effect the decision making process.

The reaction rate RPD was calculated, but as this is an observation and not a quantified value, this is not considered relevant.

7.8.3 Laboratory QA/QC

ALS Laboratory is accredited by the National Association of Testing Authorities (NATA) for the analyses performed. The internal laboratory Quality Assurance results are presented in Appendix E.

Internal laboratory QA/QC results for the soil investigation are as follows:

- For all matrices, no Method Blank value outliers occurred;
- For all matrices, no Duplicate outliers occurred;
- For all matrices, no Laboratory Control outliers occurred;
- For all matrices, no Matrix Spike outliers occurred;
- For all regular sample matrices, no Surrogate Recovery outliers occurred;
- No Analysis Holding Time outliers occurred; and
- No Quality Control Sample Frequency outliers occurred.

7.8.4 Summary of QA/QC

The review of the laboratory and field Quality Assurance and Quality Control data indicates that the analytical data is considered to be of an adequate quality upon which to draw meaningful conclusions regarding the presence of ASS across the development area.

8. Groundwater Investigation

8.1 Groundwater wells

The groundwater wells were installed on the 30/09/2014. The wells are positioned to ensure that groundwater quality hydraulically up-gradient, on-site and down-gradient of the site during construction could be captured. The monitoring bores were constructed to a maximum depth of 9.5 m. The construction details of the monitoring bores are summarised in Table 9.

Table 9 Bore Construction Details

Bore ID	Top of Casing	Top of Screen	Bottom of Screen	Base of Bore	Groundwater Level	Groundwater Level
	(m AHD)	(m bgl)	(m bgl)	(m bgl)	(m BTOC)	(m AHD)
MB01	29.74	6.5	9.5	9.5	8.38	21.36
MB02	24.72	2.5	5.5	5.5	2.99	21.73
MB03	24.48	2.0	5.0	5.0	3.37	21.11
MB04	23.56	2.0	5.5	5.5	3.21	20.35

The groundwater monitoring bore locations are presented in Map 4.

8.2 Groundwater Sampling Methodology

Groundwater sampling was undertaken with reference to the DER Development of Sampling and Analysis Programs guideline (DEP 2001) and Australian Standard AS 5667 - 1998.

The standing water level of each of the four groundwater monitoring wells was measured prior to sampling. The wells were purged and sampled using low-density poly-ethylene tubing coupled to a submersible twister style high flow pump. The pump was lowered to approximately 0.5 m from the base of the well.

Field parameters measured during purging included temperature, pH, conductivity, dissolved oxygen and redox potential. Field parameters were recorded on field data sheets. Bores were purged until field parameters stabilised.

The variance associated with the above mentioned parameters required to establish chemical stabilisation are as follows:

- pH: 0.1 unit
- Temperature: 0.2 ^{o}C
- Eh (ORP): 10%
- DO: 10%
- EC: 10%

Samples were collected using new disposable gloves and placed directly into laboratory provided sample bottles. Heavy metals samples were field filtered using a 0.45 micron filter prior to being placed in sample containers.

8.3 Laboratory Program

8.3.1 Groundwater Monitoring Suite

All samples from the Site were submitted to Eurofins MGT Environmental Laboratory, accredited by the NATA for the required analyses, outlined within Table 10.

Table 10 Groundwater Laboratory Suite

Parameter	Analyte
Field Parameters	Static Water Level (SWL), pH, electrical conductivity, dissolved oxygen, redox potential, temperature
Misc Parameters	Total acidity, total alkalinity, pH, total dissolved solids (TDS), conductivity
Major Ions	Cations (Ca, Mg, Na, K) Anions (Cl, SO_4, HCO_3) and ionic balance
Dissolved metals	Al, As, Cd, Cr (III+VI), Fe, Mn, Ni, Se, Zn
Total metals	Al and Fe
Nutrients	Ammonia as N, Total Oxidised Nitrogen, Total Nitrogen, Reactive Phosphorous, Total Phosphorous

8.4 Groundwater assessment criteria

The following assessment criteria have been adopted for a preliminary assessment of pre-existing contamination (if present) and ASS groundwater indicators at the Site and are referred to in the DER (DEC, 2010) Assessment Levels for Soil Sediment and Water (Version 4.1):

- Fresh Water Guidelines;
- Short Term Irrigation (STI) Guidelines; and
- DER ASS indicator criteria.

8.4.1 Freshwater guidelines

Guidelines for the protection of ecological receptors are provided in *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000), and adopted by DER in *Assessment Levels for Soil, Sediment and Water* (DEC, 2010, Version 4.1).

The site is located within the vicinity of natural receptors (palusplain flats) and the freshwater guidelines are considered appropriate conservative criteria to determine whether dewatered effluent may have a detrimental effect on natural receptor water quality. The freshwater guidelines present various assessment criteria depending upon the surrounding environs. It is considered for this site that where more than one assessment criterion has been made available, the Wetland values will be selected.

8.4.2 Short term irrigation water guidelines

Dewatered effluent was monitored utilising the trigger criteria outlined within the ASSMP and the DER ASS Guideline Series (DEC, 2011). Effluent was also compared to the Short-Term Irrigation Guidelines specified in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ, 2000).

8.4.3 DER ASS indicator criteria

The DER ASS Guideline Series (DEC, 2013) outline chemical indicators that may indicate the groundwater is being affected by, or has already been affected by, the oxidation of sulfides. These indicators are outlined below.

- An alkalinity:sulfate ratio of less than 5 (Swedish EPA, 2002);
- A pH of less than 5; and/or
- A soluble aluminium concentration greater than 1 mg/L.

It should be noted that the above criteria are indicators only and do not necessarily denote that the oxidation of ASS materials has occurred. Any exceedence of the criteria should be identified and compared to other analytes prior to drawing conclusions on ASS.

Additional groundwater assessment criteria (adopted by the DER from the Swedish EPA), relate alkalinity with pH and infer the potential buffering capacity of groundwater. The assessment guide for the buffering capacity of groundwater is provided in Table 11.

Table 11 Assessment of the Buffering Capacity of Groundwater

Class	Designation	Alkalinity mg/L	pH	Description
1	Very high alkalinity	>180	>6.5	Adequate to maintain acceptable pH level in the future.
2	High alkalinity	60-80	>6.0	Adequate to maintain acceptable pH level in the future.
3	Moderate alkalinity	30-80	5.5-7.5	Inadequate to maintain stable, acceptable pH level on areas vulnerable to acidification.
4	Low alkalinity	10-30	5.0-6.0	Inadequate to maintain stable, acceptable pH level.
5	Very low alkalinity	<10	<6.0	Unacceptable pH level under all circumstances.

Table 8, adapted from Swedish EPA, 2002.

8.5 Baseline groundwater monitoring results

The laboratory results and the NATA endorsed final laboratory reports are presented in Appendix G and Appendix H respectively.

8.5.1 Field parameters

The following general water quality parameters were noted:

- pH values presented ranged between pH 4.69 and 5.23 and are indicative of acidic conditions
- EC values presented ranged between 0.386 and 0.593 mS/cm and are indicative of fresh water in MB01, MB02 and MB03. The EC value in MB04 was 1.50 mS/cm, which indicates saline water
- Dissolved oxygen ranged between 3.9 and 17.1 % saturation

8.5.2 Physical parameters

The following general water quality parameters were noted:

- pH values presented ranged between pH 4.9 and 5.8 and are indicative of acidic conditions
- EC values presented ranged between 0.39 and 0.61 mS/cm and are indicative of fresh water in MB01, MB02 and MB03. The EC value in MB04 was 2.10 mS/cm, which indicates saline water
- Total dissolved solid values presented ranged between 220 mg/L and 420 mg/L in MB01, MB02 and MB03, with MB04 having a TDS value of 1500 mg/L
- Acidity values presented ranged between 43 mg/L $CaCO_3$ to 190 mg/L $CaCO_3$, indicating acidic water
- Alkalinity values (present as total alkalinity) were all below the limit of reporting of 20 mg/L $CaCO_3$
- Sulfate values presented ranged between 11 mg/L and 72 mg/L

8.5.3 Inorganic metals and metal compounds

The following observations were noted:

- Filtered aluminium concentrations were all above the freshwater guideline of 0.055mg/L ranging from 0.0.1 mg/L to 4.8 mg/L.
- Filtered iron concentrations all exceed the freshwater guideline of 0.3 mg/L ranging from 0.43 to 34 mg/L, with one sample also exceeding the short-term irrigation guideline of 10 mg/L at MB04.
- Three filtered selenium concentrations exceeded the freshwater guideline of 0.005, ranging from 0.013 to 0.033 at MB02, MB03 and MB04.
- One filtered Zinc concentration of 0.038 mg/L at MB01 exceeds the freshwater guideline value of 0.008 mg/L

8.5.4 Nutrients

The following observations were noted:

- The concentration of Nitrogen (total) for MB04 of 2.8 mg/L exceeds the freshwater guideline of 2 mg/L
- The limit of reporting for Phosphorous (0.5 mg/L) exceeded the freshwater guideline of 0.2 mg/L.

8.5.5 Acid sulfate soil indicators

The following groundwater indicators were noted:

- There was one sample below a pH 5.0, at MB04 (4.9 pH units)
- The acidity was high when compared with alkalinity levels for the majority of samples
- The alkalinity to sulfate ratio indicates the groundwater is affected and/or has been affected by the oxidation of sulfides within all four bores. Alkalinity:Sulfate ratios range from 0.28 to 1.8.

8.5.6 Indicative groundwater buffering capacity

On comparison to the assessment of buffering capacity of groundwater, the groundwater from all four bores would be 'Class 4 – *Inadequate to maintain stable, acceptable pH level*', and may be of 'Class 5 – *Unacceptable pH level under all circumstance*' as per the DER ASS Guideline Series, as the criteria for this is below the limit of reporting for total alkalinity of 20 mg/L (DEC, 2011). Regardless, it should be considered vulnerable to acidification should dewatering occur at the site.

8.6 Groundwater discussion

The groundwater quality results indicate low to moderate levels of dissolved metals (mostly iron and aluminium) throughout the site within the groundwater. They may be naturally attributed to the mineral weathering within the local geology,considered to consist of alluvial sand and clay and local basal conglomerate.

Dissolved iron and aluminium was elevated in MB02 and MB04. These metal concentrations are consistent with the accumulation of observed coffee rock at MB02, however there is no such material at MB04. Dissolved aluminium exceeded the DER ASS indicator of 1mg/L at both of these wells. Elevated localised concentrations may be attributed to the precipitation of humates and iron during the formation of process of coffee rock which may consequently have been exposed to oxygen during seasonal fluctuations and the oxidation of these deposits to form localised acidity.

Dissolved metals, particularly iron and aluminium may cause environmental harm if the dewatering effluent is discharged prior to treatment and/or retention. Discharge without given sufficient retention time may cause metal hydroxides to precipitate out into receiving water bodies (particularly surface water). These chemical reactions may release large quantities of acid and consume oxygen causing de-oxygenation of the water column in nearby ecosystems or impact the local groundwater system that has limited buffering capacity (alkalinity). In groundwater system that has low alkalinity content, acidification of the groundwater may occur.

The total acidity exceeds the total alkalinity (acid buffering capacity) across the site, with the acidity at least double the value of alkalinity. Groundwater across the site is classified as Class 4 (DEC, 2011) and is inadequate to maintain acceptable pH level in the future.

Nutrients associated with the previous pastoral land use (total phosphorous, total nitrogen and ammonia-N) exceed the Freshwater Guidelines and are consistent with the regional trends of the superficial aquifer system.

Based on the above groundwater quality information obtained during the baseline groundwater monitoring event in October 2014, a dewatering management plan will be required to manage treatment dewatering effluent prior to discharge. The dewatering management is discussed further within Section 9.

8.6.1 Baseline groundwater sampling

The groundwater results presented herein are considered to an initial groundwater geochemistry assessment at this time. It must be noted however that groundwater geochemistry within the wells sampled will likely change between the time this report is written and the commencement of construction. As such, a groundwater sampling event should be undertaken just prior to construction with both sets of results be considered baseline groundwater quality against which results collected during and post-construction should be assessed. This sampling event should include the wells that currently exist and any future wells determined necessary during the review of the construction programme.

8.7 Quality Assurance/Quality Control (QA/QC)

8.7.1 Introduction

Quality Assurance and Quality Control (QA/QC) requirements were undertaken in accordance with Section 8.2 of DEC ASS Series Guidelines: *Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes* (DEC 2013). The GHD field duplicate results are presented in Appendix F, and are discussed in Section 8.7.2. The Laboratory QA/QC results are presented in Appendix E, and are discussed in Section 8.7.3.

8.7.2 Field Duplicates – Relative Percentage Differences

During the baseline groundwater investigation, one (1) field duplicate was collected at MB01 for the purposes of QA/QC.

A quantitative measure of the precision of the analytical results is made by calculating the Relative Percent Difference (RPD) between primary and duplicate results. GHD considers the RPD acceptable if it is less than 50%, and where the concentrations are less than 10 times the Limit Of Reporting (LOR). This acceptance criterion is based on the criteria listed in AS4482.1 (2005).

An RPD of greater than 50% was noted for two (2) analytes (Total Kjeldahl Nitrogen and Nitrogen (Total)). The results were less than 10 times the laboratory LOR, so the exceedance of the RPD is not considered significant.

8.7.3 Laboratory QA/QC

ALS Laboratory is accredited by the National Association of Testing Authorities (NATA) for the analyses performed. The internal laboratory Quality Assurance results are presented in Appendix E.

Internal laboratory QA/QC results for the baseline groundwater investigation are as follows:

- For all matrices, no Method Blank value outliers occurred;
- For all matrices, no Duplicate outliers occurred;
- For all matrices, no Laboratory Control outliers occurred;
- For all matrices, no Matrix Spike outliers occurred;
- For all regular sample matrices, no Surrogate Recovery outliers occurred;
- No Quality Control Sample Frequency outliers occurred; and
- The following Analysis Holding Time outliers occurred:

8.7.4 Summary of QA/QC

The review of the laboratory and field Quality Assurance and Quality Control data indicates that the analytical data is considered to be of an adequate quality upon which to draw meaningful conclusions regarding the predevelopment baseline groundwater quality at the site.

9. Conclusions and Recommendations

9.1 Conclusions

An assessment of potential for soil and groundwater contamination and ASS was completed by GHD at the proposed Hammond Park High School site in September and October 2014. In general accordance with applicable DER guidelines, the assessment included a desktop investigation of historical and current land uses and site condition, along with intrusive soil and groundwater investigation. A total of nine (9) locations were investigated for potential soil contamination and ASS, via soil bores. Four (4) groundwater wells were installed and monitored.

The findings of the assessment included:

- The site has a history of agricultural uses, with a potential for contamination associated with agricultural chemical use;
- The ASS regional risk mapping indicates the soil is at moderate to low risk of acid sulphate soils occurring within 3 m of the ground surface;
- Based on pH screening and quantitative ASS analysis of soil and groundwater conducted it is considered that an ASS Management Plan will likely be required for the site if soil below the groundwater table is to be disturbed or dewatering is required. A review of the available information will be required once construction information such as site layout and final design levels is available to identify depth and volume of any soil disturbance; and
- The assessment of potential contamination at the 9 locations included in this investigation did not indicate the presence of contamination due to heavy metals or pesticide above applicable guidelines or at levels considered to pose a significant risk to human health.
- Shallow groundwater quality was variable, with one well (MB04) showing signs of acidification with low pH, high salinity and high dissolved iron and aluminium (above irrigation guidelines). If shallow groundwater was to be used for irrigation purposes, it is likely water treatment would be required.

9.2 Recommendations

The following recommendations are made:

- If any dewatering or disturbance of in-situ soil is required for works associated with the proposed onsite development an Acid Sulphate Soil and Dewatering Management Plan will be required and may require treatment of dewatering effluent; and
- The groundwater results presented as part of this investigation are considered to represent an initial groundwater geochemistry assessment at this time. It must be noted however that groundwater geochemistry within the wells sampled will likely change between the time this report is written and the commencement of construction. As such, groundwater sampling should be undertaken just prior to construction and this should then be considered the most representative baseline groundwater quality against which results collected during and post-construction should be assessed. This sampling event

should include the wells that currently exist and any future wells determined necessary during the review of the construction programme.

10. References

GHD 2011, Stage 1 Report for School Site, Inspection and Feasibility Study, Hammond Park High School, Report for Building & Management Works

GHD 2013, Hammond Park High School Flora, Fauna and Vegetation Assessment, Report for Department of Education

GHD 2014, Hammond Park High School Flora, Fauna and Vegetation Assessment, Report for Department of Education

Taylor Robinson 2011, Hammond Park High School DoE Business Case Development, Report for Department of Education

R & E O'Connor Pty Ltd 2014, Aboriginal Analysis of Proposed Hammond Park School Site

Department of Water (DoW), Perth Groundwater Atlas, http://www.water.wa.gov.au/idelve/gwa/

Department of Water (DoW), WIN Database

Inherit, Heritage Council, State Heritage office, http://inherit.stateheritage.wa.gov.au/public

Figures

LEGEND

- Contour (mAHD)
- Cadastre
- School Site
- Environmentally Sensitive Areas
- Nature Reserve
- Aboriginal Heritage Sites

Public Drinking Water Supply Areas

- Protection Area-P2
- Protection Area-P3

Geomorphic Wetlands

- Multiple Use
- Resource Enhancement
- Conservation
- Not Applicable

Paper size : A3

0 37.5 75 150 225 300 375

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Schools PPP - Desktop Study

Job Number 61-31027
Revision 0
Date 17 Sep 2014

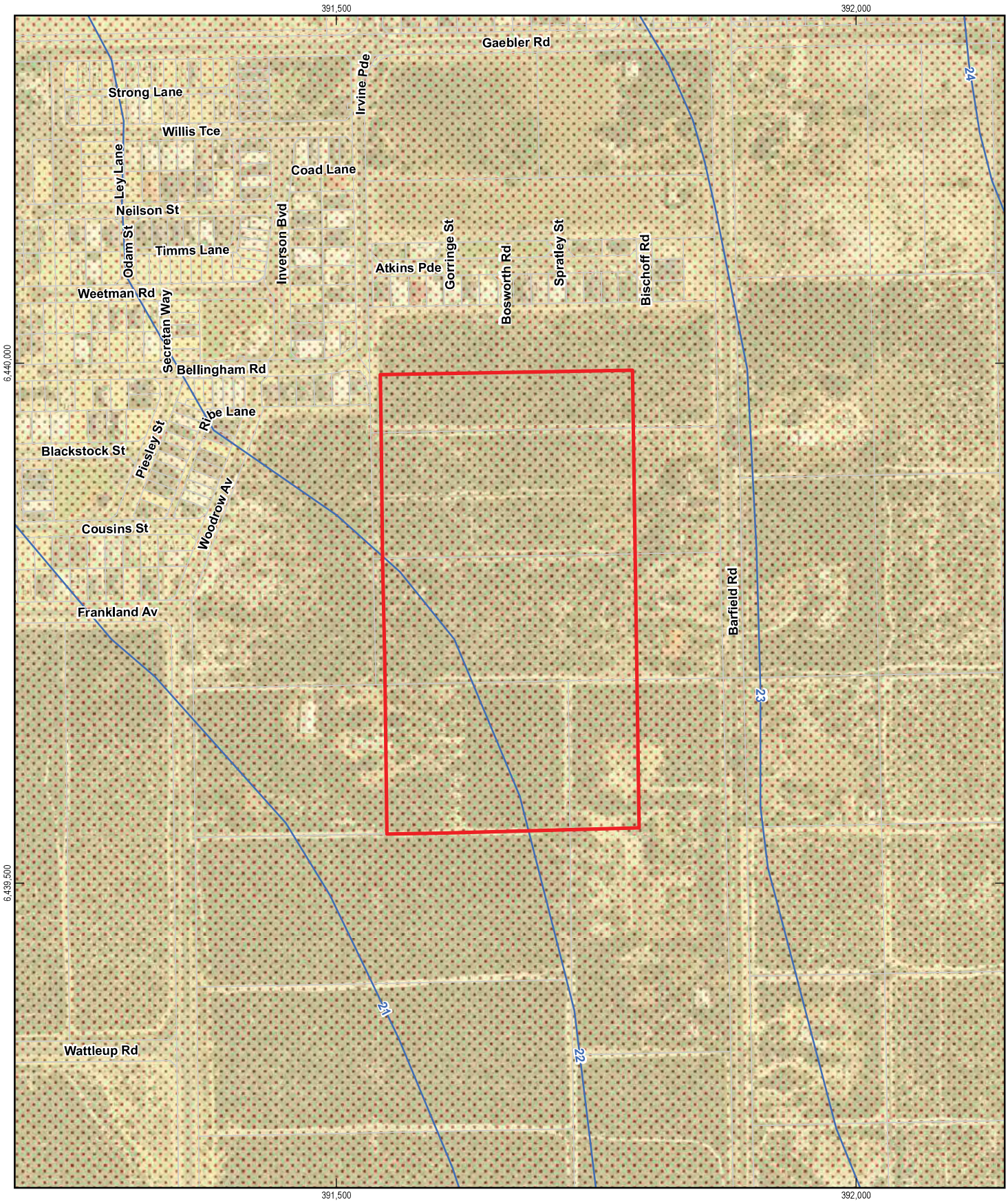
Hammond Park High School Opportunities and Constraints

Map 2

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G002_HammondParkHS_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate Metro Central 2014 Mosaic - 20140526, Road Names - 20131120, Contour (mAHD) - 20140323, Cadastre - 20140323; GHD: School Site - 20140516; DEC: Geomorphic Wetlands - 20130912, Environmentally Sensitive Areas - 20130912, DEC Estates - 20130912; DoW: Public Drinking Water Source Areas - 20130912; DAA: Aboriginal Heritage Sites - 20140526. Created by: jbmonteignies



LEGEND

- Maximum groundwater contours (m AHD)
- School Site
- Cadastre

Fremantle 50k Env Geology

- S8: SAND - very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin (Bassendean Sand)

Scale 1:5,000 (Paper Size A4)

0 25 50 100 150 200

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

Department of Finance
Schools PPP - Desktop Study

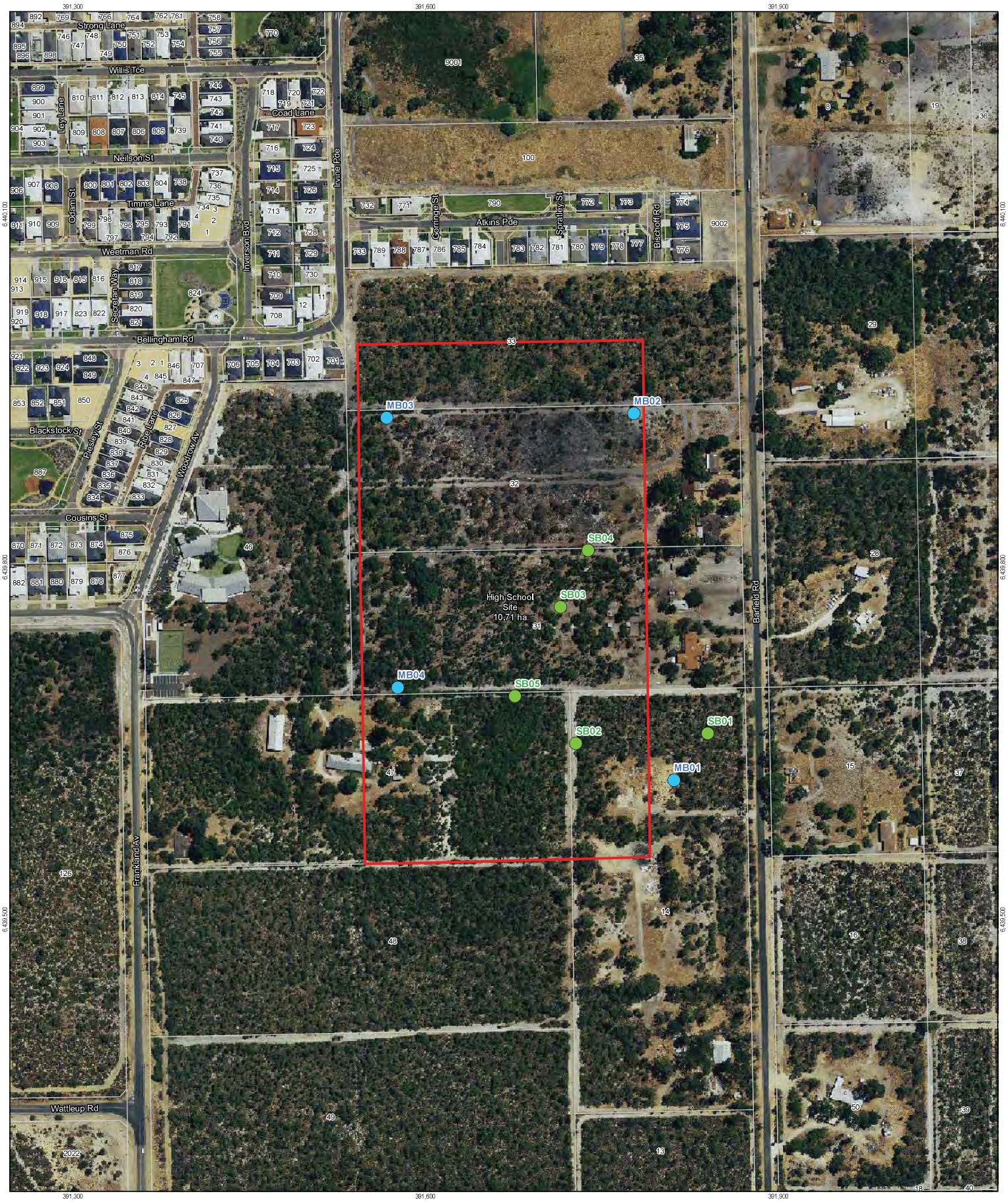
Job Number 61-31027
Revision 0
Date 22 Sep 2014

Hammond Park High School
Locality and Regional Geology

Map 3

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G003_HammondParkHS_Rev0.mxd 239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central 2013 Mosaic - 20140611, Road Names - 20140613, Cadastre - 20140523; GHD: School site - 20130904; DOIR: 50k Geology - 20140611; DoW: Groundwater Contour - 20140611. Created by: jbmonteignies



LEGEND

- Monitoring Well
- Soil Borehole
- School Site
- Cadastre

Paper size : A3

0 15 30 60 90 120 150

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

SLIP ENABLER

Department of Finance
Schools PPP - Desktop Study

Hammond Park High School
Soil and groundwater sampling locations

Map 4

Job Number	61-31027
Revision	0
Date	10 Oct 2014

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G004_HammondParkHS_Rev0.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central 2014 Mosaic - 20140526, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911, Soil and Groundwater well locations - 20141010. Created by: jcmatic

Appendices

Appendix A – Certificates of Title

INDEXED ✓ JT

Transfer 91973/66
Volume 13 Folio 59A

WESTERN AUSTRALIA

ORIGINAL

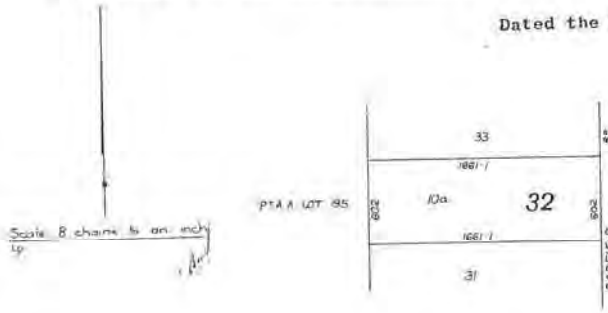
VOL. 13 FOL. 61A

Certificate of Title

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

Lavinio Panizza, Truck Driver, and Loredana Panizza, his Wife, both of 14 Smith Street, Hilton Park, are now the proprietors as joint tenants of an estate in fee simple subject to the easements and encumbrances notified hereunder in the natural surface and therefrom to a depth of two thousand feet of all that piece of land delineated and coloured green on the map hereon containing ten acres or thereabouts, being portion of Jandakot Agricultural Area Lot 195 and being Lot 32 on Diagram 32142.

Dated the 23rd day of December, 1966.



REGISTRAR OF TITLES.

Transfer A382386 to Dirven van Eenennaam of 6 Ellesmere Road Mount Lawley, Marine Engineer. Registered 18th March 1971 at 11.23 a.m.

Transfer H150005 to Victor Soltoggio, Company Director and Barbara Soltoggio, Married Woman, both of 6 Gannett Street, Bateman, as joint tenants. Registered 14th May 1975 at 5.30 o'c.

Application H334723. The registered proprietor is Barbara Soltoggio of 10A St Michael's Terrace Mount Pleasant, by survivorship. Registered 13th January 2000 at 8.28 hrs.

Transfer H334724 to Ching Hsi Liao and Mei Li Tsao both of 28 Marita Road, Nedlands, as joint tenants. Registered 13th January 2000 at 8.28 hrs.

28308/7/66—50M—OIFAL

For encumbrances and other matters affecting the land see back

EASEMENTS AND ENCUMBRANCES REFERRED TO

Mortgage H334725 to National Australia Bank Ltd. Registered 13th January 2000 at 8.28 hrs.

LT 0013 0061A B

CERTIFICATE OF TITLE

VOL. 13 FOL. 61A

WESTERN AUSTRALIA

REGISTER NUMBER	
32/D32142	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	9/7/2009

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 13 FOLIO 61A

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 32 ON DIAGRAM 32142

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CHING HSI LIAO
MEI LI TSAO
BOTH OF 140 BARFIELD ROAD, HAMMOND PARK
AS JOINT TENANTS

(T H334724) REGISTERED 13 JANUARY 2000

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *L821897 CAVEAT BY MINISTER FOR EDUCATION LODGED 29.12.2011.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 13-61A (32/D32142).
PREVIOUS TITLE: 13-59A.
PROPERTY STREET ADDRESS: 144 BARFIELD RD, HAMMOND PARK.
LOCAL GOVERNMENT AREA: CITY OF COCKBURN.

CT 1667 0069 F

1667 069

Transfer C772611

WESTERN AUSTRALIA

Volume	Folio
1675	356
1675	357

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

N. J. Smyth
REGISTRAR OF TITLES

OFFICE OF TITLES WESTERN AUSTRALIA

Dated 17th May, 1984

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Jandakot Agricultural Area Lot 194 and being Lot 14 on Diagram 30747, delineated and coloured green on the map in the Third Schedule hereto, limited however to the natural surface and therefrom to a depth of 60.96 metres.

FIRST SCHEDULE (continued overleaf)

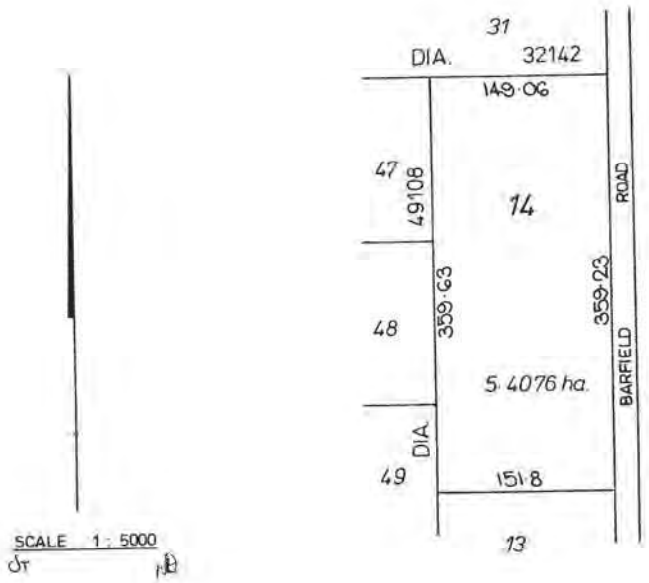
George William Morgan, Labourer and Rosemary Morgan, Married Woman, both of 47 Skeahan Street, Spearwood, as joint tenants.

SECOND SCHEDULE (continued overleaf)

NIL

N. J. Smyth
REGISTRAR OF TITLES

THIRD SCHEDULE



Page 1 (of 2 pages) 1667 VOL. 069 FOL.

LT. 37

FIRST SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	INITIALS
The correct address of the registered proprietors is now Lot 14 Barfield Road Banjup.	By	E2431[illegible]	2.4.91	14.38		

SECOND SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

	INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	INITIALS	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	INITIALS
	~~Caveat~~	~~D587353~~	~~Lodged 26.10.1987 at 13.30 hrs.~~									
X	Mortgage	E348101	to Custom Credit Corporation Ltd.	27.4.90	14.38			Withdrawn	D783180	15.6.88		
	Mortgage	E842104	to Citibank Savings Ltd.	26.3.92	15.32			Discharged	E842103	26.3.92		

CERTIFICATE OF TITLE VOL. 1667 069

WESTERN AUSTRALIA

REGISTER NUMBER	
14/D30747	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	9/11/2004

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 1667 FOLIO 69

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 14 ON DIAGRAM 30747

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

GOLD ESTATES HOLDINGS PTY LTD OF LEVEL 10, 200 ST GEORGES TERRACE, PERTH
(T J043371) REGISTERED 6 OCTOBER 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1667-69 (14/D30747).
PREVIOUS TITLE:	1575-357, 1575-356.
PROPERTY STREET ADDRESS:	194 BARFIELD RD, HAMMOND PARK.
LOCAL GOVERNMENT AREA:	CITY OF COCKBURN.

ORIGINAL – NOT TO BE REMOVED FROM OFFICE OF T

CT 1698 0219 F

Sundry Document D61124

Volume 1418 Folio 842

WESTERN AUSTRALIA

VOL. 1698 FOL. 219

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

This is to certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

N. J. Smyth

REGISTRAR OF TITLES

Dated 21st June, 1985

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Jandakot Agricultural Area Lot 402 and being Lot 47 on Diagram 49108, delineated and coloured green on the map in the Third Schedule hereto, limited however to the natural surface and therefrom to a depth of 60.96 metres.

FIRST SCHEDULE (continued overleaf)

Edward John Philip Neesham, Accountant and Kerry Anne Neesham, Housewife, both of 54 Hammad Street, Palmyra, as joint tenants of 276 undivided one thousandth shares, Catherine Therese Clark, Dental Therapist, of 181 undivided one thousandth shares, David Lindsay Clark, Furniture Manufacturer, of 181 undivided one thousandth shares, and Laurie Stuart Clark, Furniture Manufacturer, of 362 undivided one thousandth shares, all of Lot 47 Frankland Avenue, Banjup, as tenants in common.

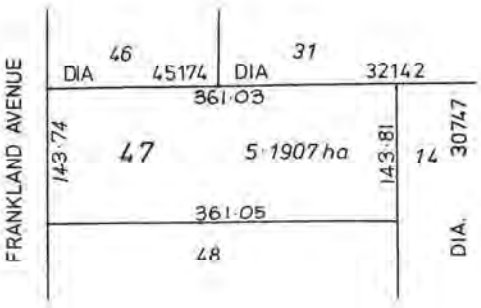
SECOND SCHEDULE (continued overleaf)

1. ~~MORTGAGE C26776 to Bank of New South Wales. Registered 11.11.80 at 2.18 o'c.~~
   Discharged G611537 28.10.97
2. ~~MORTGAGE C424311 to Bank of New South Wales Savings Bank Ltd. Registered 17.9.82 at 9.14 o'c.~~
   Discharged G611538 28.10.97
3. ~~MORTGAGE C424312 to Bank of New South Wales. Registered 17.9.82 at 9.14 o'c.~~
   Discharged G611539 28.10.97
4. ~~MORTGAGE D49036 to Westpac Savings Bank Ltd. Registered 21.6.85 at 9.06 o'c.~~
   Discharged G611540 28.10.97

N. J. Smyth

REGISTRAR OF TITLES

THIRD SCHEDULE



SCALE 1:6000

Superseded - Copy for Sketch Only

Page 1 (of 2 pages) VOL. 1698 FOL. 219

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

72009/12/77-45M-S/2960

LT. 37

FIRST SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	INITIALS
The correct address of the third registered proprietor is Lot 47A Frankland Avenue, Banjup and the fifth registered proprietor is Lot 47B Frankland Avenue, Banjup	Bg	G611542	28.10.97	8.13		

SECOND SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	INITIALS	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	INITIALS
Mortgage	F689337	to Westpac Banking Corporation.	30.9.94	14.46			Discharged	G611541	28.10.97		
Mortgage	G611542	to Bank of Western Australia Ltd.	28.10.97	8.13							

CERTIFICATE OF TITLE VOL. 1698 219

WESTERN AUSTRALIA

REGISTER NUMBER	
47/D49108	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	3/3/2007

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 1698 FOLIO 219

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 47 ON DIAGRAM 49108

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

EDWARD JOHN PHILIP NEESHAM
KERRY ANNE NEESHAM
BOTH OF 54 HAMMAD STREET, PALMYRA
AS JOINT TENANTS IN 276/1000 SHARE
CATHERINE THERESE CLARK OF LOT 47A FRANKLAND AVENUE, BANJUP
IN 181/1000 SHARE
DAVID LINDSAY CLARK OF LOT 47A FRANKLAND AVENUE, BANJUP
IN 181/1000 SHARE
LAURIE STUART CLARK OF LOT 47B FRANKLAND AVENUE, BANJUP
IN 362/1000 SHARE
AS TENANTS IN COMMON

(XA D061124) REGISTERED 21 JUNE 1985

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *K102737 CAVEAT BY MINISTER FOR EDUCATION AS TO PORTION ONLY. LODGED 27.2.2007.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1698-219 (47/D49108).
PREVIOUS TITLE: 1418-842.
PROPERTY STREET ADDRESS: 213 FRANKLAND AV, HAMMOND PARK.
LOCAL GOVERNMENT AREA: CITY OF COCKBURN.

LT. 37

ORIGINAL – NOT TO BE REMOVED FROM OFFICE OF

CT 1749 0064 F

1749 064

Transfer D376048

Volume 42 Folio 228A

WESTERN AUSTRALIA

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

Page 1 (of 2 pages) VOL. 1749 FOL. 064

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

N. J. Smyth

REGISTRAR OF TITLES

Dated 5th December, 1986

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Jandakot Agricultural Area Lot 195 and being Lot 31 on Diagram 32142, delineated on the map in the Third Schedule hereto, limited however to the natural surface and therefrom to a depth of 609.6 metres.

FIRST SCHEDULE (continued overleaf)

~~Graeme Oliver Ford and Pamela Violet Ford both of 47 Farrington Road, Leeming, Godfrey~~ Directors.

SECOND SCHEDULE (continued overleaf)

~~1. MORTGAGE D376049 to Statewide Australia Ltd. Registered 5.12.86 at 3.26 o'~~

Discharged E967121 20.8.92

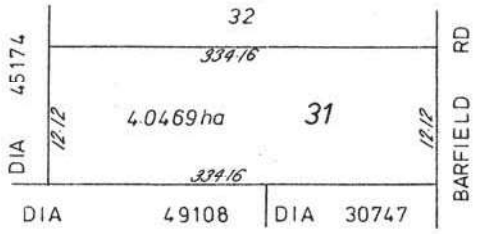
~~2. MORTGAGE D376050 to Commonwealth Bank of Australia. Registered 5.12.86 at 3.27 o'~~

Discharged E879709 12.5.92 (Dup C/T ~~not~~ prod.)

N. J. Smyth

REGISTRAR OF TITLES

THIRD SCHEDULE



SCALE 1: 5000

K.L RR

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

72009/12/77-45M-S/2860

LT. 37

FIRST SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	INITIALS
The correct address of the registered proprietors is now: 21 Barfield Road, Lamlup	B	E31658	27.2.89	10.36		
Jade Falls Pty Ltd of 19 Castellon Crescent, Coogee, of one undivided fifth share, Peter Lori Sumich of 16 Daffodil Court, Spearwood, of one undivided fifth share and Lovre Nominees Pty Ltd of 19 Castellon Crescent, Coogee, of three undivided fifth shares, as tenants in common.	Transfer	G426121	19.3.97	14.48		
The correct address of the first and third proprietors is 56 Ranch Road, Mariginiup.	By	H60955	24.3.99	8.53		

SECOND SCHEDULE (continued)

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	INITIALS	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	INITIALS
Mortgage	E31658	to CBFC Limited	27.2.89	10.36			Dup. Title Discharged	~~not~~ prod. E879708	12.5.92		
Transfer	E331671	of Mortgage D376049 to Bank of Melbourne Ltd.	3.4.90	11.13			By Discharge	E967121	20.8.92		
Extension	E331672	of Mortgage D376049.	3.4.90	11.13			By Discharge	E967121	20.8.92		
Mortgage	E967122	to National Australia Bank Ltd.	20.8.92	8.05			Discharged	G131098	20.3.96		
Mortgage	H60955	to Australia & New Zealand Banking Group Ltd.	24.3.99	8.53							

CERTIFICATE OF TITLE VOL. 1749 064

WESTERN AUSTRALIA

REGISTER NUMBER	
31/D32142	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	18/8/2008

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 1749 FOLIO 64

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 31 ON DIAGRAM 32142

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

JADE FALLS PTY LTD OF 56 RANCH ROAD, MARIGINIUP
IN 1/5 SHARE
PETER LORI SUMICH OF 16 DAFFODIL COURT, SPEARWOOD
IN 1/5 SHARE
LOVRE NOMINEES PTY LTD OF 56 RANCH ROAD, MARIGINIUP
IN 3/5 SHARE
AS TENANTS IN COMMON

(T G426121) REGISTERED 19 MARCH 1997

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *K635742 CAVEAT BY MINISTER OF EDUCATION AS TO PORTION ONLY. LODGED 25.6.2008.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1749-64 (31/D32142).
PREVIOUS TITLE: 42-228A.
PROPERTY STREET ADDRESS: 156 BARFIELD RD, HAMMOND PARK.
LOCAL GOVERNMENT AREA: CITY OF COCKBURN.

INDEXED JT

Transfer 23885/67
Volume 13 Folio 59A

WESTERN AUSTRALIA ORIGINAL REGISTER BOOK

VOL. 22 FOL. 201A

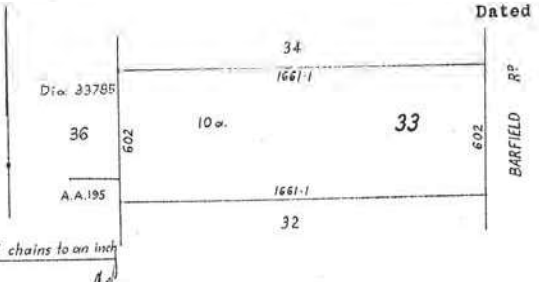
CT 0022 0201A F

Certificate of Title

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

Giacomo Bombara, Salesman, and Roberta Joy Bombara, his Wife, both of 8 McCallum Crescent, Applecross, are now the proprietors as joint tenants of an estate in fee simple subject to the easements and encumbrances notified hereunder in the natural surface and therefrom to a depth of two thousand feet of all that piece of land delineated and coloured green on the map hereon containing ten acres or thereabouts, being portion of Jandakot Agricultural Area Lot 195 and being Lot 33 on Diagram 32142.

Dated the 6th day of April, 1967.



REGISTRAR OF TITLES.

Transfer 23886/67 to Wilfred Arthur Carran, Sales Manager, Nancy Joan Carran, his wife and Jean Frances Mc Kinlay, Spinister, all of 24 Nisbet Road, Applecross, as tenants in common in the following shares, that is to say to the said Wilfred Arthur Carran and Nancy Joan Carran, as joint tenants, two undivided third shares, and to the said Jean Frances Mc Kinlay the remaining one undivided third share. Registered 3rd April 1967 at 9 oc

REGISTRAR OF TITLES

Transfer A189871 to Vincenzo Passione of 92 Swan Street, Swart Hill, Bricklayer Registered 15th July 1969 at 9·37 o'

ASSISTANT REGISTRAR OF TITLES

28308/7/66—50M—O/FAL

For encumbrances and other matters affecting the land see back

EASEMENTS AND ENCUMBRANCES REFERRED TO

Mortgage 23587/67 to Alliance Acceptance Co. Limited Registered 6th April 1967 at 9 o'c DISCHARGED

REGISTRAR OF TITLES

Discharge H199870 of Mortgage 23587/67 Registered 15th July 1969 at 9.36 a.c.

ASSISTANT REGISTRAR OF TITLES

Mortgage H199872 to Alliance Acceptance Co Limited Registered 15th July 1969 at 9.37 a.c.

DISCHARGED

ASSISTANT REGISTRAR OF TITLES

Discharge B539697 of Mortgage H199872. Registered 24th May 1978 at 2.09 o'c.

Mortgage D659365 to Westpac Banking Corporation. Registered 28th January, 1988 at 9.05 hrs.

DISCHARGED

Discharge F194607 of Mortgage D659365. Registered 20th May, 1993 at 8.39 hrs.

0072 0201A B

CERTIFICATE OF TITLE

VOL. 22 FOL. 201A

WESTERN AUSTRALIA

REGISTER NUMBER	
33/D32142	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 22 FOLIO 201A

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 33 ON DIAGRAM 32142

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

VINCENZO PASSIONE OF 92 SWAN STREET, TUART HILL
(T A189871) REGISTERED 15 JULY 1969

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *L843928 CAVEAT BY MINISTER FOR EDUCATION AS TO PORTION ONLY. LODGED 30.1.2012.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

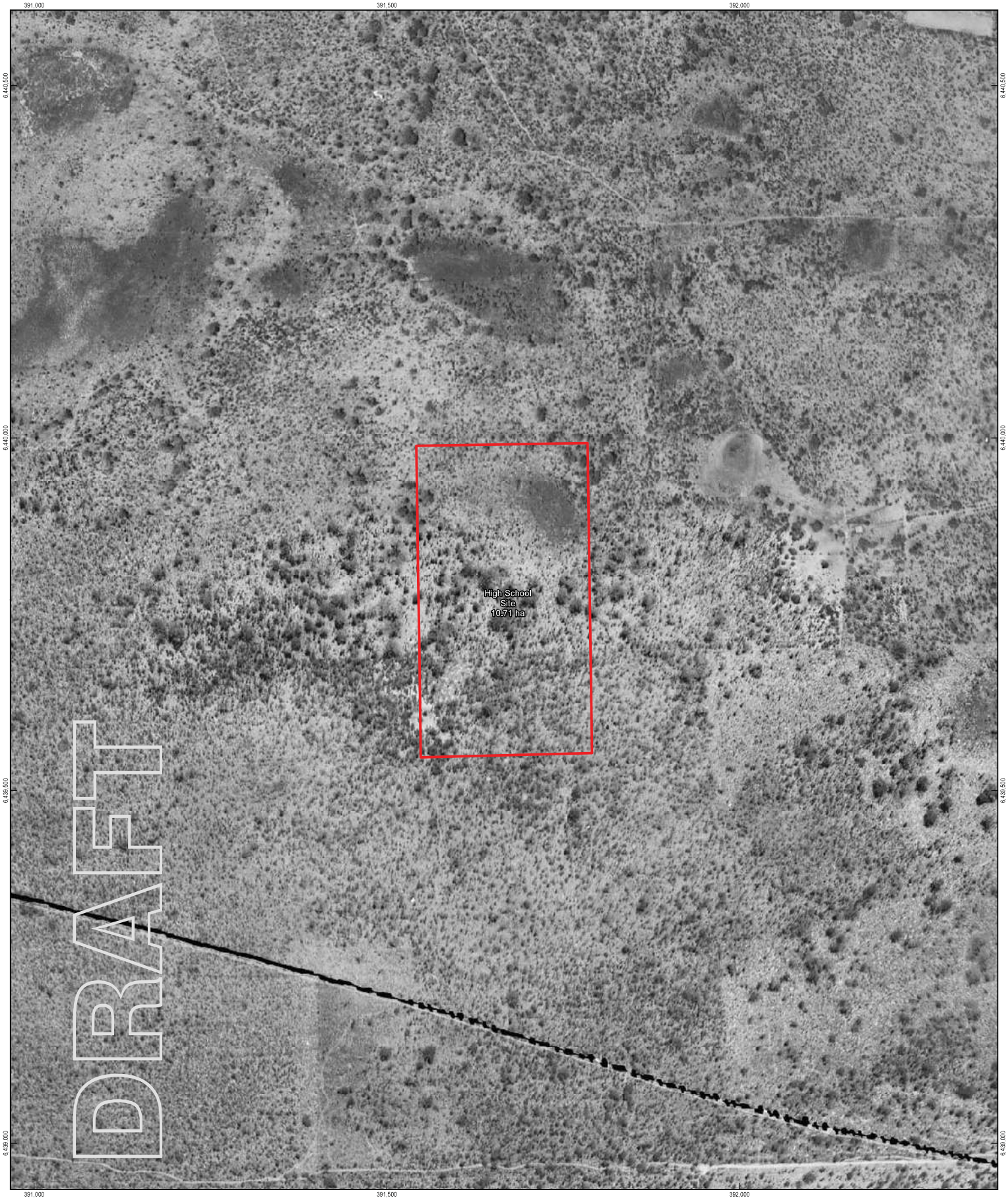
----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 22-201A (33/D32142).
PREVIOUS TITLE: 13-59A.
PROPERTY STREET ADDRESS: LOT 33 BARFIELD RD, HAMMOND PARK.
LOCAL GOVERNMENT AREA: CITY OF COCKBURN.

Appendix B – Historic Aerial Photographs



LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Hammond Park HS
Historical Aerial Photography - 1953

Job Number	61-31027
Revision	A
Date	01 Jul 2014

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61131027_G001_HammondParkHS_Aerial1953_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Oct Nov 1953 Mosaic - 20140526, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: bforlorczak, jcmatic

LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

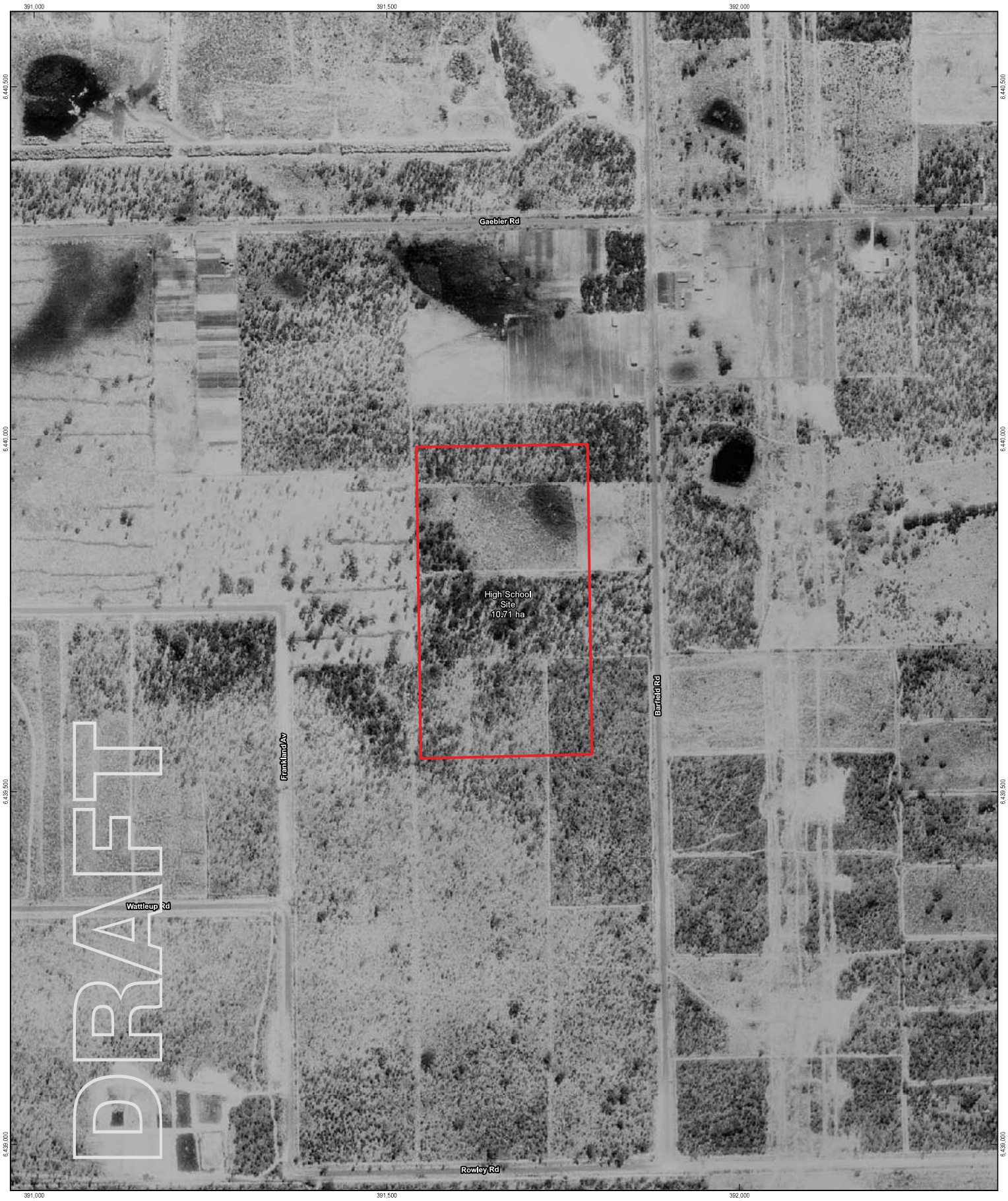
Job Number 61-31027
Revision A
Date 01 Jul 2014

Hammond Park HS
Historical Aerial Photography - 1965

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61131027_G001_HammondParkHS_Aerial1965_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Mar 1965 Mosaic - 20140701, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jcmatic



LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Job Number 61-31027
Revision A
Date 01 Jul 2014

Hammond Park HS
Historical Aerial Photography - 1974

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61310 27_G001_HammondParkHS_Aerial1974_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Jul Sep 1974 Mosaic - 20140701, Road Names - 20131120, Cadastre - 20140523, GHD. School Site - 20130911. Created by: jcmatic

LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Job Number 61-31027
Revision A
Date 01 Jul 2014

Hammond Park HS
Historical Aerial Photography - 1985

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61310 27_G001_HammondParkHS_Aerial1985_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Apr Jun 1985 Mosaic - 20140701, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jcmatic

LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Hammond Park HS
Historical Aerial Photography - 1995

Job Number	61-31027
Revision	A
Date	01 Jul 2014

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61310 27_G001_HammondParkHS_Aerial1995_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Jan Feb 1995 Mosaic - 20140701, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jcmatic

LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Job Number 61-31027
Revision A
Date 01 Jul 2014

Hammond Park HS
Historical Aerial Photography - 2005

G:\61\31027\GIS\Maps\Working\Hammond Park HS\6131027_G001_HammondParkHS_Aerial2005_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro North West 2005 Mosaic - 20140701, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: jcmatic

LEGEND

School Site

Paper size : A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 50

N

GHD

Government of Western Australia
Department of Finance

powered by SLIP ENABLER

Department of Finance
Priority One - School Sites

Job Number 61-31027
Revision A
Date 02 Jul 2014

Hammond Park HS
Historical Aerial Photography - 1953

G:\61\31027\GIS\Maps\Working\Hammond Park HS\61310 27_G001_HammondParkHS_Aerial2014_RevA.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au

Data source: Landgate: Metro Central Feb 2014 Mosaic - 20140526, Road Names - 20131120, Cadastre - 20140523; GHD: School Site - 20130911. Created by: bflorczak, jcmatic

Appendix C – Field Work Forms

GROUNDWATER WELL MONITORING RECORD

Date	Time	Sampler	Well ID	Total Depth of Well (m below top of casing)	Depth to Water Level (m below top of casing)	Top of casing to ground level (m)	Water Column (m)	Litres to purge *	pH	EC (µS/cm) mS	DO (%)	ORP (mV)	Temp (C°)	Comments (distance to dewatering op, condition of headworks, requirement for filtering) / observations (colour, sediment load, odour)
7/10		DM	MB02	5.97	2.99	0.63	3	18	5.14	0.605	2.4	-159	18.86	Dark brown opaque running to brown transparent
7/10		DM	MB03	5.69	3.37	0.62	2	12	4.72	0.593	3.9	-158	17.91	Yellow brown ~~clear~~
7/10		DM	MB01	10.32	8.38	0.64	2	12	5.23	0.386	17.1	-40	19.5	QA01, clear
7/10		DM	MB04	6.06	3.21	0.55	3	18	4.69	1.5	10.4	-133	17.69	Yellow clear

* Litres to purge = Water column (m) x 6

Groundwater, surface water and dewatering effluent pH is to remain above 6 while acidity is to remain below 40 mg/L. If water quality falls 'outside' the aforementioned criteria, the Superintentendent's Representative(Water Corporation) and the Environmental Consultant should be notified immediately as treatment and more frequent mositoring will likely be required.

ECO Environmental

Environmental monitoring
& sampling equipment
Rentals and sales.

Tel: +61 8 9328 2900
fax: +61 8 9328 2677
eco@ecoenvironmental.com.au
www.ecoenvironmental.com.au
214 Lord St Perth WA 6000

Equipment Information

Instrument: YSIPP1
Serial Number: Serial #: 11F100649 (Display)
Lot #: 12H100189 (Sonde)

Equipment Check

	Enclosed	Comment
YSI Pro Plus Display	☑	
YSI Quatro Sonde	☑	
- YSI 1001 pH Probe *(LN: YSI1001A 11E)*	☑	
- YSI 1002 ORP Probe *(LN: YSI1002 11B)*	☑	
- YSI 5560 Cond/Temp Probe (LN: 11F100408)	☑	
- YSI Polarographic DO Sensor *(LN: 11C 102881)*	☑	
Flow Cell	☑	
Probe Guard	☑	
Rubber Storage/Calibration Sleeve	☑	
Calibration Cup + Cap	☑	
YSI Cable Management Kit	☑	
YSI Pro Series ProComm II Kit	☑	
Instruction Manual + Instruction and Calibration Sheets	☑	
Spare Batteries (x 2)	☐	

Sensor Calibration Details

	Calibration Undertaken	Accuracy	Pass	Fail
Temperature	Factory Calibrated	±0.2°C	☑	☐
Dissolved Oxygen	☑ 100% Saturation	±2%	☑	☐
	Pressure Compensation	1013 hPa	☐	☐
Conductivity	☑ 1288mS/cm	±0.5%	☑	☐
	☑ Check linearity at 1.4mS/cm	±0.5%	☑	☐
Salinity	Auto Calibrated	±1%	☑	☐
pH	☑ pH 7.00	± 0.2	☑	☐
	☑ pH 4.00	± 0.2	☑	☐
ORP	☑ 229 mV at 25 °C	±20mV	☑	☐

This is to certify that where possible, this instrument has been calibrated in accordance with the manufacturer's calibration procedure as recommended in the instrument service manual.

ECO Standard Rental Terms & Conditions apply to all equipment calibrations.

Regards

Equipment Specialist
ECO Environmental
26.9.14

Appendix D – Soil and Groundwater Chemistry Tables

Hammond Park
Table 1
Acid Sulphate Soil Results

Department of Treasury
Hammond Park Senior High School
Schools PPP

			ASS - Acid Base Accounting						ASS - Acidity Trail		ASS - BT ANC			ASS - Field	ASS - Potential Acidity		Inorganics	Field		SPOCAS	
			Net Acidity excluding ANC (acidity units)	Net Acidity excluding ANC (sulfur units)	ANC/FF	LR	a-NetAcidity	s-NetAcidity	s-TAA	TAA	ANCBT	a-ANCBT	s-ANCBT	Reaction	SCr	a-SCr	Moisture Content (dried @ 103°C)	pH (Field)	delta pH (field - Ox)	pH (KCl)	pH (Ox)
			mole H+/t	%S	-	kg CaCO3/t	mole H+/t	%S	%S	mole H+/t	% CaCO3	mole H+/t	%S	-	%S	mole H+/t	%	pH Units	pH Units	pH Units	pH Units
EQL			10	0.02		1	10	0.02	0.02	2	0.01	2	0.02		0.005	3	0.1	0.1		0.1	0.1
WA DER 2013 ASS Criteria			18.7	0.03					0.03	18.7					0.03			4-999	2	4-999	4-999
Location Code	Sample Depth Avg	Sample Elevation																			
MB01	0.1	28.979	-	-	-	-	-	-	-	-	-	-	-	0	-	-	3.4	8.4	2.5	-	5.9
MB01	0.5	28.579	<10	<0.02	1.5	<1	<10	<0.02	<0.02	<2	0.14	29	0.05	0	<0.005	<3	4.1	8.1	2.8	6.8	5.3
MB01	1	28.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	8	2.6	-	5.4
MB01	1.5	27.579	<10	<0.02	1.5	<1	<10	<0.02	<0.02	<2	0.34	68	0.11	0	<0.005	<3	6.5	7.8	2.4	6.9	5.4
MB01	2	27.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.5	2.2	-	5.3
MB01	2.5	26.579	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.4	2.3	-	5.1
MB01	3	26.079	<10	<0.02	1.5	<1	<10	<0.02	<0.02	3	-	-	-	0	<0.005	<3	3.5	7.2	2.2	6.2	5
MB01	3.5	25.579	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.3	2.2	-	5.1
MB01	4	25.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.2	2.1	-	5.1
MB01	4.5	24.579	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.3	2.3	-	5
MB01	5	24.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.5	2.5	-	5
MB01	6	23.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.3	2.3	-	5
MB01	7	22.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.1	2.1	-	5
MB01	8	21.079	<10	<0.02	1.5	<1	<10	<0.02	<0.02	3	-	-	-	0	<0.005	<3	13	7.1	2.2	6.1	4.9
MB01	9	20.079	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.4	1.6	-	4.8
MB02	0.1	23.953	-	-	-	-	-	-	-	-	-	-	-	0	-	-	6.4	5.6	1.8	-	3.8
MB02	0.5	23.553	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.6	1.8	-	3.8
MB02	1	23.053	<10	<0.02	1.5	<1	<10	<0.02	<0.02	3	-	-	-	0	<0.005	<3	4.6	6	2.6	6	3.4
MB02	1.5	22.553	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.8	1.6	-	4.2
MB02	2	22.053	54	0.09	1.5	4	54	0.09	0.09	54	-	-	-	0	<0.005	<3	11	4.8	1.3	4.7	3.5
MB02	2.5	21.553	110	0.18	1.5	9	110	0.18	0.16	100	-	-	-	0	<0.005	<3	15	4.6	1.4	4.4	3.2
MB02	3	21.053	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.4	1.1	-	3.3
MB02	3.5	20.553	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	1.9	-	3.3
MB02	4	20.053	20	0.03	1.5	2	20	0.03	0.03	20	-	-	-	0	<0.005	<3	20	5.4	2.2	5.3	3.2
MB02	4.5	19.553	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.1	1.7	-	3.4
MB02	5	19.053	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.6	2.4	-	3.2
MB02	5.5	18.553	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.4	2	-	3.4
MB03	0.1	23.722	-	-	-	-	-	-	-	-	-	-	-	0	-	-	2.5	5.6	2.1	-	3.5
MB03	0.5	23.322	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	1.7	-	3.5
MB03	1	22.822	<10	<0.02	1.5	<1	<10	<0.02	<0.02	4	-	-	-	0	<0.005	<3	2.1	5.4	2.2	5.8	3.2
MB03	1.5	22.322	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.3	1.8	-	3.5
MB03	2	21.822	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	1.8	-	3.4
MB03	2.5	21.322	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5	1.8	-	3.2
MB03	3	20.822	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.9	2	-	2.9
MB03	3.5	20.322	<10	<0.02	1.5	<1	<10	<0.02	<0.02	5	-	-	-	0	<0.005	<3	17	5.5	2.7	5.8	2.8
MB03	4	19.822	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6	1.9	-	4.1
MB03	4.5	19.322	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.1	2.6	-	3.5

Hammond Park
Table 1
Acid Sulphate Soil Results

Department of Treasury
Hammond Park Senior High School
Schools PPP

			ASS - Acid Base Accounting						ASS - Acidity Trail		ASS - BT ANC			ASS - Field	ASS - Potential Acidity		Inorganics	Field		SPOCAS	
			Net Acidity excluding ANC (acidity units)	Net Acidity excluding ANC (sulfur units)	ANC/FF	LR	a-NetAcidity	s-NetAcidity	s-TAA	TAA	ANCBT	a-ANCBT	s-ANCBT	Reaction	SCr	a-SCr	Moisture Content (dried @ 103°C)	pH (Field)	delta pH (field - Ox)	pH (KCl)	pH (Ox)
			mole H+/t	%S	-	kg CaCO3/t	mole H+/t	%S	%S	mole H+/t	% CaCO3	mole H+/t	%S	-	%S	mole H+/t	%	pH Units	pH Units	pH Units	pH Units
EQL			10	0.02		1	10	0.02	0.02	2	0.01	2	0.02		0.005	3	0.1	0.1		0.1	0.1
WA DER 2013 ASS Criteria			18.7	0.03					0.03	18.7					0.03			4-999	2	4-999	4-999
Location Code	Sample Depth Avg	Sample Elevation																			
MB03	5	18.822	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	2.7	-	3.2
MB04	0.1	22.839	-	-	-	-	-	-	-	-	-	-	-	0	-	-	23	5.4	2.4	-	3
MB04	0.5	22.439	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.1	2	-	3.1
MB04	1	21.939	<10	<0.02	1.5	<1	<10	<0.02	<0.02	7	-	-	-	0	<0.005	<3	1.6	5	2	5.4	3
MB04	1.5	21.439	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.8	2.7	-	3.1
MB04	2	20.939	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.4	2	-	3.4
MB04	2.5	20.439	34	0.05	1.5	3	34	0.05	0.05	34	-	-	-	0	<0.005	<3	5.9	4.8	1	5.1	3.8
MB04	3	19.939	<10	<0.02	1.5	<1	<10	<0.02	<0.02	6	-	-	-	0	<0.005	<3	15	5.5	2.3	5.2	3.2
MB04	3.5	19.439	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.8	1.8	-	3
MB04	4	18.939	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.7	1.4	-	3.3
MB04	4.5	18.439	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.5	2.4	-	3.1
MB04	5	17.939	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	2.1	-	3.1
MB04	5.5	17.439	13	0.02	1.5	1	13	0.02	<0.02	9	-	-	-	0	0.006	4	18	4.6	1.9	5.6	2.7
SB01	0.1	28.886	-	-	-	-	-	-	-	-	-	-	-	0	-	-	3.6	5.4	2.4	-	3
SB01	0.5	28.486	<10	<0.02	1.5	<1	<10	<0.02	<0.02	5	-	-	-	0	<0.005	<3	3.3	6.2	2.6	5.8	3.6
SB01	1	27.986	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.5	2.2	-	4.3
SB01	1.5	27.486	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.7	2.4	-	4.3
SB01	2	26.986	<10	<0.02	1.5	<1	<10	<0.02	<0.02	6	-	-	-	0	<0.005	<3	3.4	6.3	2.5	5.8	3.8
SB01	2.5	26.486	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.7	2.1	-	4.6
SB01	3	25.986	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	1.6	-	4.3
SB01	3.5	25.486	<10	<0.02	1.5	<1	<10	<0.02	<0.02	5	-	-	-	0	<0.005	<3	3.9	5.7	1.7	5.8	4
SB01	4	24.986	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.7	1.5	-	4.2
SB01	4.5	24.486	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.8	1.5	-	4.3
SB01	5	23.986	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	1.6	-	4.3
SB02	0.1	26.196	-	-	-	-	-	-	-	-	-	-	-	0	-	-	2.9	7.2	2.7	-	4.5
SB02	0.5	25.796	<10	<0.02	1.5	<1	<10	<0.02	<0.02	3	-	-	-	0	<0.005	<3	3.3	7	2.4	6	4.6
SB02	1	25.296	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7.1	2.4	-	4.7
SB02	1.5	24.796	<10	<0.02	1.5	<1	<10	<0.02	<0.02	3	-	-	-	0	<0.005	<3	4.1	6.9	2.3	5.9	4.6
SB02	2	24.296	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.9	2.3	-	4.6
SB02	2.5	23.796	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7	2.1	-	4.9
SB02	3	23.296	<10	<0.02	1.5	<1	<10	<0.02	<0.02	4	-	-	-	0	<0.005	<3	3	6.7	2	6	4.7
SB02	3.5	22.796	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.6	1.9	-	4.7
SB02	4	22.296	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6	1.4	-	4.6
SB02	4.5	21.796	<10	<0.02	1.5	<1	<10	<0.02	<0.02	5	-	-	-	0	<0.005	<3	7.2	6.1	1.6	5.8	4.5
SB02	5	21.296	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.9	2	-	4.9
SB03	0.1	24.018	-	-	-	-	-	-	-	-	-	-	-	0	-	-	7.9	6.3	2.9	-	3.4
SB03	0.5	23.618	<10	<0.02	1.5	<1	<10	<0.02	<0.02	6	-	-	-	0	<0.005	<3	4	6.2	2.9	5.6	3.3

Hammond Park
Table 1
Acid Sulphate Soil Results

Department of Treasury
Hammond Park Senior High School
Schools PPP

			ASS - Acid Base Accounting						ASS - Acidity Trail		ASS - BT ANC			ASS - Field	ASS - Potential Acidity		Inorganics	Field		SPOCAS	
			Net Acidity excluding ANC (acidity units)	Net Acidity excluding ANC (sulfur units)	ANC/FF	LR	a-NetAcidity	s-NetAcidity	s-TAA	TAA	ANCBT	a-ANCBT	s-ANCBT	Reaction	SCr	a-SCr	Moisture Content (dried @ 103°C)	pH (Field)	delta pH (field - Ox)	pH (KCl)	pH (Ox)
			mole H+/t	%S	-	kg CaCO3/t	mole H+/t	%S	%S	mole H+/t	% CaCO3	mole H+/t	%S	-	%S	mole H+/t	%	pH Units	pH Units	pH Units	pH Units
EQL			10	0.02		1	10	0.02	0.02	2	0.01	2	0.02		0.005	3	0.1	0.1		0.1	0.1
WA DER 2013 ASS Criteria			18.7	0.03					0.03	18.7					0.03			4-999	2	4-999	4-999
Location Code	Sample Depth Avg	Sample Elevation																			
SB03	1	23.118	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	2.4	-	3.5
SB03	1.5	22.618	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.7	2.1	-	3.6
SB03	2	22.118	<10	<0.02	1.5	1	<10	<0.02	<0.02	8	-	-	-	0	<0.005	<3	4	5.5	2.2	5.7	3.3
SB03	2.5	21.618	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.7	1.8	-	3.9
SB03	3	21.118	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	1.9	-	3.3
SB03	3.5	20.618	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.5	1.8	-	3.7
SB03	4	20.118	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	2.1	-	3.8
SB03	4.5	19.618	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.7	2.8	-	3.9
SB03	5	19.118	<10	<0.02	1.5	1	<10	<0.02	<0.02	7	-	-	-	0	<0.005	<3	16	6.2	3.4	5.2	2.8
SB04	0.1	23.482	-	-	-	-	-	-	-	-	-	-	-	0	-	-	3	5.2	2.1	-	3.1
SB04	0.5	23.082	<10	<0.02	1.5	<1	<10	<0.02	<0.02	6	-	-	-	0	<0.005	<3	2.8	5.1	2.4	5.6	2.7
SB04	1	22.582	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.9	2	-	2.9
SB04	1.5	22.082	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4.9	2.2	-	2.7
SB04	2	21.582	15	0.02	1.5	1	15	0.02	<0.02	6	-	-	-	0	0.014	9	10	5.1	2.7	5.3	2.4
SB04	2.5	21.082	12	0.02	1.5	1	12	0.02	0.02	12	-	-	-	0	<0.005	<3	13	5	2.7	4.9	2.3
SB04	3	20.582	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	2.1	-	3.1
SB04	3.5	20.082	54	0.09	1.5	4	54	0.09	0.09	54	-	-	-	0	<0.005	<3	16	5.4	2	4.9	3.4
SB04	4	19.582	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.6	3.2	-	2.4
SB04	4.5	19.082	19	0.03	1.5	1	19	0.03	0.02	11	-	-	-	0	0.012	8	14	5.8	3.5	5.1	2.3
SB04	5	18.582	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	3.4	-	2.5
SB05	0.1	24.781	-	-	-	-	-	-	-	-	-	-	-	0	-	-	11	6.4	3.2	-	3.2
SB05	0.5	24.381	<10	<0.02	1.5	<1	<10	<0.02	<0.02	4	-	-	-	0	<0.005	<3	3.7	6.5	2.9	5.7	3.6
SB05	1	23.881	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6.4	2	-	4.4
SB05	1.5	23.381	<10	<0.02	1.5	1	<10	<0.02	<0.02	9	-	-	-	0	<0.005	<3	4.7	5.4	1.6	5.5	3.8
SB05	2	22.881	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	6	1.8	-	4.2
SB05	2.5	22.381	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.2	1.2	-	4
SB05	3	21.881	<10	<0.02	1.5	<1	<10	<0.02	<0.02	7	-	-	-	0	<0.005	<3	4.3	5.5	1.7	5.8	3.8
SB05	3.5	21.381	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.9	1.8	-	4.1
SB05	4	20.881	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	7	2.4	-	4.6
SB05	4.5	20.381	67	0.11	1.5	5	67	0.11	0.08	53	-	-	-	0	0.022	14	14	5.6	1.6	4.8	4
SB05	5	19.881	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	5.6	1.5	-	4.1
Statistical Summary																					
Number of Results			33	33	33	33	33	33	33	33	2	2	2	105	33	33	42	105	105	33	105
Number of Detects			10	10	33	13	10	10	8	31	2	2	2	105	4	4	42	105	105	33	105
Minimum Concentration			<10	<0.02	1.5	<1	<10	<0.02	<0.02	<2	0.14	29	0.05	0	<0.005	<3	1.6	4.4	1	4.4	2.3
Minimum Detect			12	0.02	1.5	1	12	0.02	0.02	3	0.14	29	0.05	ND	0.006	4	1.6	4.4	1	4.4	2.3

Hammond Park
Table 1
Acid Sulphate Soil Results

	ASS - Acid Base Accounting						ASS - Acidity Trail		ASS - BT ANC			ASS - Field	ASS - Potential Acidity		Inorganics	Field		SPOCAS	
	Net Acidity excluding ANC (acidity units)	Net Acidity excluding ANC (sulfur units)	ANC/FF	LR	a-NetAcidity	s-NetAcidity	s-TAA	TAA	ANCBT	a-ANCBT	s-ANCBT	Reaction	SCr	a-SCr	Moisture Content (dried @ 103°C)	pH (Field)	delta pH (field - Ox)	pH (KCl)	pH (Ox)
	mole H+/t	%S	-	kg CaCO3/t	mole H+/t	%S	%S	mole H+/t	% CaCO3	mole H+/t	%S	-	%S	mole H+/t	%	pH Units	pH Units	pH Units	pH Units
EQL	10	0.02		1	10	0.02	0.02	2	0.01	2	0.02		0.005	3	0.1	0.1		0.1	0.1
WA DER 2013 ASS Criteria	18.7	0.03					0.03	18.7					0.03			4-999	2	4-999	4-999
Location Code **Sample Depth Avg** **Sample Elevation**																			
Maximum Concentration	110	0.18	1.5	9	110	0.18	0.16	100	0.34	68	0.11	0	0.022	14	23	8.4	3.5	6.9	5.9
Maximum Detect	110	0.18	1.5	9	110	0.18	0.16	100	0.34	68	0.11	ND	0.022	14	23	8.4	3.5	6.9	5.9
Average Concentration	16	0.026	1.5	1.3	16	0.026	0.024	14				0	0.0038	2.4	8	6	2.1419	5.6	3.8
Median Concentration	5	0.01	1.5	0.5	5	0.01	0.01	6	0.24	48.5	0.08	0	0.0025	1.5	4.65	5.8	2.1	5.7	3.7
Standard Deviation	23	0.038	0	1.8	23	0.038	0.034	21				0	0.0042	2.7	5.8	0.88	0.49024	0.55	0.82
Number of Guideline Exceedances	7	7	0	0	0	0	6	6	0	0	0	0	0	0	0	0	59	0	62
Number of Guideline Exceedances(Detects Only)	7	7	0	0	0	0	6	6	0	0	0	0	0	0	0	0	59	0	62

Hammond Park
Table 2
Soil Chemistry Results

Department of Treasury
Hammond Park Senior High School
Schools PPP

	Unassigned	Metals								OC Pesticides																					OP Pesticic									
	Tokuthion	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Mercury	Nickel	Zinc	4,4-DDE	a-BHC	Aldrin	b-BHC	chlordane	d-BHC	4,4 DDD	4,4 DDT	Dieldrin	Endosulfan I	Endosulfan II	Endosulfan sulphate	Endrin	Endrin aldehyde	Endrin ketone	g-BHC (Lindane)	Heptachlor	Heptachlor epoxide	Hexachlorobenzene	Methoxychlor	Toxaphene	Azinophos methyl	Bolstar (Sulprofos)	Chlorpyrifos	Demeton-O	Diazinon	Dichlorvos	Disulfoton	Ethion	Ethoprop	Fenitrothion
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.2	2	0.4	5	5	5	0.1	5	5	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
NEPM 2013 EIL-Urban Residential- Public Open Space		100			60	1100		30	70								180																							
Location_Code	**Sample Depth Avg**	**Sample Elevation**																																						
MB01	0.1	28.979	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MB02	0.1	23.953	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MB03	0.1	23.722	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
MB04	0.1	22.839	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
SB01	0.1	28.886	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
SB02	0.1	26.196	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
SB03	0.1	24.018	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
SB04	0.1	23.482	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
SB05	0.1	24.781	<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Statistical Summary																																								
Number of Results		9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
Number of Detects		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minimum Concentration		<0.2	<2	<0.4	<5	<5	<5	<0.1	<5	<5	<0.05	<0.05	<0.05	<0.05	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<1	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Minimum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration		<0,2	<2	<0,4	<5	<5	<5	<0,1	<5	<5	<0,05	<0,05	<0,05	<0,05	<0,1	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<1	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2	<0,2
Maximum Detect		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration		0,1	1	0,2	2,5	2,5	2,5	0,05	2,5	2,5	0,025	0,025	0,025	0,025	0,05	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,5	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Median Concentration		0,1	1	0,2	2,5	2,5	2,5	0,05	2,5	2,5	0,025	0,025	0,025	0,025	0,05	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,025	0,5	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Standard Deviation		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Hammond Park
Table 2
Soil Chemistry Results

	Pesticides								
	Fensulfothion	Fenthion	Merphos	Methyl parathion	Mevinphos (Phosdrin)	Naled (Dibrom)	Phorate	Ronnel	Trichloronate
	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
EQL	0.2	0.2	0.2	0.2	0.2	0.5	0.2	0.2	0.2
NEPM 2013 EIL-Urban Residential- Public Open Spa									
Location_Code / **Sample Depth Avg** / **Sample Elevation**									
MB01 / 0.1 / 28.979	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
MB02 / 0.1 / 23.953	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
MB03 / 0.1 / 23.722	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
MB04 / 0.1 / 22.839	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
SB01 / 0.1 / 28.886	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
SB02 / 0.1 / 26.196	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
SB03 / 0.1 / 24.018	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
SB04 / 0.1 / 23.482	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
SB05 / 0.1 / 24.781	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
Statistical Summary									
Number of Results	9	9	9	9	9	9	9	9	9
Number of Detects	0	0	0	0	0	0	0	0	0
Minimum Concentration	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
Minimum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND
Maximum Concentration	<0.2	<0.2	<0.2	<0.2	<0.2	<0.5	<0.2	<0.2	<0.2
Maximum Detect	ND	ND	ND	ND	ND	ND	ND	ND	ND
Average Concentration	0.1	0.1	0.1	0.1	0.1	0.25	0.1	0.1	0.1
Median Concentration	0.1	0.1	0.1	0.1	0.1	0.25	0.1	0.1	0.1
Standard Deviation	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances	0	0	0	0	0	0	0	0	0
Number of Guideline Exceedances(Detects Only)	0	0	0	0	0	0	0	0	0

Hammond Park
Table 3
Groundwater Chemistry Results

							Location_Code	MB01	MB02	MB03	MB04											
							Sampled_Date_Time	7/10/2014	7/10/2014	7/10/2014	7/10/2014											
				WA DEC 2010	WA DER 2011	WA DEC 2010						Statistical Summary										
Chem_Group	ChemName	output unit	EQL	Fresh waters	Acid Sulphate Soils	Short-term irrigation						Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
Unassigned	Phosphorous filterable reactive (P)	mg/L	0.05				<0.05	<0.05	<0.05	<0.05	4	0	<0.05	ND	<0.05	ND	0.025	0.025	0	0	0
	Acidity (as CaCO3)	mg/L	10000		40		43	100	110	190	4	4	43000	43000	190000	190000	110750	105000	60517	4	4
Inorganics	Electrical conductivity (lab)	µS/cm	10				390	590	610	2100	4	4	390	390	2100	2100	923	600	791	0	0
	Total Kjeldahl Nitrogen	mg/L	0.2				0.4	1.3	1.4	2.8	4	4	0.4	0.4	2.8	2.8	1.5	1.35	0.99	0	0
	pH (Lab)	pH Units	0.1	6.5-8.5	<6		5.8	5.4	5.3	4.9	4	4	4.9	4.9	5.8	5.8	5.4	5.35	0.37	4	4
	Total Dissolved Solids	mg/L	10				220	400	420	1500	4	4	220	220	1500	1500	635	410	584	0	0
Field	Temperature (Field)	°C					19.5	18.86	17.91	17.69	4	4	17.69	17.69	19.5	19.5	18	18.385	0.84	0	0
	Dissolved Oxygen (% saturated) (Field) (Filtered)	%S					17.1	8.4	3.9	10.4	4	4	3.9	3.9	17.1	17.1	10	9.4	5.5	0	0
	Electrical conductivity (field)	uS/cm					386	605	593	1500	4	4	386	386	1500	1500	771	599	496	0	0
	pH (Field)	pH Units			<6		5.23	5.14	4.72	4.69	4	4	4.69	4.69	5.23	5.23	4.9	4.93	0.28	0	0
Metals	Aluminium	mg/L	0.05	0.055		20	0.35	7.4	0.26	7.2	4	4	0.26	0.26	7.4	7.4	3.8	3.775	4	0	0
	Aluminium (Filtered)	mg/L	0.05	0.055		20	0.1	1	0.26	4.8	4	4	0.1	0.1	4.8	4.8	1.5	0.63	2.2	0	0
	Arsenic (Filtered)	mg/L	0.001			2	<0.001	0.002	<0.001	0.003	4	2	<0.001	0.002	0.003	0.003	0.0015	0.00125	0.0012	0	0
	Cadmium (Filtered)	mg/L	0.0002	0.0002		0.05	<0.0002	<0.0002	<0.0002	<0.0002	4	0	<0.0002	ND	<0.0002	ND	0.0001	0.0001	0	0	0
	Chromium (III+VI) (Filtered)	mg/L	0.001			1	<0.001	0.001	0.003	0.028	4	3	<0.001	0.001	0.028	0.028	0.0081	0.002	0.013	0	0
	Iron	mg/L	0.05	0.3		10	0.52	1.4	0.64	34	4	4	0.52	0.52	34	34	9.1	1.02	17	0	0
	Iron (Filtered)	mg/L	0.05	0.3		10	0.43	1.3	0.64	34	4	4	0.43	0.43	34	34	9.1	0.97	17	0	0
	Manganese (Filtered)	mg/L	0.005	1.9		10	<0.005	0.016	<0.005	0.012	4	2	<0.005	0.012	0.016	0.016	0.0083	0.00725	0.0068	0	0
	Nickel (Filtered)	mg/L	0.001	0.011		2	0.002	0.001	0.004	0.004	4	4	0.001	0.001	0.004	0.004	0.0028	0.003	0.0015	0	0
	Selenium (Filtered)	mg/L	0.001	0.005		0.05	<0.001	0.013	0.032	0.033	4	3	<0.001	0.013	0.033	0.033	0.02	0.0225	0.016	0	0
	Zinc (Filtered)	mg/L	0.001	0.008		5	0.038	0.005	0.002	0.002	4	4	0.002	0.002	0.038	0.038	0.012	0.0035	0.018	0	0
Alkalinity	Alkalinity (total) as CaCO3	mg/L	20		<30		<20	<20	<20	<20	4	0	<20	ND	<20	ND	10	10	0	4	4
Major Ions	Chloride	mg/L	1				83	150	110	480	4	4	83	83	480	480	206	130	185	0	0
	Sodium	mg/L	0.5				43	72	56	290	4	4	43	43	290	290	115	64	117	0	0
	Sulphate as S	mg/L	5				14	11	25	72	4	4	11	11	72	72	31	19.5	28	0	0
Nutrients	Ammonia as N	mg/L	0.01				0.04	0.43	0.31	0.08	4	4	0.04	0.04	0.43	0.43	0.22	0.195	0.19	0	0
	Nitrogen (Total Oxidised)	mg/L	0.05				<0.05	0.09	<0.05	<0.05	4	1	<0.05	0.09	0.09	0.09	0.041	0.025	0.033	0	0
	Nitrogen (Total)	mg/L	0.2	2			0.4	1.4	1.4	2.8	4	4	0.4	0.4	2.8	2.8	1.5	1.4	0.99	0	0
	Phosphorus	mg/L	0.5	0.2			<0.5	<0.5	<0.5	<0.5	4	0	<0.5	ND	<0.5	ND	0.25	0.25	0	0	0

Appendix E – Laboratory Reports

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project Hammond Park Schools PPP
Client Department of Finance
Job Manager Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results) joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPMB01_ 0.1		30/09/2014		SOIL	~~Bag~~, JAR	✓	✓	✓		
HPMB01_ 0.5		30/09/2014		SOIL		✓				
HPMB01_ 1		30/09/2014		SOIL	JAR	✓				Missing bar.
HPMB01_ 1.5		30/09/2014		SOIL		✓				
HPMB01_ 2		30/09/2014		SOIL		✓				
HPMB01_ 2.5		30/09/2014		SOIL		✓				
HPMB01_ 3		30/09/2014		SOIL		✓				
HPMB01_ 3.5		30/09/2014		SOIL		✓				
HPMB01_ 4		30/09/2014		SOIL		✓				
HPMB01_ 4.5		30/09/2014		SOIL		✓				
HPMB01_ 5		30/09/2014		SOIL		✓				
HPMB01_ 6		30/09/2014		SOIL		✓				
HPMB01_ 7		30/09/2014		SOIL		✓				
HPMB01_ 8		30/09/2014		SOIL		✓				
HPMB01_ 9		30/09/2014		SOIL		✓				
~~HPMB01_ 10~~		~~30/09/2014~~		~~SOIL~~		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:

Received by: RAW
Date: 3/10
Time: 830

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Project Hammond Park Schools PPP
Client Department of Finance
Job Manager Peter Tilley
Invoicing:

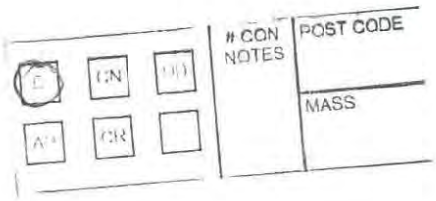
Job Number: 61/31027
E-mail Address (Results) joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPMB02_ 0.1		30/09/2014		SOIL	BAG, JAR	✓	✓	✓		
HPMB02_ 0.5		30/09/2014		SOIL		✓				
HPMB02_ 1		30/09/2014		SOIL	JAR	✓				
HPMB02_ 1.5		30/09/2014		SOIL		✓				
HPMB02_ 2		30/09/2014		SOIL		✓				
HPMB02_ 2.5		30/09/2014		SOIL		✓				
HPMB02_ 3		30/09/2014		SOIL		✓				
HPMB02_ 3.5		30/09/2014		SOIL		✓				
HPMB02_ 4		30/09/2014		SOIL		✓				
HPMB02_ 4.5		30/09/2014		SOIL		✓				
HPMB02_ 5		30/09/2014		SOIL		✓				
HPMB02_ 5.5		30/09/2014		SOIL		✓				
~~HPMB02_ 7~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPMB02_ 8~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPMB02_ 9~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPMB02_ 10~~		~~30/09/2014~~		~~SOIL~~		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: GIAN G.
Date: 3/10/14
Time: 8:30

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project Hammond Park Schools PPP
Client Department of Finance
Job Manager Peter Tilley
Invoicing:

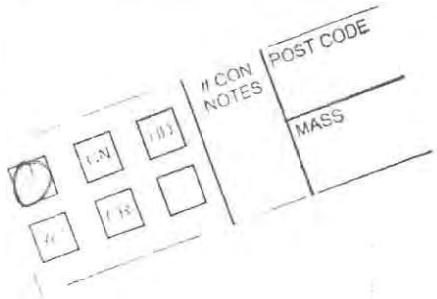
Job Number: 61/31027
E-mail Address (Results) joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPMB03_ 0.1		30/09/2014		SOIL	BAG, JAR	✓	✓	✓		
HPMB03_ 0.5		30/09/2014		SOIL		✓				
HPMB03_ 1		30/09/2014		SOIL	JAR	✓				
HPMB03_ 1.5		30/09/2014		SOIL		✓				
HPMB03_ 2		30/09/2014		SOIL		✓				
HPMB03_ 2.5		30/09/2014		SOIL		✓				
HPMB03_ 3		30/09/2014		SOIL		✓				
HPMB03_ 3.5		30/09/2014		SOIL		✓				
HPMB03_ 4		30/09/2014		SOIL		✓				
HPMB03_ 4.5		30/09/2014		SOIL		✓				
HPMB03_ 5		30/09/2014		SOIL		✓				
~~HPMB03_ 6~~		~~30/09/2014~~		~~SOIL~~		✓				
HPMB03_ 7		30/09/2014		SOIL		✓				
~~HPMB03_ 8~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPMB03_ 9~~		~~30/09/2014~~		SOIL		✓				
~~HPMB03_ 10~~		30/09/2014		SOIL		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: RYAN L.
Date: 3/10
Time: 8:30AM

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	8 Metals	OC/OP Pesticides	Hold	Comment
HPMB04_0.1		30/09/2014		SOIL	BAG JAR	✓	✓	✓		
HPMB04_0.5		30/09/2014		SOIL		✓				
HPMB04_1		30/09/2014		SOIL	JAR	✓				
HPMB04_1.5		30/09/2014		SOIL		✓				
HPMB04_2		30/09/2014		SOIL		✓				
HPMB04_2.5		30/09/2014		SOIL		✓				
HPMB04_3		30/09/2014		SOIL		✓				
HPMB04_3.5		30/09/2014		SOIL		✓				
HPMB04_4		30/09/2014		SOIL		✓				
HPMB04_4.5		30/09/2014		SOIL		✓				
HPMB04_5		30/09/2014		SOIL		✓				
HPMB04_~~6~~ 5.5		30/09/2014		SOIL		✓				
~~HPMB04_7~~		~~30/09/2014~~		~~SOIL~~		~~✓~~				
~~HPMB04_8~~		~~30/09/2014~~		~~SOIL~~		~~✓~~				
~~HPMB04_9~~		~~30/09/2014~~		~~SOIL~~		~~✓~~				
~~HPMB04_10~~		~~30/09/2014~~		~~SOIL~~		~~✓~~				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:

CON NOTES | POST CODE | MASS
L | CN | HD | AP | CR

Received by: DuAnd L.
Date: 3/10
Time: 830

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

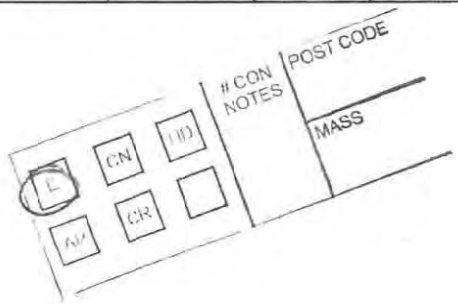
Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5 91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPSB01_ 0.1		30/09/2014		SOIL	BAG JAR	✓	✓	✓		
HPSB01_ 0.5		30/09/2014		SOIL		✓				
HPSB01_ 1		30/09/2014		SOIL	JAR	✓				
HPSB01_ 1.5		30/09/2014		SOIL		✓				
HPSB01_ 2		30/09/2014		SOIL		✓				
HPSB01_ 2.5		30/09/2014		SOIL		✓				
HPSB01_ 3		30/09/2014		SOIL		✓				
HPSB01_ 3.5		30/09/2014		SOIL		✓				
HPSB01_ 4		30/09/2014		SOIL		✓				
HPSB01_ 4.5		30/09/2014		SOIL		✓				
HPSB01_ 5		30/09/2014		SOIL		✓				
~~HPSB01_ 6~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB01_ 7~~		~~30/09/2014~~		~~SOIL~~		✓				
HPSB01_ 8		30/09/2014		SOIL		✓				
HPSB01_ 9		30/09/2014		SOIL		✓				
HPSB01_ 10		~~30/09/2014~~		~~SOIL~~		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: Brian G.
Date: 31/10
Time: 8:30

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

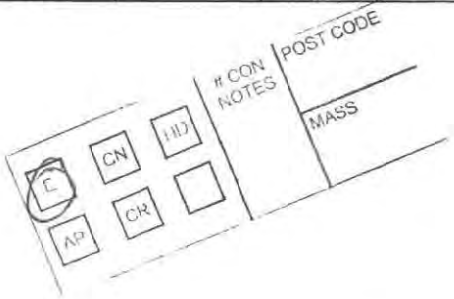
Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5 91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPSB02_ 0.1		30/09/2014		SOIL	BAG, JAR	✓	✓	✓		
HPSB02_ 0.5		30/09/2014		SOIL		✓				
HPSB02_ 1		30/09/2014		SOIL	JAR	✓				
HPSB02_ 1.5		30/09/2014		SOIL		✓				
HPSB02_ 2		30/09/2014		SOIL		✓				
HPSB02_ 2.5		30/09/2014		SOIL		✓				
HPSB02_ 3		30/09/2014		SOIL		✓				
HPSB02_ 3.5		30/09/2014		SOIL		✓				
HPSB02_ 4		30/09/2014		SOIL		✓				
HPSB02_ 4.5		30/09/2014		SOIL		✓				
HPSB02_ 5		30/09/2014		SOIL		✓				
~~HPSB02_ 6~~		~~30/09/2014~~		SOIL		✓				
~~HPSB02_ 7~~		30/09/2014		SOIL		✓				
~~HPSB02_ 8~~		~~30/09/2014~~		SOIL		✓				
~~HPSB02_ 9~~		~~30/09/2014~~		SOIL		✓				
~~HPSB02_ 10~~		30/09/2014		SOIL		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: RMAN C.
Date: 3/10
Time: 830

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

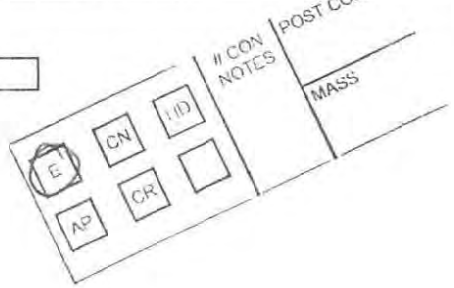
Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPSB03_ 0.1		30/09/2014		SOIL	JAR	✓	✓	✓		
HPSB03_ 0.5		30/09/2014		SOIL		✓				
HPSB03_ 1		30/09/2014		SOIL	JAR	✓				
HPSB03_ 1.5		30/09/2014		SOIL		✓				
HPSB03_ 2		30/09/2014		SOIL		✓				
HPSB03_ 2.5		30/09/2014		SOIL		✓				
HPSB03_ 3		30/09/2014		SOIL		✓				
HPSB03_ 3.5 ✓		30/09/2014		SOIL		✓				
HPSB03_ 4		30/09/2014		SOIL		✓				
HPSB03_ 4.5		30/09/2014		SOIL		✓				
HPSB03_ 5		30/09/2014		SOIL	↓	✓				
~~HPSB03_ 6~~		~~30/09/2014~~		SOIL		✓				
~~HPSB03_ 7~~		30/09/2014		SOIL		✓				
~~HPSB03_ 8~~		~~30/09/2014~~		SOIL		✓				
~~HPSB03_ 9~~		~~30/09/2014~~		~~SOIL~~		✓				
HPSB03_ 10		~~30/09/2014~~		SOIL		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: RYAN G.
Date: 3/10
Time: 8:40

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6000
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Laboratory: MGT
Address: 5 91 Leach Highway, Kewdale WA 6105

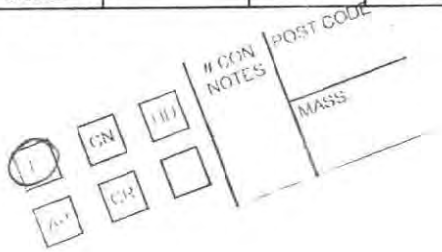
Project Hammond Park Schools PPP
Client Department of Finance
Job Manager Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results) joanna.stegena@ghd.com
Turnaround: 3 days

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPSB04_ 0.1		30/09/2014		SOIL	B4,JAR	✓	✓	✓		
HPSB04_ 0.5		30/09/2014		SOIL		✓				
HPSB04_ 1		30/09/2014		SOIL	JAR	✓				Missing Jar
HPSB04_ 1.5		30/09/2014		SOIL		✓				
HPSB04_ 2		30/09/2014		SOIL		✓				
HPSB04_ 2.5		30/09/2014		SOIL		✓				
HPSB04_ 3		30/09/2014		SOIL		✓				
HPSB04_ 3.5		30/09/2014		SOIL		✓				
HPSB04_ 4		30/09/2014		SOIL		✓				
HPSB04_ 4.5		30/09/2014		SOIL		✓				
HPSB04_ 5		30/09/2014		SOIL		✓				
~~HPSB04_ 6~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB04_ 7~~		30/09/2014		SOIL		✓				
~~HPSB04_ 8~~		~~30/09/2014~~		SOIL		✓				
~~HPSB04_ 9~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB04_ 10~~		~~30/09/2014~~		~~SOIL~~		✓				

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: RYAN L
Date: 3/10
Time: 830

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6000
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

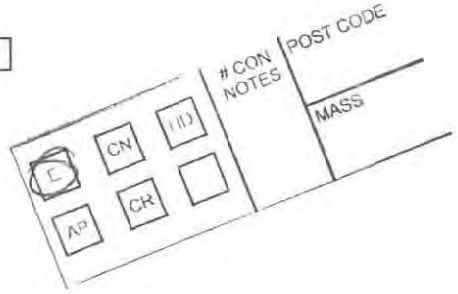
Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: NGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
HPSB05_ 0.1		30/09/2014		SOIL	BAG, JAR	✓	✓	✓		
HPSB05_ 0.5		30/09/2014		SOIL		✓				
HPSB05_ 1		30/09/2014		SOIL	JAR	✓				
HPSB05_ 1.5		30/09/2014		SOIL		✓				
HPSB05_ 2		30/09/2014		SOIL		✓				
HPSB05_ 2.5		30/09/2014		SOIL		✓				
HPSB05_ 3		30/09/2014		SOIL		✓				
HPSB05_ 3.5		30/09/2014		SOIL		✓				
HPSB05_ 4		30/09/2014		SOIL		✓				
HPSB05_ 4.5		30/09/2014		SOIL		✓				
HPSB05_ 5		30/09/2014		SOIL		✓				
~~HPSB05_ 6~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB05_ 7~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB05_ 8~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB05_ 9~~		~~30/09/2014~~		~~SOIL~~		✓				
~~HPSB05_ 10~~		~~30/09/2014~~		~~SOIL~~						

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:



Received by: RMAW L
Date: 3/10
Time: 83.

434212

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
QA01		30/09/2014		SOIL	JAR		✓	✓		
QA03		30/09/2014		SOIL	BAG	✓				
QA05		30/09/2014		SOIL	BAG	✓				
QA07		30/09/2014		SOIL	BAG	✓				
QA09		30/09/2014		SOIL	BAG	✓				
QA11		30/09/2014		SOIL	BAG	✓				
QA13		30/09/2014		SOIL	BAG	✓				
QA15		30/09/2014		SOIL	BAG	✓				
										Extra Jars not on CoC.
QA07										1
QA08										

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:

E | GN | HH | AP | CR | # CON NOTES | POST CODE | MASS

Received by: RMANCL.
Date: 3/10
Time: 830

434212

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Sample Receipt Advice

Company name:	**GHD Pty Ltd WA**
Contact name:	Joanna Stegena
Project name:	HAMMOND PARK SCHOOLS PPP
Project ID:	61/31027
COC number:	Not provided
Turn around time:	3 Day
Date/Time received:	Oct 3, 2014 8:30 AM
Eurofins | mgt reference:	**434212**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

Jars not received for HPMB01_1.0 & HPSB_1.0. Extra jar received for QA07 * QA08

Contact notes

If you have any questions with respect to these samples please contact:

Natalie Krasselt on Phone : (+61) (3) 8564 5000 or by e.mail: NatalieKrasselt@eurofins.com.au

Results will be delivered electronically via e.mail to Joanna Stegena - joanna.stegena@ghd.com.

Eurofins | mgt Sample Receipt

eurofins | mgt

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd WA
239 Adelaide Terrace
Perth
WA 6004

Attention: **Joanna Stegena**

Report **434212-S**
Project name HAMMOND PARK SCHOOLS PPP
Project ID 61/31027
Received Date Oct 03, 2014

Client Sample ID			HPMB01_0.1	HPMB01_0.5	HPMB01_1.0	HPMB01_1.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02480	B14-Oc02481	B14-Oc02482	B14-Oc02483
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	-	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	-	-
a-BHC	0.05	mg/kg	< 0.05	-	-	-
Aldrin	0.05	mg/kg	< 0.05	-	-	-
b-BHC	0.05	mg/kg	< 0.05	-	-	-
d-BHC	0.05	mg/kg	< 0.05	-	-	-
Dieldrin	0.05	mg/kg	< 0.05	-	-	-
Endosulfan I	0.05	mg/kg	< 0.05	-	-	-
Endosulfan II	0.05	mg/kg	< 0.05	-	-	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	-	-
Endrin	0.05	mg/kg	< 0.05	-	-	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	-	-
Endrin ketone	0.05	mg/kg	< 0.05	-	-	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	-	-
Heptachlor	0.05	mg/kg	< 0.05	-	-	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	-	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	-	-
Methoxychlor	0.05	mg/kg	< 0.05	-	-	-
Toxaphene	1	mg/kg	< 1	-	-	-
Dibutylchlorendate (surr.)	1	%	129	-	-	-
Tetrachloro-m-xylene (surr.)	1	%	101	-	-	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	< 0.2	-	-	-
Chlorpyrifos	0.2	mg/kg	< 0.2	-	-	-
Demeton-O	0.2	mg/kg	< 0.2	-	-	-
Diazinon	0.2	mg/kg	< 0.2	-	-	-
Dichlorvos	0.2	mg/kg	< 0.2	-	-	-
Disulfoton	0.2	mg/kg	< 0.2	-	-	-
Ethion	0.2	mg/kg	< 0.2	-	-	-
Ethoprop	0.2	mg/kg	< 0.2	-	-	-
Fenitrothion	0.2	mg/kg	< 0.2	-	-	-
Fensulfothion	0.2	mg/kg	< 0.2	-	-	-
Fenthion	0.2	mg/kg	< 0.2	-	-	-

Client Sample ID			HPMB01_0.1	HPMB01_0.5	HPMB01_1.0	HPMB01_1.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02480	B14-Oc02481	B14-Oc02482	B14-Oc02483
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Organophosphorous Pesticides						
Merphos	0.2	mg/kg	< 0.2	-	-	-
Methyl azinphos	0.2	mg/kg	< 0.2	-	-	-
Methyl parathion	0.2	mg/kg	< 0.2	-	-	-
Mevinphos	0.2	mg/kg	< 0.2	-	-	-
Naled	0.5	mg/kg	< 0.5	-	-	-
Phorate	0.2	mg/kg	< 0.2	-	-	-
Ronnel	0.2	mg/kg	< 0.2	-	-	-
Tokuthion	0.2	mg/kg	< 0.2	-	-	-
Trichloronate	0.2	mg/kg	< 0.2	-	-	-
Triphenylphosphate (surr.)	1	%	69	-	-	-
Heavy Metals						
Arsenic	2	mg/kg	< 2	-	-	-
Cadmium	0.4	mg/kg	< 0.4	-	-	-
Chromium	5	mg/kg	< 5	-	-	-
Copper	5	mg/kg	< 5	-	-	-
Lead	5	mg/kg	< 5	-	-	-
Mercury	0.1	mg/kg	< 0.1	-	-	-
Nickel	5	mg/kg	< 5	-	-	-
Zinc	5	mg/kg	< 5	-	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	8.4	8.1	8.0	7.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.9	5.3	5.4	5.4
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	3.4	-	-	-

Client Sample ID			HPMB01_2.0	HPMB01_2.5	HPMB01_3.0	HPMB01_3.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02484	B14-Oc02485	B14-Oc02486	B14-Oc02487
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.5	7.4	7.2	7.3
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.3	5.1	5.0	5.1
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID			HPMB01_4.0	HPMB01_4.5	HPMB01_5.0	HPMB01_6.0
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02488	B14-Oc02489	B14-Oc02490	B14-Oc02491
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.2	7.3	7.5	7.3
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.1	5.0	5.0	5.0
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB01_7.0 Soil B14-Oc02492 Sep 30, 2014	HPMB01_8.0 Soil B14-Oc02493 Sep 30, 2014	HPMB01_9.0 Soil B14-Oc02494 Sep 30, 2014	HPMB02_0.1 Soil B14-Oc02495 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	-	< 0.1
4.4'-DDD	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDE	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDT	0.05	mg/kg	-	-	-	< 0.05
a-BHC	0.05	mg/kg	-	-	-	< 0.05
Aldrin	0.05	mg/kg	-	-	-	< 0.05
b-BHC	0.05	mg/kg	-	-	-	< 0.05
d-BHC	0.05	mg/kg	-	-	-	< 0.05
Dieldrin	0.05	mg/kg	-	-	-	< 0.05
Endosulfan I	0.05	mg/kg	-	-	-	< 0.05
Endosulfan II	0.05	mg/kg	-	-	-	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	-	-	< 0.05
Endrin	0.05	mg/kg	-	-	-	< 0.05
Endrin aldehyde	0.05	mg/kg	-	-	-	< 0.05
Endrin ketone	0.05	mg/kg	-	-	-	< 0.05
g-BHC (Lindane)	0.05	mg/kg	-	-	-	< 0.05
Heptachlor	0.05	mg/kg	-	-	-	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	-	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	-	< 0.05
Methoxychlor	0.05	mg/kg	-	-	-	< 0.05
Toxaphene	1	mg/kg	-	-	-	< 1
Dibutylchlorendate (surr.)	1	%	-	-	-	135
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	95
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	-	< 0.2
Chlorpyrifos	0.2	mg/kg	-	-	-	< 0.2
Demeton-O	0.2	mg/kg	-	-	-	< 0.2
Diazinon	0.2	mg/kg	-	-	-	< 0.2
Dichlorvos	0.2	mg/kg	-	-	-	< 0.2
Disulfoton	0.2	mg/kg	-	-	-	< 0.2
Ethion	0.2	mg/kg	-	-	-	< 0.2
Ethoprop	0.2	mg/kg	-	-	-	< 0.2
Fenitrothion	0.2	mg/kg	-	-	-	< 0.2
Fensulfothion	0.2	mg/kg	-	-	-	< 0.2
Fenthion	0.2	mg/kg	-	-	-	< 0.2
Merphos	0.2	mg/kg	-	-	-	< 0.2
Methyl azinphos	0.2	mg/kg	-	-	-	< 0.2
Methyl parathion	0.2	mg/kg	-	-	-	< 0.2
Mevinphos	0.2	mg/kg	-	-	-	< 0.2
Naled	0.5	mg/kg	-	-	-	< 0.5
Phorate	0.2	mg/kg	-	-	-	< 0.2
Ronnel	0.2	mg/kg	-	-	-	< 0.2
Tokuthion	0.2	mg/kg	-	-	-	< 0.2
Trichloronate	0.2	mg/kg	-	-	-	< 0.2
Triphenylphosphate (surr.)	1	%	-	-	-	78

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB01_7.0 Soil B14-Oc02492 Sep 30, 2014	HPMB01_8.0 Soil B14-Oc02493 Sep 30, 2014	HPMB01_9.0 Soil B14-Oc02494 Sep 30, 2014	HPMB02_0.1 Soil B14-Oc02495 Sep 30, 2014
Heavy Metals						
Arsenic	2	mg/kg	-	-	-	< 2
Cadmium	0.4	mg/kg	-	-	-	< 0.4
Chromium	5	mg/kg	-	-	-	< 5
Copper	5	mg/kg	-	-	-	< 5
Lead	5	mg/kg	-	-	-	< 5
Mercury	0.1	mg/kg	-	-	-	< 0.1
Nickel	5	mg/kg	-	-	-	< 5
Zinc	5	mg/kg	-	-	-	< 5
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	7.1	7.1	6.4	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	5.0	4.9	4.8	3.8
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	-	-	-	6.4

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB02_0.5 Soil B14-Oc02496 Sep 30, 2014	HPMB02_1.0 Soil B14-Oc02497 Sep 30, 2014	HPMB02_1.5 Soil B14-Oc02498 Sep 30, 2014	HPMB02_2.0 Soil B14-Oc02499 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.6	6.0	5.8	4.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.8	3.4	4.2	3.5
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB02_2.5 Soil B14-Oc02500 Sep 30, 2014	HPMB02_3.0 Soil B14-Oc02501 Sep 30, 2014	HPMB02_3.5 Soil B14-Oc02502 Sep 30, 2014	HPMB02_4.0 Soil B14-Oc02503 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	4.6	4.4	5.2	5.4
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.2	3.3	3.3	3.2
Reaction Ratings*		comment	High	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB02_4.5 Soil B14-Oc02504 Sep 30, 2014	HPMB02_5.0 Soil B14-Oc02505 Sep 30, 2014	HPMB02_5.5 Soil B14-Oc02506 Sep 30, 2014	HPMB03_0.1 Soil B14-Oc02507 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	-	< 0.1
4.4'-DDD	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDE	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDT	0.05	mg/kg	-	-	-	< 0.05
a-BHC	0.05	mg/kg	-	-	-	< 0.05
Aldrin	0.05	mg/kg	-	-	-	< 0.05
b-BHC	0.05	mg/kg	-	-	-	< 0.05
d-BHC	0.05	mg/kg	-	-	-	< 0.05
Dieldrin	0.05	mg/kg	-	-	-	< 0.05
Endosulfan I	0.05	mg/kg	-	-	-	< 0.05
Endosulfan II	0.05	mg/kg	-	-	-	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	-	-	< 0.05
Endrin	0.05	mg/kg	-	-	-	< 0.05
Endrin aldehyde	0.05	mg/kg	-	-	-	< 0.05
Endrin ketone	0.05	mg/kg	-	-	-	< 0.05
g-BHC (Lindane)	0.05	mg/kg	-	-	-	< 0.05
Heptachlor	0.05	mg/kg	-	-	-	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	-	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	-	< 0.05
Methoxychlor	0.05	mg/kg	-	-	-	< 0.05
Toxaphene	1	mg/kg	-	-	-	< 1
Dibutylchlorendate (surr.)	1	%	-	-	-	53
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	50
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	-	< 0.2
Chlorpyrifos	0.2	mg/kg	-	-	-	< 0.2
Demeton-O	0.2	mg/kg	-	-	-	< 0.2
Diazinon	0.2	mg/kg	-	-	-	< 0.2
Dichlorvos	0.2	mg/kg	-	-	-	< 0.2
Disulfoton	0.2	mg/kg	-	-	-	< 0.2
Ethion	0.2	mg/kg	-	-	-	< 0.2
Ethoprop	0.2	mg/kg	-	-	-	< 0.2
Fenitrothion	0.2	mg/kg	-	-	-	< 0.2
Fensulfothion	0.2	mg/kg	-	-	-	< 0.2
Fenthion	0.2	mg/kg	-	-	-	< 0.2
Merphos	0.2	mg/kg	-	-	-	< 0.2
Methyl azinphos	0.2	mg/kg	-	-	-	< 0.2
Methyl parathion	0.2	mg/kg	-	-	-	< 0.2
Mevinphos	0.2	mg/kg	-	-	-	< 0.2
Naled	0.5	mg/kg	-	-	-	< 0.5
Phorate	0.2	mg/kg	-	-	-	< 0.2
Ronnel	0.2	mg/kg	-	-	-	< 0.2
Tokuthion	0.2	mg/kg	-	-	-	< 0.2
Trichloronate	0.2	mg/kg	-	-	-	< 0.2
Triphenylphosphate (surr.)	1	%	-	-	-	84

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB02_4.5 Soil B14-Oc02504 Sep 30, 2014	HPMB02_5.0 Soil B14-Oc02505 Sep 30, 2014	HPMB02_5.5 Soil B14-Oc02506 Sep 30, 2014	HPMB03_0.1 Soil B14-Oc02507 Sep 30, 2014
Heavy Metals						
Arsenic	2	mg/kg	-	-	-	< 2
Cadmium	0.4	mg/kg	-	-	-	< 0.4
Chromium	5	mg/kg	-	-	-	< 5
Copper	5	mg/kg	-	-	-	< 5
Lead	5	mg/kg	-	-	-	< 5
Mercury	0.1	mg/kg	-	-	-	< 0.1
Nickel	5	mg/kg	-	-	-	< 5
Zinc	5	mg/kg	-	-	-	< 5
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.1	5.6	5.4	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.4	3.2	3.4	3.5
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	-	-	-	2.5

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB03_0.5 Soil B14-Oc02508 Sep 30, 2014	HPMB03_1.0 Soil B14-Oc02509 Sep 30, 2014	HPMB03_1.5 Soil B14-Oc02510 Sep 30, 2014	HPMB03_2.0 Soil B14-Oc02511 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.2	5.4	5.3	5.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.5	3.2	3.5	3.4
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB03_2.5 Soil B14-Oc02512 Sep 30, 2014	HPMB03_3.0 Soil B14-Oc02513 Sep 30, 2014	HPMB03_3.5 Soil B14-Oc02514 Sep 30, 2014	HPMB03_4.0 Soil B14-Oc02515 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	4.9	5.5	6.0
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.2	2.9	2.8	4.1
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB03_4.5 Soil B14-Oc02516 Sep 30, 2014	HPMB03_5.0 Soil B14-Oc02517 Sep 30, 2014	HPMB04_0.1 Soil B14-Oc02518 Sep 30, 2014	HPMB04_0.5 Soil B14-Oc02519 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	-	-	< 0.05	-
a-BHC	0.05	mg/kg	-	-	< 0.05	-
Aldrin	0.05	mg/kg	-	-	< 0.05	-
b-BHC	0.05	mg/kg	-	-	< 0.05	-
d-BHC	0.05	mg/kg	-	-	< 0.05	-
Dieldrin	0.05	mg/kg	-	-	< 0.05	-
Endosulfan I	0.05	mg/kg	-	-	< 0.05	-
Endosulfan II	0.05	mg/kg	-	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	-	-	< 0.05	-
Endrin	0.05	mg/kg	-	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	-	-	< 0.05	-
Endrin ketone	0.05	mg/kg	-	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	-	-	< 0.05	-
Heptachlor	0.05	mg/kg	-	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	-	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	-	-	< 0.05	-
Methoxychlor	0.05	mg/kg	-	-	< 0.05	-
Toxaphene	1	mg/kg	-	-	< 1	-
Dibutylchlorendate (surr.)	1	%	-	-	55	-
Tetrachloro-m-xylene (surr.)	1	%	-	-	60	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	< 0.2	-
Chlorpyrifos	0.2	mg/kg	-	-	< 0.2	-
Demeton-O	0.2	mg/kg	-	-	< 0.2	-
Diazinon	0.2	mg/kg	-	-	< 0.2	-
Dichlorvos	0.2	mg/kg	-	-	< 0.2	-
Disulfoton	0.2	mg/kg	-	-	< 0.2	-
Ethion	0.2	mg/kg	-	-	< 0.2	-
Ethoprop	0.2	mg/kg	-	-	< 0.2	-
Fenitrothion	0.2	mg/kg	-	-	< 0.2	-
Fensulfothion	0.2	mg/kg	-	-	< 0.2	-
Fenthion	0.2	mg/kg	-	-	< 0.2	-
Merphos	0.2	mg/kg	-	-	< 0.2	-
Methyl azinphos	0.2	mg/kg	-	-	< 0.2	-
Methyl parathion	0.2	mg/kg	-	-	< 0.2	-
Mevinphos	0.2	mg/kg	-	-	< 0.2	-
Naled	0.5	mg/kg	-	-	< 0.5	-
Phorate	0.2	mg/kg	-	-	< 0.2	-
Ronnel	0.2	mg/kg	-	-	< 0.2	-
Tokuthion	0.2	mg/kg	-	-	< 0.2	-
Trichloronate	0.2	mg/kg	-	-	< 0.2	-
Triphenylphosphate (surr.)	1	%	-	-	77	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB03_4.5 Soil B14-Oc02516 Sep 30, 2014	HPMB03_5.0 Soil B14-Oc02517 Sep 30, 2014	HPMB04_0.1 Soil B14-Oc02518 Sep 30, 2014	HPMB04_0.5 Soil B14-Oc02519 Sep 30, 2014
Heavy Metals						
Arsenic	2	mg/kg	-	-	< 2	-
Cadmium	0.4	mg/kg	-	-	< 0.4	-
Chromium	5	mg/kg	-	-	< 5	-
Copper	5	mg/kg	-	-	< 5	-
Lead	5	mg/kg	-	-	< 5	-
Mercury	0.1	mg/kg	-	-	< 0.1	-
Nickel	5	mg/kg	-	-	< 5	-
Zinc	5	mg/kg	-	-	< 5	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.1	5.9	5.4	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.5	3.2	3.0	3.1
Reaction Ratings*		comment	Slight	Slight	High	Slight
% Moisture	0.1	%	-	-	23	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB04_1.0 Soil B14-Oc02520 Sep 30, 2014	HPMB04_1.5 Soil B14-Oc02521 Sep 30, 2014	HPMB04_2.0 Soil B14-Oc02522 Sep 30, 2014	HPMB04_2.5 Soil B14-Oc02523 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	5.8	5.4	4.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.0	3.1	3.4	3.8
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB04_3.0 Soil B14-Oc02524 Sep 30, 2014	HPMB04_3.5 Soil B14-Oc02525 Sep 30, 2014	HPMB04_4.0 Soil B14-Oc02526 Sep 30, 2014	HPMB04_4.5 Soil B14-Oc02527 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.5	4.8	4.7	5.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.2	3.0	3.3	3.1
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPMB04_5.0 Soil B14-Oc02528 Sep 30, 2014	HPMB04_5.5 Soil B14-Oc02529 Sep 30, 2014	HPSB01_0.1 Soil B14-Oc02530 Sep 30, 2014	HPSB01_0.5 Soil B14-Oc02531 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	-	-	< 0.05	-
a-BHC	0.05	mg/kg	-	-	< 0.05	-
Aldrin	0.05	mg/kg	-	-	< 0.05	-
b-BHC	0.05	mg/kg	-	-	< 0.05	-
d-BHC	0.05	mg/kg	-	-	< 0.05	-
Dieldrin	0.05	mg/kg	-	-	< 0.05	-
Endosulfan I	0.05	mg/kg	-	-	< 0.05	-
Endosulfan II	0.05	mg/kg	-	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	-	-	< 0.05	-
Endrin	0.05	mg/kg	-	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	-	-	< 0.05	-
Endrin ketone	0.05	mg/kg	-	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	-	-	< 0.05	-
Heptachlor	0.05	mg/kg	-	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	-	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	-	-	< 0.05	-
Methoxychlor	0.05	mg/kg	-	-	< 0.05	-
Toxaphene	1	mg/kg	-	-	< 1	-
Dibutylchlorendate (surr.)	1	%	-	-	57	-
Tetrachloro-m-xylene (surr.)	1	%	-	-	65	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	< 0.2	-
Chlorpyrifos	0.2	mg/kg	-	-	< 0.2	-
Demeton-O	0.2	mg/kg	-	-	< 0.2	-
Diazinon	0.2	mg/kg	-	-	< 0.2	-
Dichlorvos	0.2	mg/kg	-	-	< 0.2	-
Disulfoton	0.2	mg/kg	-	-	< 0.2	-
Ethion	0.2	mg/kg	-	-	< 0.2	-
Ethoprop	0.2	mg/kg	-	-	< 0.2	-
Fenitrothion	0.2	mg/kg	-	-	< 0.2	-
Fensulfothion	0.2	mg/kg	-	-	< 0.2	-
Fenthion	0.2	mg/kg	-	-	< 0.2	-
Merphos	0.2	mg/kg	-	-	< 0.2	-
Methyl azinphos	0.2	mg/kg	-	-	< 0.2	-
Methyl parathion	0.2	mg/kg	-	-	< 0.2	-
Mevinphos	0.2	mg/kg	-	-	< 0.2	-
Naled	0.5	mg/kg	-	-	< 0.5	-
Phorate	0.2	mg/kg	-	-	< 0.2	-
Ronnel	0.2	mg/kg	-	-	< 0.2	-
Tokuthion	0.2	mg/kg	-	-	< 0.2	-
Trichloronate	0.2	mg/kg	-	-	< 0.2	-
Triphenylphosphate (surr.)	1	%	-	-	79	-

Client Sample ID			HPMB04_5.0	HPMB04_5.5	HPSB01_0.1	HPSB01_0.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02528	B14-Oc02529	B14-Oc02530	B14-Oc02531
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Heavy Metals						
Arsenic	2	mg/kg	-	-	< 2	-
Cadmium	0.4	mg/kg	-	-	< 0.4	-
Chromium	5	mg/kg	-	-	< 5	-
Copper	5	mg/kg	-	-	< 5	-
Lead	5	mg/kg	-	-	< 5	-
Mercury	0.1	mg/kg	-	-	< 0.1	-
Nickel	5	mg/kg	-	-	< 5	-
Zinc	5	mg/kg	-	-	< 5	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.2	4.6	5.4	6.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.1	2.7	3.0	3.6
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	-	-	3.6	-

Client Sample ID			HPSB01_1.0	HPSB01_1.5	HPSB01_2.0	HPSB01_2.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02532	B14-Oc02533	B14-Oc02534	B14-Oc02535
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.5	6.7	6.3	6.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.3	3.8	4.6
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID			HPSB01_3.0	HPSB01_3.5	HPSB01_4.0	HPSB01_4.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02536	B14-Oc02537	B14-Oc02538	B14-Oc02539
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	5.7	5.7	5.8
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.0	4.2	4.3
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB01_5.0 Soil B14-Oc02540 Sep 30, 2014	HPSB02_0.1 Soil B14-Oc02541 Sep 30, 2014	HPSB02_0.5 Soil B14-Oc02542 Sep 30, 2014	HPSB02_1.0 Soil B14-Oc02543 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	< 0.1	-	-
4.4'-DDD	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDE	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDT	0.05	mg/kg	-	< 0.05	-	-
a-BHC	0.05	mg/kg	-	< 0.05	-	-
Aldrin	0.05	mg/kg	-	< 0.05	-	-
b-BHC	0.05	mg/kg	-	< 0.05	-	-
d-BHC	0.05	mg/kg	-	< 0.05	-	-
Dieldrin	0.05	mg/kg	-	< 0.05	-	-
Endosulfan I	0.05	mg/kg	-	< 0.05	-	-
Endosulfan II	0.05	mg/kg	-	< 0.05	-	-
Endosulfan sulphate	0.05	mg/kg	-	< 0.05	-	-
Endrin	0.05	mg/kg	-	< 0.05	-	-
Endrin aldehyde	0.05	mg/kg	-	< 0.05	-	-
Endrin ketone	0.05	mg/kg	-	< 0.05	-	-
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05	-	-
Heptachlor	0.05	mg/kg	-	< 0.05	-	-
Heptachlor epoxide	0.05	mg/kg	-	< 0.05	-	-
Hexachlorobenzene	0.05	mg/kg	-	< 0.05	-	-
Methoxychlor	0.05	mg/kg	-	< 0.05	-	-
Toxaphene	1	mg/kg	-	< 1	-	-
Dibutylchlorendate (surr.)	1	%	-	54	-	-
Tetrachloro-m-xylene (surr.)	1	%	-	63	-	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	< 0.2	-	-
Chlorpyrifos	0.2	mg/kg	-	< 0.2	-	-
Demeton-O	0.2	mg/kg	-	< 0.2	-	-
Diazinon	0.2	mg/kg	-	< 0.2	-	-
Dichlorvos	0.2	mg/kg	-	< 0.2	-	-
Disulfoton	0.2	mg/kg	-	< 0.2	-	-
Ethion	0.2	mg/kg	-	< 0.2	-	-
Ethoprop	0.2	mg/kg	-	< 0.2	-	-
Fenitrothion	0.2	mg/kg	-	< 0.2	-	-
Fensulfothion	0.2	mg/kg	-	< 0.2	-	-
Fenthion	0.2	mg/kg	-	< 0.2	-	-
Merphos	0.2	mg/kg	-	< 0.2	-	-
Methyl azinphos	0.2	mg/kg	-	< 0.2	-	-
Methyl parathion	0.2	mg/kg	-	< 0.2	-	-
Mevinphos	0.2	mg/kg	-	< 0.2	-	-
Naled	0.5	mg/kg	-	< 0.5	-	-
Phorate	0.2	mg/kg	-	< 0.2	-	-
Ronnel	0.2	mg/kg	-	< 0.2	-	-
Tokuthion	0.2	mg/kg	-	< 0.2	-	-
Trichloronate	0.2	mg/kg	-	< 0.2	-	-
Triphenylphosphate (surr.)	1	%	-	74	-	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB01_5.0 Soil B14-Oc02540 Sep 30, 2014	HPSB02_0.1 Soil B14-Oc02541 Sep 30, 2014	HPSB02_0.5 Soil B14-Oc02542 Sep 30, 2014	HPSB02_1.0 Soil B14-Oc02543 Sep 30, 2014
Heavy Metals						
Arsenic	2	mg/kg	-	< 2	-	-
Cadmium	0.4	mg/kg	-	< 0.4	-	-
Chromium	5	mg/kg	-	< 5	-	-
Copper	5	mg/kg	-	< 5	-	-
Lead	5	mg/kg	-	< 5	-	-
Mercury	0.1	mg/kg	-	< 0.1	-	-
Nickel	5	mg/kg	-	< 5	-	-
Zinc	5	mg/kg	-	< 5	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	7.2	7.0	7.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.3	4.5	4.6	4.7
Reaction Ratings*		comment	Slight	High	Slight	Slight
% Moisture	0.1	%	-	2.9	-	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB02_1.5 Soil B14-Oc02544 Sep 30, 2014	HPSB02_2.0 Soil B14-Oc02545 Sep 30, 2014	HPSB02_2.5 Soil B14-Oc02546 Sep 30, 2014	HPSB02_3.0 Soil B14-Oc02547 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.9	6.9	7.0	6.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.6	4.6	4.9	4.7
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB02_3.5 Soil B14-Oc02548 Sep 30, 2014	HPSB02_4.0 Soil B14-Oc02549 Sep 30, 2014	HPSB02_4.5 Soil B14-Oc02550 Sep 30, 2014	HPSB02_5.0 Soil B14-Oc02551 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.6	6.0	6.1	6.9
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.7	4.6	4.5	4.9
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB03_0.1 Soil B14-Oc02552 Sep 30, 2014	HPSB03_0.5 Soil B14-Oc02553 Sep 30, 2014	HPSB03_1.0 Soil B14-Oc02554 Sep 30, 2014	HPSB03_1.5 Soil B14-Oc02555 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	< 0.1	-	-	-
4.4'-DDD	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDE	0.05	mg/kg	< 0.05	-	-	-
4.4'-DDT	0.05	mg/kg	< 0.05	-	-	-
a-BHC	0.05	mg/kg	< 0.05	-	-	-
Aldrin	0.05	mg/kg	< 0.05	-	-	-
b-BHC	0.05	mg/kg	< 0.05	-	-	-
d-BHC	0.05	mg/kg	< 0.05	-	-	-
Dieldrin	0.05	mg/kg	< 0.05	-	-	-
Endosulfan I	0.05	mg/kg	< 0.05	-	-	-
Endosulfan II	0.05	mg/kg	< 0.05	-	-	-
Endosulfan sulphate	0.05	mg/kg	< 0.05	-	-	-
Endrin	0.05	mg/kg	< 0.05	-	-	-
Endrin aldehyde	0.05	mg/kg	< 0.05	-	-	-
Endrin ketone	0.05	mg/kg	< 0.05	-	-	-
g-BHC (Lindane)	0.05	mg/kg	< 0.05	-	-	-
Heptachlor	0.05	mg/kg	< 0.05	-	-	-
Heptachlor epoxide	0.05	mg/kg	< 0.05	-	-	-
Hexachlorobenzene	0.05	mg/kg	< 0.05	-	-	-
Methoxychlor	0.05	mg/kg	< 0.05	-	-	-
Toxaphene	1	mg/kg	< 1	-	-	-
Dibutylchlorendate (surr.)	1	%	64	-	-	-
Tetrachloro-m-xylene (surr.)	1	%	76	-	-	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	< 0.2	-	-	-
Chlorpyrifos	0.2	mg/kg	< 0.2	-	-	-
Demeton-O	0.2	mg/kg	< 0.2	-	-	-
Diazinon	0.2	mg/kg	< 0.2	-	-	-
Dichlorvos	0.2	mg/kg	< 0.2	-	-	-
Disulfoton	0.2	mg/kg	< 0.2	-	-	-
Ethion	0.2	mg/kg	< 0.2	-	-	-
Ethoprop	0.2	mg/kg	< 0.2	-	-	-
Fenitrothion	0.2	mg/kg	< 0.2	-	-	-
Fensulfothion	0.2	mg/kg	< 0.2	-	-	-
Fenthion	0.2	mg/kg	< 0.2	-	-	-
Merphos	0.2	mg/kg	< 0.2	-	-	-
Methyl azinphos	0.2	mg/kg	< 0.2	-	-	-
Methyl parathion	0.2	mg/kg	< 0.2	-	-	-
Mevinphos	0.2	mg/kg	< 0.2	-	-	-
Naled	0.5	mg/kg	< 0.5	-	-	-
Phorate	0.2	mg/kg	< 0.2	-	-	-
Ronnel	0.2	mg/kg	< 0.2	-	-	-
Tokuthion	0.2	mg/kg	< 0.2	-	-	-
Trichloronate	0.2	mg/kg	< 0.2	-	-	-
Triphenylphosphate (surr.)	1	%	75	-	-	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB03_0.1 Soil B14-Oc02552 Sep 30, 2014	HPSB03_0.5 Soil B14-Oc02553 Sep 30, 2014	HPSB03_1.0 Soil B14-Oc02554 Sep 30, 2014	HPSB03_1.5 Soil B14-Oc02555 Sep 30, 2014
Heavy Metals						
Arsenic	2	mg/kg	< 2	-	-	-
Cadmium	0.4	mg/kg	< 0.4	-	-	-
Chromium	5	mg/kg	< 5	-	-	-
Copper	5	mg/kg	< 5	-	-	-
Lead	5	mg/kg	< 5	-	-	-
Mercury	0.1	mg/kg	< 0.1	-	-	-
Nickel	5	mg/kg	< 5	-	-	-
Zinc	5	mg/kg	< 5	-	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.3	6.2	5.9	5.7
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.4	3.3	3.5	3.6
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	7.9	-	-	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB03_2.0 Soil B14-Oc02556 Sep 30, 2014	HPSB03_2.5 Soil B14-Oc02557 Sep 30, 2014	HPSB03_3.0 Soil B14-Oc02558 Sep 30, 2014	HPSB03_3.5 Soil B14-Oc02559 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.5	5.7	5.2	5.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.3	3.9	3.3	3.7
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB03_4.0 Soil B14-Oc02560 Sep 30, 2014	HPSB03_4.5 Soil B14-Oc02561 Sep 30, 2014	HPSB03_5.0 Soil B14-Oc02562 Sep 30, 2014	HPSB04_0.1 Soil B14-Oc02563 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	-	< 0.1
4.4'-DDD	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDE	0.05	mg/kg	-	-	-	< 0.05
4.4'-DDT	0.05	mg/kg	-	-	-	< 0.05
a-BHC	0.05	mg/kg	-	-	-	< 0.05
Aldrin	0.05	mg/kg	-	-	-	< 0.05
b-BHC	0.05	mg/kg	-	-	-	< 0.05
d-BHC	0.05	mg/kg	-	-	-	< 0.05
Dieldrin	0.05	mg/kg	-	-	-	< 0.05
Endosulfan I	0.05	mg/kg	-	-	-	< 0.05
Endosulfan II	0.05	mg/kg	-	-	-	< 0.05
Endosulfan sulphate	0.05	mg/kg	-	-	-	< 0.05
Endrin	0.05	mg/kg	-	-	-	< 0.05
Endrin aldehyde	0.05	mg/kg	-	-	-	< 0.05
Endrin ketone	0.05	mg/kg	-	-	-	< 0.05

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB03_4.0 Soil B14-Oc02560 Sep 30, 2014	HPSB03_4.5 Soil B14-Oc02561 Sep 30, 2014	HPSB03_5.0 Soil B14-Oc02562 Sep 30, 2014	HPSB04_0.1 Soil B14-Oc02563 Sep 30, 2014
Organochlorine Pesticides						
g-BHC (Lindane)	0.05	mg/kg	-	-	-	< 0.05
Heptachlor	0.05	mg/kg	-	-	-	< 0.05
Heptachlor epoxide	0.05	mg/kg	-	-	-	< 0.05
Hexachlorobenzene	0.05	mg/kg	-	-	-	< 0.05
Methoxychlor	0.05	mg/kg	-	-	-	< 0.05
Toxaphene	1	mg/kg	-	-	-	< 1
Dibutylchlorendate (surr.)	1	%	-	-	-	101
Tetrachloro-m-xylene (surr.)	1	%	-	-	-	114
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	-	< 0.2
Chlorpyrifos	0.2	mg/kg	-	-	-	< 0.2
Demeton-O	0.2	mg/kg	-	-	-	< 0.2
Diazinon	0.2	mg/kg	-	-	-	< 0.2
Dichlorvos	0.2	mg/kg	-	-	-	< 0.2
Disulfoton	0.2	mg/kg	-	-	-	< 0.2
Ethion	0.2	mg/kg	-	-	-	< 0.2
Ethoprop	0.2	mg/kg	-	-	-	< 0.2
Fenitrothion	0.2	mg/kg	-	-	-	< 0.2
Fensulfothion	0.2	mg/kg	-	-	-	< 0.2
Fenthion	0.2	mg/kg	-	-	-	< 0.2
Merphos	0.2	mg/kg	-	-	-	< 0.2
Methyl azinphos	0.2	mg/kg	-	-	-	< 0.2
Methyl parathion	0.2	mg/kg	-	-	-	< 0.2
Mevinphos	0.2	mg/kg	-	-	-	< 0.2
Naled	0.5	mg/kg	-	-	-	< 0.5
Phorate	0.2	mg/kg	-	-	-	< 0.2
Ronnel	0.2	mg/kg	-	-	-	< 0.2
Tokuthion	0.2	mg/kg	-	-	-	< 0.2
Trichloronate	0.2	mg/kg	-	-	-	< 0.2
Triphenylphosphate (surr.)	1	%	-	-	-	123
Heavy Metals						
Arsenic	2	mg/kg	-	-	-	< 2
Cadmium	0.4	mg/kg	-	-	-	< 0.4
Chromium	5	mg/kg	-	-	-	< 5
Copper	5	mg/kg	-	-	-	< 5
Lead	5	mg/kg	-	-	-	< 5
Mercury	0.1	mg/kg	-	-	-	< 0.1
Nickel	5	mg/kg	-	-	-	< 5
Zinc	5	mg/kg	-	-	-	< 5
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.9	6.7	6.2	5.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.8	3.9	2.8	3.1
Reaction Ratings*		comment	Slight	Slight	High	Slight
% Moisture	0.1	%	-	-	-	3.0

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB04_0.5 Soil B14-Oc02564 Sep 30, 2014	HPSB04_1.0 Soil B14-Oc02565 Sep 30, 2014	HPSB04_1.5 Soil B14-Oc02566 Sep 30, 2014	HPSB04_2.0 Soil B14-Oc02567 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.1	4.9	4.9	5.1
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.7	2.9	2.7	2.4
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB04_2.5 Soil B14-Oc02568 Sep 30, 2014	HPSB04_3.0 Soil B14-Oc02569 Sep 30, 2014	HPSB04_3.5 Soil B14-Oc02570 Sep 30, 2014	HPSB04_4.0 Soil B14-Oc02571 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.0	5.2	5.4	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.3	3.1	3.4	2.4
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB04_4.5 Soil B14-Oc02572 Sep 30, 2014	HPSB04_5.0 Soil B14-Oc02573 Sep 30, 2014	HPSB05_0.1 Soil B14-Oc02574 Sep 30, 2014	HPSB05_0.5 Soil B14-Oc02575 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	-	< 0.1	-
4.4'-DDD	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDE	0.05	mg/kg	-	-	< 0.05	-
4.4'-DDT	0.05	mg/kg	-	-	< 0.05	-
a-BHC	0.05	mg/kg	-	-	< 0.05	-
Aldrin	0.05	mg/kg	-	-	< 0.05	-
b-BHC	0.05	mg/kg	-	-	< 0.05	-
d-BHC	0.05	mg/kg	-	-	< 0.05	-
Dieldrin	0.05	mg/kg	-	-	< 0.05	-
Endosulfan I	0.05	mg/kg	-	-	< 0.05	-
Endosulfan II	0.05	mg/kg	-	-	< 0.05	-
Endosulfan sulphate	0.05	mg/kg	-	-	< 0.05	-
Endrin	0.05	mg/kg	-	-	< 0.05	-
Endrin aldehyde	0.05	mg/kg	-	-	< 0.05	-
Endrin ketone	0.05	mg/kg	-	-	< 0.05	-
g-BHC (Lindane)	0.05	mg/kg	-	-	< 0.05	-
Heptachlor	0.05	mg/kg	-	-	< 0.05	-
Heptachlor epoxide	0.05	mg/kg	-	-	< 0.05	-
Hexachlorobenzene	0.05	mg/kg	-	-	< 0.05	-
Methoxychlor	0.05	mg/kg	-	-	< 0.05	-
Toxaphene	1	mg/kg	-	-	< 1	-
Dibutylchlorendate (surr.)	1	%	-	-	106	-
Tetrachloro-m-xylene (surr.)	1	%	-	-	128	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB04_4.5 Soil B14-Oc02572 Sep 30, 2014	HPSB04_5.0 Soil B14-Oc02573 Sep 30, 2014	HPSB05_0.1 Soil B14-Oc02574 Sep 30, 2014	HPSB05_0.5 Soil B14-Oc02575 Sep 30, 2014
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	-	< 0.2	-
Chlorpyrifos	0.2	mg/kg	-	-	< 0.2	-
Demeton-O	0.2	mg/kg	-	-	< 0.2	-
Diazinon	0.2	mg/kg	-	-	< 0.2	-
Dichlorvos	0.2	mg/kg	-	-	< 0.2	-
Disulfoton	0.2	mg/kg	-	-	< 0.2	-
Ethion	0.2	mg/kg	-	-	< 0.2	-
Ethoprop	0.2	mg/kg	-	-	< 0.2	-
Fenitrothion	0.2	mg/kg	-	-	< 0.2	-
Fensulfothion	0.2	mg/kg	-	-	< 0.2	-
Fenthion	0.2	mg/kg	-	-	< 0.2	-
Merphos	0.2	mg/kg	-	-	< 0.2	-
Methyl azinphos	0.2	mg/kg	-	-	< 0.2	-
Methyl parathion	0.2	mg/kg	-	-	< 0.2	-
Mevinphos	0.2	mg/kg	-	-	< 0.2	-
Naled	0.5	mg/kg	-	-	< 0.5	-
Phorate	0.2	mg/kg	-	-	< 0.2	-
Ronnel	0.2	mg/kg	-	-	< 0.2	-
Tokuthion	0.2	mg/kg	-	-	< 0.2	-
Trichloronate	0.2	mg/kg	-	-	< 0.2	-
Triphenylphosphate (surr.)	1	%	-	-	110	-
Heavy Metals						
Arsenic	2	mg/kg	-	-	< 2	-
Cadmium	0.4	mg/kg	-	-	< 0.4	-
Chromium	5	mg/kg	-	-	< 5	-
Copper	5	mg/kg	-	-	< 5	-
Lead	5	mg/kg	-	-	< 5	-
Mercury	0.1	mg/kg	-	-	< 0.1	-
Nickel	5	mg/kg	-	-	< 5	-
Zinc	5	mg/kg	-	-	< 5	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.8	5.9	6.4	6.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	2.3	2.5	3.2	3.6
Reaction Ratings*		comment	Slight	Slight	Slight	Slight
% Moisture	0.1	%	-	-	11	-

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB05_1.0 Soil B14-Oc02576 Sep 30, 2014	HPSB05_1.5 Soil B14-Oc02577 Sep 30, 2014	HPSB05_2.0 Soil B14-Oc02578 Sep 30, 2014	HPSB05_2.5 Soil B14-Oc02579 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.4	5.4	6.0	5.2
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.4	3.8	4.2	4.0
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB05_3.0 Soil B14-Oc02580 Sep 30, 2014	HPSB05_3.5 Soil B14-Oc02581 Sep 30, 2014	HPSB05_4.0 Soil B14-Oc02582 Sep 30, 2014	HPSB05_4.5 Soil B14-Oc02583 Sep 30, 2014
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.5	5.9	7.0	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.8	4.1	4.6	4.0
Reaction Ratings*		comment	Slight	Slight	Slight	Slight

Client Sample ID Sample Matrix Eurofins | mgt Sample No. Date Sampled Test/Reference	LOR	Unit	HPSB05_5.0 Soil B14-Oc02584 Sep 30, 2014	QA01 Soil B14-Oc02585 Sep 30, 2014	QA03 Soil B14-Oc02586 Sep 30, 2014	QA05 Soil B14-Oc02587 Sep 30, 2014
Organochlorine Pesticides						
Chlordanes - Total	0.1	mg/kg	-	< 0.1	-	-
4.4'-DDD	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDE	0.05	mg/kg	-	< 0.05	-	-
4.4'-DDT	0.05	mg/kg	-	< 0.05	-	-
a-BHC	0.05	mg/kg	-	< 0.05	-	-
Aldrin	0.05	mg/kg	-	< 0.05	-	-
b-BHC	0.05	mg/kg	-	< 0.05	-	-
d-BHC	0.05	mg/kg	-	< 0.05	-	-
Dieldrin	0.05	mg/kg	-	< 0.05	-	-
Endosulfan I	0.05	mg/kg	-	< 0.05	-	-
Endosulfan II	0.05	mg/kg	-	< 0.05	-	-
Endosulfan sulphate	0.05	mg/kg	-	< 0.05	-	-
Endrin	0.05	mg/kg	-	< 0.05	-	-
Endrin aldehyde	0.05	mg/kg	-	< 0.05	-	-
Endrin ketone	0.05	mg/kg	-	< 0.05	-	-
g-BHC (Lindane)	0.05	mg/kg	-	< 0.05	-	-
Heptachlor	0.05	mg/kg	-	< 0.05	-	-
Heptachlor epoxide	0.05	mg/kg	-	< 0.05	-	-
Hexachlorobenzene	0.05	mg/kg	-	< 0.05	-	-
Methoxychlor	0.05	mg/kg	-	< 0.05	-	-
Toxaphene	1	mg/kg	-	< 1	-	-
Dibutylchlorendate (surr.)	1	%	-	114	-	-
Tetrachloro-m-xylene (surr.)	1	%	-	133	-	-
Organophosphorous Pesticides						
Bolstar	0.2	mg/kg	-	< 0.2	-	-
Chlorpyrifos	0.2	mg/kg	-	< 0.2	-	-
Demeton-O	0.2	mg/kg	-	< 0.2	-	-
Diazinon	0.2	mg/kg	-	< 0.2	-	-
Dichlorvos	0.2	mg/kg	-	< 0.2	-	-
Disulfoton	0.2	mg/kg	-	< 0.2	-	-
Ethion	0.2	mg/kg	-	< 0.2	-	-
Ethoprop	0.2	mg/kg	-	< 0.2	-	-
Fenitrothion	0.2	mg/kg	-	< 0.2	-	-
Fensulfothion	0.2	mg/kg	-	< 0.2	-	-
Fenthion	0.2	mg/kg	-	< 0.2	-	-
Merphos	0.2	mg/kg	-	< 0.2	-	-
Methyl azinphos	0.2	mg/kg	-	< 0.2	-	-
Methyl parathion	0.2	mg/kg	-	< 0.2	-	-

Client Sample ID			HPSB05_5.0	QA01	QA03	QA05
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02584	B14-Oc02585	B14-Oc02586	B14-Oc02587
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Organophosphorous Pesticides						
Mevinphos	0.2	mg/kg	-	< 0.2	-	-
Naled	0.5	mg/kg	-	< 0.5	-	-
Phorate	0.2	mg/kg	-	< 0.2	-	-
Ronnel	0.2	mg/kg	-	< 0.2	-	-
Tokuthion	0.2	mg/kg	-	< 0.2	-	-
Trichloronate	0.2	mg/kg	-	< 0.2	-	-
Triphenylphosphate (surr.)	1	%	-	116	-	-
Heavy Metals						
Arsenic	2	mg/kg	-	< 2	-	-
Cadmium	0.4	mg/kg	-	< 0.4	-	-
Chromium	5	mg/kg	-	< 5	-	-
Copper	5	mg/kg	-	< 5	-	-
Lead	5	mg/kg	-	< 5	-	-
Mercury	0.1	mg/kg	-	< 0.1	-	-
Nickel	5	mg/kg	-	< 5	-	-
Zinc	5	mg/kg	-	< 5	-	-
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	5.6	-	5.5	6.5
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	4.1	-	3.6	4.2
Reaction Ratings*		comment	Slight	-	Slight	Slight
% Moisture	0.1	%	-	8.7	-	-

Client Sample ID			QA07	QA09	QA11	QA13
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc02588	B14-Oc02589	B14-Oc02590	B14-Oc02591
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Acid Sulfate Soils Field pH Test						
pH-F (Field pH test)*	0.1	pH Units	6.1	5.1	6.1	5.3
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.3	3.5	3.2	3.6
Reaction Ratings*		comment	Slight	Slight	Slight	High

Client Sample ID			QA15
Sample Matrix			Soil
Eurofins | mgt Sample No.			B14-Oc02592
Date Sampled			Sep 30, 2014
Test/Reference	LOR	Unit	
Acid Sulfate Soils Field pH Test			
pH-F (Field pH test)*	0.1	pH Units	5.6
pH-FOX (Field pH Peroxide test)*	0.1	pH Units	3.3
Reaction Ratings*		comment	Slight

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Organochlorine Pesticides	Melbourne	Oct 06, 2014	14 Day
- Method: USEPA 8081 Organochlorine Pesticides			
Organophosphorous Pesticides	Melbourne	Oct 06, 2014	14 Day
- Method: USEPA 8270 Organophoshorus Pesticides			
Metals M8	Melbourne	Oct 06, 2014	28 Day
- Method: USEPA 6010/6020 Heavy Metals & USEPA 7470/71 Mercury			
Acid Sulfate Soils Field pH Test	Brisbane	Oct 07, 2014	7 Day
- Method: Acid Sulphate Soils Guideline Series			
% Moisture	Melbourne	Oct 03, 2014	14 Day
- Method: Method 102 - ANZECC - % Moisture			

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 3, 2014 8:30 AM
Address:	239 Adelaide Terrace	**Report #:**	434212	**Due:**	Oct 9, 2014
	Perth	**Phone:**	08 6222 8222	**Priority:**	3 Day
	WA 6004	**Fax:**	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	HAMMOND PARK SCHOOLS PPP				
Project ID:	61/31027				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**						
HPMB01_0.1	Sep 30, 2014		Soil	B14-Oc02480	X		X	X	X	X
HPMB01_0.5	Sep 30, 2014		Soil	B14-Oc02481	X				X	
HPMB01_1.0	Sep 30, 2014		Soil	B14-Oc02482	X				X	
HPMB01_1.5	Sep 30, 2014		Soil	B14-Oc02483	X				X	
HPMB01_2.0	Sep 30, 2014		Soil	B14-Oc02484	X				X	
HPMB01_2.5	Sep 30, 2014		Soil	B14-Oc02485	X				X	
HPMB01_3.0	Sep 30, 2014		Soil	B14-Oc02486	X				X	
HPMB01_3.5	Sep 30, 2014		Soil	B14-Oc02487	X				X	
HPMB01_4.0	Sep 30, 2014		Soil	B14-Oc02488	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPMB01_4.5	Sep 30, 2014		Soil	B14-Oc02489	X				X	
HPMB01_5.0	Sep 30, 2014		Soil	B14-Oc02490	X				X	
HPMB01_6.0	Sep 30, 2014		Soil	B14-Oc02491	X				X	
HPMB01_7.0	Sep 30, 2014		Soil	B14-Oc02492	X				X	
HPMB01_8.0	Sep 30, 2014		Soil	B14-Oc02493	X				X	
HPMB01_9.0	Sep 30, 2014		Soil	B14-Oc02494	X				X	
HPMB02_0.1	Sep 30, 2014		Soil	B14-Oc02495	X		X	X	X	X
HPMB02_0.5	Sep 30, 2014		Soil	B14-Oc02496	X				X	
HPMB02_1.0	Sep 30, 2014		Soil	B14-Oc02497	X				X	
HPMB02_1.5	Sep 30, 2014		Soil	B14-Oc02498	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPMB02_2.0	Sep 30, 2014		Soil	B14-Oc02499	X				X	
HPMB02_2.5	Sep 30, 2014		Soil	B14-Oc02500	X				X	
HPMB02_3.0	Sep 30, 2014		Soil	B14-Oc02501	X				X	
HPMB02_3.5	Sep 30, 2014		Soil	B14-Oc02502	X				X	
HPMB02_4.0	Sep 30, 2014		Soil	B14-Oc02503	X				X	
HPMB02_4.5	Sep 30, 2014		Soil	B14-Oc02504	X				X	
HPMB02_5.0	Sep 30, 2014		Soil	B14-Oc02505	X				X	
HPMB02_5.5	Sep 30, 2014		Soil	B14-Oc02506	X				X	
HPMB03_0.1	Sep 30, 2014		Soil	B14-Oc02507	X		X	X	X	X
HPMB03_0.5	Sep 30, 2014		Soil	B14-Oc02508	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 3, 2014 8:30 AM
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434212	**Due:**	Oct 9, 2014
		Phone:	08 6222 8222	**Priority:**	3 Day
		Fax:	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	HAMMOND PARK SCHOOLS PPP				
Project ID:	61/31027				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPMB03_1.0	Sep 30, 2014		Soil	B14-Oc02509	X				X	
HPMB03_1.5	Sep 30, 2014		Soil	B14-Oc02510	X				X	
HPMB03_2.0	Sep 30, 2014		Soil	B14-Oc02511	X				X	
HPMB03_2.5	Sep 30, 2014		Soil	B14-Oc02512	X				X	
HPMB03_3.0	Sep 30, 2014		Soil	B14-Oc02513	X				X	
HPMB03_3.5	Sep 30, 2014		Soil	B14-Oc02514	X				X	
HPMB03_4.0	Sep 30, 2014		Soil	B14-Oc02515	X				X	
HPMB03_4.5	Sep 30, 2014		Soil	B14-Oc02516	X				X	
HPMB03_5.0	Sep 30, 2014		Soil	B14-Oc02517	X				X	
HPMB04_0.1	Sep 30, 2014		Soil	B14-Oc02518	X		X	X	X	X

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPMB04_0.5	Sep 30, 2014		Soil	B14-Oc02519	X				X	
HPMB04_1.0	Sep 30, 2014		Soil	B14-Oc02520	X				X	
HPMB04_1.5	Sep 30, 2014		Soil	B14-Oc02521	X				X	
HPMB04_2.0	Sep 30, 2014		Soil	B14-Oc02522	X				X	
HPMB04_2.5	Sep 30, 2014		Soil	B14-Oc02523	X				X	
HPMB04_3.0	Sep 30, 2014		Soil	B14-Oc02524	X				X	
HPMB04_3.5	Sep 30, 2014		Soil	B14-Oc02525	X				X	
HPMB04_4.0	Sep 30, 2014		Soil	B14-Oc02526	X				X	
HPMB04_4.5	Sep 30, 2014		Soil	B14-Oc02527	X				X	
HPMB04_5.0	Sep 30, 2014		Soil	B14-Oc02528	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434212
		Phone:	08 6222 8222
		Fax:	08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPMB04_5.5	Sep 30, 2014		Soil	B14-Oc02529	X				X	
HPSB01_0.1	Sep 30, 2014		Soil	B14-Oc02530	X		X	X	X	X
HPSB01_0.5	Sep 30, 2014		Soil	B14-Oc02531	X				X	
HPSB01_1.0	Sep 30, 2014		Soil	B14-Oc02532	X				X	
HPSB01_1.5	Sep 30, 2014		Soil	B14-Oc02533	X				X	
HPSB01_2.0	Sep 30, 2014		Soil	B14-Oc02534	X				X	
HPSB01_2.5	Sep 30, 2014		Soil	B14-Oc02535	X				X	
HPSB01_3.0	Sep 30, 2014		Soil	B14-Oc02536	X				X	
HPSB01_3.5	Sep 30, 2014		Soil	B14-Oc02537	X				X	
HPSB01_4.0	Sep 30, 2014		Soil	B14-Oc02538	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPSB01_4.5	Sep 30, 2014		Soil	B14-Oc02539	X				X	
HPSB01_5.0	Sep 30, 2014		Soil	B14-Oc02540	X				X	
HPSB02_0.1	Sep 30, 2014		Soil	B14-Oc02541	X		X	X	X	X
HPSB02_0.5	Sep 30, 2014		Soil	B14-Oc02542	X				X	
HPSB02_1.0	Sep 30, 2014		Soil	B14-Oc02543	X				X	
HPSB02_1.5	Sep 30, 2014		Soil	B14-Oc02544	X				X	
HPSB02_2.0	Sep 30, 2014		Soil	B14-Oc02545	X				X	
HPSB02_2.5	Sep 30, 2014		Soil	B14-Oc02546	X				X	
HPSB02_3.0	Sep 30, 2014		Soil	B14-Oc02547	X				X	
HPSB02_3.5	Sep 30, 2014		Soil	B14-Oc02548	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPSB02_4.0	Sep 30, 2014		Soil	B14-Oc02549	X				X	
HPSB02_4.5	Sep 30, 2014		Soil	B14-Oc02550	X				X	
HPSB02_5.0	Sep 30, 2014		Soil	B14-Oc02551	X				X	
HPSB03_0.1	Sep 30, 2014		Soil	B14-Oc02552	X		X	X	X	X
HPSB03_0.5	Sep 30, 2014		Soil	B14-Oc02553	X				X	
HPSB03_1.0	Sep 30, 2014		Soil	B14-Oc02554	X				X	
HPSB03_1.5	Sep 30, 2014		Soil	B14-Oc02555	X				X	
HPSB03_2.0	Sep 30, 2014		Soil	B14-Oc02556	X				X	
HPSB03_2.5	Sep 30, 2014		Soil	B14-Oc02557	X				X	
HPSB03_3.0	Sep 30, 2014		Soil	B14-Oc02558	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPSB03_3.5	Sep 30, 2014		Soil	B14-Oc02559	X				X	
HPSB03_4.0	Sep 30, 2014		Soil	B14-Oc02560	X				X	
HPSB03_4.5	Sep 30, 2014		Soil	B14-Oc02561	X				X	
HPSB03_5.0	Sep 30, 2014		Soil	B14-Oc02562	X				X	
HPSB04_0.1	Sep 30, 2014		Soil	B14-Oc02563	X		X	X	X	X
HPSB04_0.5	Sep 30, 2014		Soil	B14-Oc02564	X				X	
HPSB04_1.0	Sep 30, 2014		Soil	B14-Oc02565	X				X	
HPSB04_1.5	Sep 30, 2014		Soil	B14-Oc02566	X				X	
HPSB04_2.0	Sep 30, 2014		Soil	B14-Oc02567	X				X	
HPSB04_2.5	Sep 30, 2014		Soil	B14-Oc02568	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM	
Due:	Oct 9, 2014	
Priority:	3 Day	
Contact Name:	Joanna Stegena	

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPSB04_3.0	Sep 30, 2014		Soil	B14-Oc02569	X				X	
HPSB04_3.5	Sep 30, 2014		Soil	B14-Oc02570	X				X	
HPSB04_4.0	Sep 30, 2014		Soil	B14-Oc02571	X				X	
HPSB04_4.5	Sep 30, 2014		Soil	B14-Oc02572	X				X	
HPSB04_5.0	Sep 30, 2014		Soil	B14-Oc02573	X				X	
HPSB05_0.1	Sep 30, 2014		Soil	B14-Oc02574	X		X	X	X	X
HPSB05_0.5	Sep 30, 2014		Soil	B14-Oc02575	X				X	
HPSB05_1.0	Sep 30, 2014		Soil	B14-Oc02576	X				X	
HPSB05_1.5	Sep 30, 2014		Soil	B14-Oc02577	X				X	
HPSB05_2.0	Sep 30, 2014		Soil	B14-Oc02578	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM
Due:	Oct 9, 2014
Priority:	3 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
HPSB05_2.5	Sep 30, 2014		Soil	B14-Oc02579	X				X	
HPSB05_3.0	Sep 30, 2014		Soil	B14-Oc02580	X				X	
HPSB05_3.5	Sep 30, 2014		Soil	B14-Oc02581	X				X	
HPSB05_4.0	Sep 30, 2014		Soil	B14-Oc02582	X				X	
HPSB05_4.5	Sep 30, 2014		Soil	B14-Oc02583	X				X	
HPSB05_5.0	Sep 30, 2014		Soil	B14-Oc02584	X				X	
QA01	Sep 30, 2014		Soil	B14-Oc02585	X		X	X		X
QA03	Sep 30, 2014		Soil	B14-Oc02586	X				X	
QA05	Sep 30, 2014		Soil	B14-Oc02587	X				X	
QA07	Sep 30, 2014		Soil	B14-Oc02588	X				X	

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434212 08 6222 8222 08 9429 6555
Project Name:	HAMMOND PARK SCHOOLS PPP		
Project ID:	61/31027		

Received:	Oct 3, 2014 8:30 AM	
Due:	Oct 9, 2014	
Priority:	3 Day	
Contact Name:	Joanna Stegena	

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	HOLD	Organochlorine Pesticides	Organophosphorous Pesticides	Acid Sulfate Soils Field pH Test	Metals M8
Laboratory where analysis is conducted										
Melbourne Laboratory - NATA Site # 1254 & 14271							X	X		X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794					X	X			X	
External Laboratory										
QA09	Sep 30, 2014		Soil	B14-Oc02589	X				X	
QA11	Sep 30, 2014		Soil	B14-Oc02590	X				X	
QA13	Sep 30, 2014		Soil	B14-Oc02591	X				X	
QA15	Sep 30, 2014		Soil	B14-Oc02592	X				X	
QA08	Sep 30, 2014		Soil	B14-Oc02593		X				
QA07	Sep 30, 2014		Soil	B14-Oc02634		X				

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Organochlorine Pesticides							
Chlordanes - Total	mg/kg	< 0.1			0.1	Pass	
4.4'-DDD	mg/kg	< 0.05			0.05	Pass	
4.4'-DDE	mg/kg	< 0.05			0.05	Pass	
4.4'-DDT	mg/kg	< 0.05			0.05	Pass	
a-BHC	mg/kg	< 0.05			0.05	Pass	
Aldrin	mg/kg	< 0.05			0.05	Pass	
b-BHC	mg/kg	< 0.05			0.05	Pass	
d-BHC	mg/kg	< 0.05			0.05	Pass	
Dieldrin	mg/kg	< 0.05			0.05	Pass	
Endosulfan I	mg/kg	< 0.05			0.05	Pass	
Endosulfan II	mg/kg	< 0.05			0.05	Pass	
Endosulfan sulphate	mg/kg	< 0.05			0.05	Pass	
Endrin	mg/kg	< 0.05			0.05	Pass	
Endrin aldehyde	mg/kg	< 0.05			0.05	Pass	
Endrin ketone	mg/kg	< 0.05			0.05	Pass	
g-BHC (Lindane)	mg/kg	< 0.05			0.05	Pass	
Heptachlor	mg/kg	< 0.05			0.05	Pass	
Heptachlor epoxide	mg/kg	< 0.05			0.05	Pass	
Hexachlorobenzene	mg/kg	< 0.05			0.05	Pass	
Methoxychlor	mg/kg	< 0.05			0.05	Pass	
Toxaphene	mg/kg	< 1			1	Pass	
Method Blank							
Organophosphorous Pesticides							
Bolstar	mg/kg	< 0.2			0.2	Pass	
Chlorpyrifos	mg/kg	< 0.2			0.2	Pass	
Demeton-O	mg/kg	< 0.2			0.2	Pass	
Diazinon	mg/kg	< 0.2			0.2	Pass	
Dichlorvos	mg/kg	< 0.2			0.2	Pass	
Disulfoton	mg/kg	< 0.2			0.2	Pass	
Ethion	mg/kg	< 0.2			0.2	Pass	
Ethoprop	mg/kg	< 0.2			0.2	Pass	
Fenitrothion	mg/kg	< 0.2			0.2	Pass	
Fensulfothion	mg/kg	< 0.2			0.2	Pass	
Fenthion	mg/kg	< 0.2			0.2	Pass	
Merphos	mg/kg	< 0.2			0.2	Pass	
Methyl azinphos	mg/kg	< 0.2			0.2	Pass	
Methyl parathion	mg/kg	< 0.2			0.2	Pass	
Mevinphos	mg/kg	< 0.2			0.2	Pass	
Naled	mg/kg	< 0.5			0.5	Pass	
Phorate	mg/kg	< 0.2			0.2	Pass	
Ronnel	mg/kg	< 0.2			0.2	Pass	
Tokuthion	mg/kg	< 0.2			0.2	Pass	
Trichloronate	mg/kg	< 0.2			0.2	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/kg	< 2			2	Pass	
Cadmium	mg/kg	< 0.4			0.4	Pass	
Chromium	mg/kg	< 5			5	Pass	
Copper	mg/kg	< 5			5	Pass	
Lead	mg/kg	< 5			5	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Mercury	mg/kg	< 0.1			0.1	Pass	
Nickel	mg/kg	< 5			5	Pass	
Zinc	mg/kg	< 5			5	Pass	
LCS - % Recovery							
Organochlorine Pesticides							
4.4'-DDD	%	125			70-130	Pass	
4.4'-DDE	%	113			70-130	Pass	
4.4'-DDT	%	100			70-130	Pass	
a-BHC	%	96			70-130	Pass	
Aldrin	%	100			70-130	Pass	
b-BHC	%	87			70-130	Pass	
d-BHC	%	103			70-130	Pass	
Dieldrin	%	99			70-130	Pass	
Endosulfan I	%	99			70-130	Pass	
Endosulfan II	%	114			70-130	Pass	
Endosulfan sulphate	%	115			70-130	Pass	
Endrin	%	99			70-130	Pass	
Endrin aldehyde	%	115			70-130	Pass	
Endrin ketone	%	127			70-130	Pass	
g-BHC (Lindane)	%	97			70-130	Pass	
Heptachlor	%	99			70-130	Pass	
Heptachlor epoxide	%	99			70-130	Pass	
Hexachlorobenzene	%	88			70-130	Pass	
Methoxychlor	%	117			70-130	Pass	
LCS - % Recovery							
Organophosphorous Pesticides							
Diazinon	%	126			70-130	Pass	
Ethion	%	130			70-130	Pass	
Fenitrothion	%	114			70-130	Pass	
Methyl parathion	%	97			70-130	Pass	
Mevinphos	%	92			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	82			80-120	Pass	
Cadmium	%	101			80-120	Pass	
Chromium	%	104			80-120	Pass	
Copper	%	104			80-120	Pass	
Lead	%	106			80-120	Pass	
Mercury	%	90			75-125	Pass	
Nickel	%	103			80-120	Pass	
Zinc	%	103			80-120	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Organochlorine Pesticides				Result 1					
4.4'-DDD	M14-Oc03559	NCP	%	109			70-130	Pass	
4.4'-DDE	M14-Oc03559	NCP	%	103			70-130	Pass	
4.4'-DDT	M14-Oc04251	NCP	%	77			70-130	Pass	
a-BHC	M14-Oc03559	NCP	%	93			70-130	Pass	
Aldrin	M14-Oc03559	NCP	%	100			70-130	Pass	
b-BHC	M14-Oc03559	NCP	%	93			70-130	Pass	
d-BHC	M14-Oc03559	NCP	%	99			70-130	Pass	
Dieldrin	M14-Oc03559	NCP	%	102			70-130	Pass	
Endosulfan I	M14-Oc03559	NCP	%	119			70-130	Pass	
Endosulfan II	M14-Oc03559	NCP	%	104			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Endosulfan sulphate	M14-Oc03559	NCP	%	103			70-130	Pass	
Endrin	M14-Oc03559	NCP	%	90			70-130	Pass	
Endrin aldehyde	M14-Oc03559	NCP	%	106			70-130	Pass	
Endrin ketone	M14-Oc03559	NCP	%	121			70-130	Pass	
g-BHC (Lindane)	M14-Oc03559	NCP	%	93			70-130	Pass	
Heptachlor	M14-Oc03559	NCP	%	97			70-130	Pass	
Heptachlor epoxide	M14-Oc03559	NCP	%	98			70-130	Pass	
Hexachlorobenzene	M14-Oc03559	NCP	%	96			70-130	Pass	
Methoxychlor	M14-Oc03559	NCP	%	92			70-130	Pass	
Spike - % Recovery									
Organophosphorous Pesticides				Result 1					
Diazinon	M14-Oc02985	NCP	%	79			70-130	Pass	
Ethion	M14-Oc02985	NCP	%	104			70-130	Pass	
Fenitrothion	M14-Oc02985	NCP	%	85			70-130	Pass	
Methyl parathion	M14-Oc02985	NCP	%	71			70-130	Pass	
Mevinphos	M14-Oc02985	NCP	%	92			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	S14-Oc02405	NCP	%	87			75-125	Pass	
Cadmium	M14-Oc01388	NCP	%	86			75-125	Pass	
Chromium	M14-Oc01388	NCP	%	76			75-125	Pass	
Copper	M14-Oc01388	NCP	%	103			75-125	Pass	
Lead	M14-Oc00939	NCP	%	79			75-125	Pass	
Mercury	M14-Oc02105	NCP	%	90			70-130	Pass	
Nickel	M14-Oc01388	NCP	%	79			75-125	Pass	
Zinc	S14-Oc02405	NCP	%	94			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Organochlorine Pesticides				Result 1	Result 2	RPD			
Chlordanes - Total	A14-Oc03064	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
4.4'-DDD	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDE	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
4.4'-DDT	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
a-BHC	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Aldrin	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
b-BHC	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
d-BHC	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Dieldrin	A14-Oc03064	NCP	mg/kg	0.090	< 0.05	91	30%	Fail	Q15
Endosulfan I	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan II	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endosulfan sulphate	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin aldehyde	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Endrin ketone	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
g-BHC (Lindane)	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Heptachlor epoxide	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Hexachlorobenzene	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Methoxychlor	A14-Oc03064	NCP	mg/kg	< 0.05	< 0.05	<1	30%	Pass	
Toxaphene	A14-Oc03064	NCP	mg/kg	< 1	< 1	<1	30%	Pass	

Duplicate									
Organophosphorous Pesticides				Result 1	Result 2	RPD			
Bolstar	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Chlorpyrifos	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Demeton-O	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Diazinon	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Dichlorvos	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Disulfoton	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Ethion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Ethoprop	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Fenitrothion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Fensulfothion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Fenthion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Merphos	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Methyl azinphos	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Methyl parathion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Mevinphos	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Naled	M14-Oc02980	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phorate	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Ronnel	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Tokuthion	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Trichloronate	M14-Oc02980	NCP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M14-Oc03907	NCP	mg/kg	< 2	< 2	<1	30%	Pass	
Cadmium	M14-Oc03907	NCP	mg/kg	15	18	18	30%	Pass	
Chromium	M14-Oc01388	NCP	mg/kg	21	20	4.0	30%	Pass	
Copper	M14-Oc01388	NCP	mg/kg	41	40	1.0	30%	Pass	
Lead	M14-Oc01388	NCP	mg/kg	120	120	2.0	30%	Pass	
Mercury	M14-Oc02104	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M14-Oc01388	NCP	mg/kg	28	27	2.0	30%	Pass	
Zinc	M14-Oc01388	NCP	mg/kg	22	22	2.0	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02482	CP	pH Units	8.0	8.0	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02482	CP	pH Units	5.4	5.3	pass	30%	Pass	
Reaction Ratings*	B14-Oc02482	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02492	CP	pH Units	7.1	7.1	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02492	CP	pH Units	5.0	5.0	pass	30%	Pass	
Reaction Ratings*	B14-Oc02492	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02502	CP	pH Units	5.2	5.2	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02502	CP	pH Units	3.3	3.3	pass	30%	Pass	
Reaction Ratings*	B14-Oc02502	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02512	CP	pH Units	5.0	5.0	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02512	CP	pH Units	3.2	3.1	pass	30%	Pass	
Reaction Ratings*	B14-Oc02512	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02522	CP	pH Units	5.4	5.4	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02522	CP	pH Units	3.4	3.5	pass	30%	Pass	
Reaction Ratings*	B14-Oc02522	CP	comment	Slight	Slight	pass	30%	Pass	

Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02532	CP	pH Units	6.5	6.5	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02532	CP	pH Units	4.3	4.2	pass	30%	Pass	
Reaction Ratings*	B14-Oc02532	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02542	CP	pH Units	7.0	7.1	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02542	CP	pH Units	4.6	4.6	pass	30%	Pass	
Reaction Ratings*	B14-Oc02542	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02552	CP	pH Units	6.3	6.3	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02552	CP	pH Units	3.4	3.4	pass	30%	Pass	
Reaction Ratings*	B14-Oc02552	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02562	CP	pH Units	6.2	6.3	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02562	CP	pH Units	2.8	2.8	pass	30%	Pass	
Reaction Ratings*	B14-Oc02562	CP	comment	High	High	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02572	CP	pH Units	5.8	5.8	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02572	CP	pH Units	2.3	2.3	pass	30%	Pass	
Reaction Ratings*	B14-Oc02572	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02582	CP	pH Units	7.0	7.1	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02582	CP	pH Units	4.6	4.7	pass	30%	Pass	
Reaction Ratings*	B14-Oc02582	CP	comment	Slight	Slight	pass	30%	Pass	
Duplicate									
Acid Sulfate Soils Field pH Test				Result 1	Result 2	RPD			
pH-F (Field pH test)*	B14-Oc02592	CP	pH Units	5.6	5.5	pass	30%	Pass	
pH-FOX (Field pH Peroxide test)*	B14-Oc02592	CP	pH Units	3.3	3.2	pass	30%	Pass	
Reaction Ratings*	B14-Oc02592	CP	comment	Slight	Slight	pass	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins | mgt's Acceptance Criteria as stipulated in SOP 05. Refer to Glossary Page of this report for further details

Authorised By

Natalie Krasselt	Client Services
Carroll Lee	Senior Analyst-Organic (VIC)
Emily Rosenberg	Senior Analyst-Metal (VIC)
Huong Le	Senior Analyst-Inorganic (VIC)
Richard Corner	Senior Analyst-Inorganic (QLD)

Glenn Jackson
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS | PEOPLE | PERFORMANCE

GHD: GHD House
239 Adelaide Terrace
Perth WA 6004
T 6222 8222

Project Hammond Park
Client Department of Finance
Job Manager Carolina Arias
Invoicing: Carolina.Arias@ghd.com

Job Number: 61/3102705
E-mail Address (Results): david.morgan@ghd.com
Turnaround: Normal

Lab: Eurofins
5/91 Leach Hwy, Kewdale 6105
Phone: 9251 9600

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analytes: ASS R15 - (Groundwater)	Analytes: OCP / OPP Pesticides	Analytes: HOLD	Comments: Standard GHD Rates
MB01		7/10/2014		Water	5 x bottle	✓		✓	Samples on ice immediately. Please call David with any issues - 0403 872 686 or 6222 8133
MB02		7/10/2014		Water	5 x bottle	✓		✓	
MB03		7/10/2014		Water	5 x bottle	✓		✓	
MB04		7/10/2014		Water	5 x bottle	✓		✓	SAME DAY TAT I.E. 09/10/14
QA01		7/10/2014		Water	5 x bottle	✓		✓	

Sampled By: David Morgan
Date: 7/10/2014
Time:

Relinquished by: David Morgan
Date: 8/10/2014
Time: 11am

Received by: Catherine Ef/mgt
Date: 9/10
Time: 8:59 am

434773

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Sample Receipt Advice

Company name:	**GHD Pty Ltd WA**
Contact name:	Carolina Arias
Project name:	DEPARTMENT OF FINANCE
Project ID:	61/3102705
COC number:	Not provided
Turn around time:	Same day
Date/Time received:	Oct 9, 2014 8:59 AM
Eurofins | mgt reference:	**434773**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☑ Sample containers for volatile analysis received with zero headspace.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Notes

Samples selected for HOLD & Testing in the COC. Samples logged in for testing. Please advise if need to change.

Contact notes

If you have any questions with respect to these samples please contact:

Natalie Krasselt on Phone : (+61) (3) 8564 5000 or by e.mail: NatalieKrasselt@eurofins.com.au

Results will be delivered electronically via e.mail to Carolina Arias - Carolina.Arias@ghd.com.

Eurofins | mgt Sample Receipt

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 8:59 AM
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434773	**Due:**	Oct 9, 2014
		Phone:	08 6222 8222	**Priority:**	Same day
		Fax:	08 9429 6555	**Contact Name:**	Carolina Arias
Project Name:	DEPARTMENT OF FINANCE				
Project ID:	61/3102705				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					ASS Groundwater Quality Suite - WA Department of Environment and
Laboratory where analysis is conducted					
Melbourne Laboratory - NATA Site # 1254 & 14271					X
Sydney Laboratory - NATA Site # 18217					
Brisbane Laboratory - NATA Site # 20794					
External Laboratory					
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**	
MB01	Oct 07, 2014		Water	M14-Oc06224	X
MB02	Oct 07, 2014		Water	M14-Oc06225	X
MB03	Oct 07, 2014		Water	M14-Oc06226	X
MB04	Oct 07, 2014		Water	M14-Oc06227	X
QA01	Oct 07, 2014		Water	M14-Oc06228	X

eurofins | mgt

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd WA
239 Adelaide Terrace
Perth
WA 6004

Attention: **Carolina Arias**

Report **434773-W**
Project name DEPARTMENT OF FINANCE
Project ID 61/3102705
Received Date Oct 09, 2014

Client Sample ID **Sample Matrix** **Eurofins | mgt Sample No.** **Date Sampled** Test/Reference	LOR	Unit	**MB01** **Water** **M14-Oc06224** **Oct 07, 2014**	**MB02** **Water** **M14-Oc06225** **Oct 07, 2014**	**MB03** **Water** **M14-Oc06226** **Oct 07, 2014**	**MB04** **Water** **M14-Oc06227** **Oct 07, 2014**
Acidity (as CaCO3)	10	mg/L	43	100	110	190
Ammonia (as N)	0.01	mg/L	0.04	0.43	0.31	0.08
Chloride	1	mg/L	83	150	110	480
Conductivity (at 25°C)	10	uS/cm	390	590	610	2100
pH	0.1	pH Units	5.8	5.4	5.3	4.9
Phosphorus filterable reactive (as P)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Sulphate (as S)	5	mg/L	14	11	25	72
Total Dissolved Solids	10	mg/L	220	400	420	1500
Phosphorus	0.5	mg/L	< 0.5	< 0.5	< 0.5	< 0.5
Alkalinity						
Total Alkalinity (as CaCO3)	20	mg/L	< 20	< 20	< 20	< 20
Total Nitrogen Set (as N)						
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	0.09	< 0.05	< 0.05
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	0.4	1.3	1.4	2.8
Total Nitrogen (as N)	0.2	mg/L	0.4	1.4	1.4	2.8
Heavy Metals						
Aluminium	0.05	mg/L	0.35	7.4	0.26	7.2
Aluminium (filtered)	0.05	mg/L	0.10	1.0	0.26	4.8
Arsenic (filtered)	0.001	mg/L	< 0.001	0.002	< 0.001	0.003
Cadmium (filtered)	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium (filtered)	0.001	mg/L	< 0.001	0.001	0.003	0.028
Iron	0.05	mg/L	0.52	1.4	0.64	34
Iron (filtered)	0.05	mg/L	0.43	1.3	0.64	34
Manganese (filtered)	0.005	mg/L	< 0.005	0.016	< 0.005	0.012
Nickel (filtered)	0.001	mg/L	0.002	0.001	0.004	0.004
Selenium (filtered)	0.001	mg/L	< 0.001	0.013	0.032	0.033
Zinc (filtered)	0.001	mg/L	0.038	0.005	0.002	0.002
Alkali Metals						
Sodium	0.5	mg/L	43	72	56	290

Client Sample ID			QA01
Sample Matrix			Water
Eurofins | mgt Sample No.			M14-Oc06228
Date Sampled			Oct 07, 2014
Test/Reference	LOR	Unit	
Acidity (as CaCO3)	10	mg/L	43
Ammonia (as N)	0.01	mg/L	0.05
Chloride	1	mg/L	82
Conductivity (at 25°C)	10	uS/cm	390
pH	0.1	pH Units	5.8
Phosphorus filterable reactive (as P)	0.05	mg/L	< 0.05
Sulphate (as S)	5	mg/L	13
Total Dissolved Solids	10	mg/L	230
Phosphorus	0.5	mg/L	< 0.5
Alkalinity			
Total Alkalinity (as CaCO3)	20	mg/L	< 20
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	0.7
Total Nitrogen (as N)	0.2	mg/L	0.7
Heavy Metals			
Aluminium	0.05	mg/L	0.35
Aluminium (filtered)	0.05	mg/L	0.11
Arsenic (filtered)	0.001	mg/L	< 0.001
Cadmium (filtered)	0.0002	mg/L	< 0.0002
Chromium (filtered)	0.001	mg/L	< 0.001
Iron	0.05	mg/L	0.52
Iron (filtered)	0.05	mg/L	0.43
Manganese (filtered)	0.005	mg/L	< 0.005
Nickel (filtered)	0.001	mg/L	0.002
Selenium (filtered)	0.001	mg/L	0.001
Zinc (filtered)	0.001	mg/L	0.040
Alkali Metals			
Sodium	0.5	mg/L	40

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
ASS Groundwater Quality Suite - WA Department of Environment and Conservation			
Acidity (as CaCO3)	Melbourne	Oct 09, 2014	14 Day
- Method: APHA 2310 Acidity			
Ammonia (as N)	Melbourne	Oct 09, 2014	28 Day
- Method: APHA 4500-NH3 Ammonia Nitrogen by FIA			
Chloride	Melbourne	Oct 09, 2014	28 Day
- Method: MGT 1100A			
Conductivity (at 25°C)	Melbourne	Oct 09, 2014	28 Day
- Method: APHA 2510 Conductivity by Direct Measurement			
pH	Melbourne	Oct 09, 2014	0 Hours
- Method: APHA 4500 pH by Direct Measurement - ** Samples analysed outside holding time. Analysis should be performed in situ. Results for reference only.			
Phosphorus filterable reactive (as P)	Melbourne	Oct 09, 2014	2 Day
- Method: APHA 4500-P Phosphate (filterable reactive)			
Sulphate (as S)	Melbourne	Oct 09, 2014	28 Day
- Method: In house MGT1110A (SO4 by Discrete Analyser)			
Total Dissolved Solids	Melbourne	Oct 09, 2014	7 Day
- Method: APHA 2540C Total Dissolved Solids			
Phosphorus	Melbourne	Oct 09, 2014	180 Day
- Method: USEPA 6010			
Alkalinity	Melbourne	Oct 09, 2014	14 Day
- Method: APHA 2320 Alkalinity by Titration			
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	Melbourne	Oct 09, 2014	28 Day
- Method: APHA 4500-NO3/NO2 Nitrate-Nitrite Nitrogen by FIA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Oct 09, 2014	7 Day
- Method: APHA 4500 TKN			
Heavy Metals	Melbourne	Oct 09, 2014	180 Day
- Method: USEPA 6010/6020 Heavy Metals			
Acid Sulphate Metals : Metals M9 filtered	Melbourne	Oct 09, 2014	180 Day
- Method: USEPA 6010/6020 Heavy Metals			
Alkali Metals	Melbourne	Oct 09, 2014	180 Day
- Method: USEPA 6010 Alkali Metals			

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 8:59 AM
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434773	**Due:**	Oct 9, 2014
		Phone:	08 6222 8222	**Priority:**	Same day
		Fax:	08 9429 6555	**Contact Name:**	Carolina Arias
Project Name:	DEPARTMENT OF FINANCE				
Project ID:	61/3102705				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					ASS Groundwater Quality Suite - WA Department of Environment and
Laboratory where analysis is conducted					
Melbourne Laboratory - NATA Site # 1254 & 14271					X
Sydney Laboratory - NATA Site # 18217					
Brisbane Laboratory - NATA Site # 20794					
External Laboratory					
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**	
MB01	Oct 07, 2014		Water	M14-Oc06224	X
MB02	Oct 07, 2014		Water	M14-Oc06225	X
MB03	Oct 07, 2014		Water	M14-Oc06226	X
MB04	Oct 07, 2014		Water	M14-Oc06227	X
QA01	Oct 07, 2014		Water	M14-Oc06228	X

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

eurofins | mgt

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Acidity (as CaCO3)	mg/L	< 10			10	Pass	
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Chloride	mg/L	< 1			1	Pass	
Phosphorus filterable reactive (as P)	mg/L	< 0.05			0.05	Pass	
Sulphate (as S)	mg/L	< 5			5	Pass	
Phosphorus	mg/L	< 0.5			0.5	Pass	
Method Blank							
Total Nitrogen Set (as N)							
Nitrate & Nitrite (as N)	mg/L	< 0.05			0.05	Pass	
Method Blank							
Heavy Metals							
Aluminium	mg/L	< 0.05			0.05	Pass	
Aluminium (filtered)	mg/L	< 0.05			0.05	Pass	
Arsenic (filtered)	mg/L	< 0.001			0.001	Pass	
Cadmium (filtered)	mg/L	< 0.0002			0.0002	Pass	
Chromium (filtered)	mg/L	< 0.001			0.001	Pass	
Iron	mg/L	< 0.05			0.05	Pass	
Iron (filtered)	mg/L	< 0.05			0.05	Pass	
Manganese (filtered)	mg/L	< 0.005			0.005	Pass	
Nickel (filtered)	mg/L	< 0.001			0.001	Pass	
Selenium (filtered)	mg/L	< 0.001			0.001	Pass	
Zinc (filtered)	mg/L	< 0.001			0.001	Pass	
Method Blank							
Alkali Metals							
Sodium	mg/L	< 0.5			0.5	Pass	
LCS - % Recovery							
Acidity (as CaCO3)	%	106			70-130	Pass	
Ammonia (as N)	%	90			70-130	Pass	
Chloride	%	109			70-130	Pass	
Sulphate (as S)	%	105			70-130	Pass	
Phosphorus	%	99			70-130	Pass	
LCS - % Recovery							
Total Nitrogen Set (as N)							
Nitrate & Nitrite (as N)	%	96			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Aluminium (filtered)	%	109			80-120	Pass	
Arsenic (filtered)	%	99			80-120	Pass	
Cadmium (filtered)	%	98			80-120	Pass	
Chromium (filtered)	%	98			80-120	Pass	
Iron (filtered)	%	99			80-120	Pass	
Manganese (filtered)	%	99			80-120	Pass	
Nickel (filtered)	%	99			80-120	Pass	
Selenium (filtered)	%	94			80-120	Pass	
Zinc (filtered)	%	92			80-120	Pass	
LCS - % Recovery							
Alkali Metals							
Sodium	%	100			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M14-Oc05565	NCP	%	87			70-130	Pass	
Phosphorus filterable reactive (as P)	M14-Oc06224	CP	%	109			70-130	Pass	
Sulphate (as S)	M14-Oc06224	CP	%	105			70-130	Pass	
Phosphorus	M14-Oc06224	CP	%	89			70-130	Pass	
Spike - % Recovery									
Total Nitrogen Set (as N)				Result 1					
Nitrate & Nitrite (as N)	M14-Oc05570	NCP	%	94			70-130	Pass	
Spike - % Recovery									
Alkali Metals				Result 1					
Sodium	M14-Oc06224	CP	%	89			70-130	Pass	
Spike - % Recovery									
				Result 1					
Chloride	M14-Oc06228	CP	%	114			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
Acidity (as CaCO3)	M14-Oc06224	CP	mg/L	43	43	1.0	30%	Pass	
Ammonia (as N)	M14-Oc05565	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Chloride	M14-Oc06224	CP	mg/L	83	82	1.1	30%	Pass	
Conductivity (at 25°C)	M14-Oc05953	NCP	uS/cm	690	700	2.0	30%	Pass	
pH	M14-Oc06224	CP	pH Units	5.8	5.9	pass	30%	Pass	
Phosphorus filterable reactive (as P)	M14-Oc06224	CP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Sulphate (as S)	M14-Oc06224	CP	mg/L	14	12	14	30%	Pass	
Phosphorus	M14-Oc06224	CP	mg/L	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
Alkalinity				Result 1	Result 2	RPD			
Total Alkalinity (as CaCO3)	M14-Oc06224	CP	mg/L	< 20	< 20	<1	30%	Pass	
Duplicate									
Total Nitrogen Set (as N)				Result 1	Result 2	RPD			
Nitrate & Nitrite (as N)	M14-Oc05570	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Aluminium	M14-Oc06224	CP	mg/L	0.35	0.30	16	30%	Pass	
Iron	M14-Oc06224	CP	mg/L	0.52	0.45	13	30%	Pass	
Duplicate									
Alkali Metals				Result 1	Result 2	RPD			
Sodium	M14-Oc06224	CP	mg/L	43	43	1.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Total Dissolved Solids	M14-Oc06227	CP	mg/L	1500	1400	3.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Natalie Krasselt	Client Services
Emily Rosenberg	Senior Analyst-Metal (VIC)
Huong Le	Senior Analyst-Inorganic (VIC)

Glenn Jackson
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

CLIENTS PEOPLE PERFORMANCE

GHD House 239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 6222 8222 F 6222 8555

Project: West Byford - Schools PPP
Client: Department of Finance
Job Manager: Carolina Arias (Carolina.Arias@ghd.com)
Invoicing:

Job Number: 61/31027/05
E-mail Address (Results): Joanna.Stegena@ghd.com
Turnaround: Same Day

Laboratory: MGT
Address: 5/91 Leach Highway, Kewdale WA 6105

GHD Sample ID	Previous Laboratory Sample ID	Previous Laboratory Report Number	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: CRS Suite			Comments
MB01 0.5	B14-Oc02481	434212		30/09/2014		Soil	Bag	✓			
MB01 1.5	B14-Oc02483	434212		30/09/2014		Soil	Bag	✓			
MB01 3	B14-Oc02486	434212		30/09/2014		Soil	Bag	✓			
MB01 8	B14-Oc02493	434212		30/09/2014		Soil	Bag	✓			
MB02 1	B14-Oc02497	434212		30/09/2014		Soil	Bag	✓			
MB02 2	B14-Oc02499	434212		30/09/2014		Soil	Bag	✓			
MB02 2.5	B14-Oc02500	434212		30/09/2014		Soil	Bag	✓			
MB02 4	B14-Oc02503	434212		30/09/2014		Soil	Bag	✓			
MB03 1	B14-Oc02509	434212		30/09/2014		Soil	Bag	✓			
MB03 3.5	B14-Oc02514	434212		30/09/2014		Soil	Bag	✓			
MB04 1	B14-Oc02520	434212		30/09/2014		Soil	Bag	✓			
MB04 2.5	B14-Oc02523	434212		30/09/2014		Soil	Bag	✓			
MB04 3	B14-Oc02524	434212		30/09/2014		Soil	Bag	✓			
MB04 5.5	B14-Oc02529	434212		30/09/2014		Soil	Bag	✓			
SB01 0.5	B14-Oc02531	434212		30/09/2014		Soil	Bag	✓			
SB01 2	B14-Oc02534	434212		30/09/2014		Soil	Bag	✓			
SB01 3.5	B14-Oc02537	434212		30/09/2014		Soil	Bag	✓			
SB02 0.5	B14-Oc02542	434212		30/09/2014		Soil	Bag	✓			
SB02 1.5	B14-Oc02544	434212		30/09/2014		Soil	Bag	✓			
SB02 3	B14-Oc02547	434212		30/09/2014		Soil	Bag	✓			
SB02 4.5	B14-Oc02550	434212		30/09/2014		Soil	Bag	✓			
SB03 0.5	B14-Oc02553	434212		30/09/2014		Soil	Bag	✓			
SB03 2	B14-Oc02556	434212		30/09/2014		Soil	Bag	✓			
SB03 5	B14-Oc02562	434212		30/09/2014		Soil	Bag	✓			
SB04 0.5	B14-Oc02564	434212		30/09/2014		Soil	Bag	✓			
SB04 2	B14-Oc02567	434212		30/09/2014		Soil	Bag	✓			
SB04 2.5	B14-Oc02568	434212		30/09/2014		Soil	Bag	✓			
SB04 3.5	B14-Oc02570	434212		30/09/2014		Soil	Bag	✓			
SB04 4.5	B14-Oc02572	434212		30/09/2014		Soil	Bag	✓			
SB05 0.5	B14-Oc02575	434212		30/09/2014		Soil	Bag	✓			
SB05 1.5	B14-Oc02577	434212		30/09/2014		Soil	Bag	✓			
SB05 3	B14-Oc02580	434212		30/09/2014		Soil	Bag	✓			
SB05 4.5	B14-Oc02583	434212		30/09/2014		Soil	Bag	✓			

E CN IID AP CR

CON NOTES | POST CODE | MASS

Rebatch
Ryan L.
9/10/14
9AM

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by: Joanna Stegena
Date: 8/10/2014
Time:

Received by:
Date:
Time:

LIAM 9/10
EF/MGT 9.00am

434818

Tammy Lakeland

From: Joanna Stegena <Joanna.Stegena@ghd.com>
Sent: Thursday, 9 October 2014 6:28 PM
To: Tammy Lakeland
Subject: RE: URGENT - CRS request - Lab Report Number 434212

Hi Tammy,

Thanks so much for the email, I'll adjust expectations accordingly.

Yours,
Joanna.

From: Tammy Lakeland [mailto:TammyLakeland@eurofins.com.au]
Sent: Thursday, 9 October 2014 3:26 PM
To: Joanna Stegena
Cc: EnviroSampleVIC; Natalie Krasselt
Subject: RE: URGENT - CRS request - Lab Report Number 434212

Joanna,

Cindi has just called to ask that I send you this email regarding our TAT estimate.

We have confirmed with our Lab Manager that we are not able to achieve a faster TAT than this noted below. This is due to method preparation steps required.

Regards

Tammy Lakeland
Phone : +61 3 8564 5031
Email : TammyLakeland@eurofins.com.au

From: Tammy Lakeland
Sent: Thursday, 9 October 2014 11:58 AM
To: Joanna.Stegena@ghd.com
Cc: EnviroSampleQLD; EnviroSampleVIC; Enquiries Perth; Natalie Krasselt
Subject: FW: URGENT - CRS request - Lab Report Number 434212
Importance: High

Joanna,

We will begin analysis of these samples today. Sameday analysis for Chromium reducible suite is not possible, however we will place on a fast 2 day TAT.

Please note that if any samples require confirmation analysis it will be 3 working days instead until reporting.

A Sample Receipt Advice with information on the report number that has been assigned will be emailed through to you once the login process is finalised.

Regards

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh Vic 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Sample Receipt Advice

Company name:	**GHD Pty Ltd WA**
Contact name:	Joanna Stegena
Project name:	WEST BYFORD - SCHOOLS PPP
Project ID:	61/321027/05
COC number:	Not provided
Turn around time:	Same day
Date/Time received:	Oct 9, 2014 9:00 AM
Eurofins | mgt reference:	**434818**

Sample information

☑ A detailed list of analytes logged into our LIMS, is included in the attached summary table.

☑ All samples have been received as described on the above COC.

☑ COC has been completed correctly.

☑ Attempt to chill was evident.

☑ Appropriately preserved sample containers have been used.

☑ All samples were received in good condition.

☑ Samples have been provided with adequate time to commence analysis in accordance with the relevant holding times.

☑ Appropriate sample containers have been used.

☒ Some samples have been subcontracted.

N/A Custody Seals intact (if used).

Contact notes

If you have any questions with respect to these samples please contact:

Natalie Krasselt on Phone : (+61) (3) 8564 5000 or by e.mail: NatalieKrasselt@eurofins.com.au

Results will be delivered electronically via e.mail to Joanna Stegena - joanna.stegena@ghd.com.

Eurofins | mgt Sample Receipt

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 9:00 AM
Address:	239 Adelaide Terrace	**Report #:**	434818	**Due:**	Oct 9, 2014
	Perth	**Phone:**	08 6222 8222	**Priority:**	Same day
	WA 6004	**Fax:**	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	WEST BYFORD - SCHOOLS PPP				
Project ID:	61/321027/05				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
MB01 0.5	Sep 30, 2014		Soil	B14-Oc06624	X	X
MB01 1.5	Sep 30, 2014		Soil	B14-Oc06625	X	X
MB01 3	Sep 30, 2014		Soil	B14-Oc06626	X	X
MB01 8	Sep 30, 2014		Soil	B14-Oc06627	X	X
MB02 1	Sep 30, 2014		Soil	B14-Oc06628	X	X
MB02 2	Sep 30, 2014		Soil	B14-Oc06629	X	X
MB02 2.5	Sep 30, 2014		Soil	B14-Oc06630	X	X
MB02 4	Sep 30, 2014		Soil	B14-Oc06631	X	X
MB03 1	Sep 30, 2014		Soil	B14-Oc06632	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 9:00 AM
Address:	239 Adelaide Terrace	**Report #:**	434818	**Due:**	Oct 9, 2014
	Perth	**Phone:**	08 6222 8222	**Priority:**	Same day
	WA 6004	**Fax:**	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	WEST BYFORD - SCHOOLS PPP				
Project ID:	61/321027/05				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
MB03 3.5	Sep 30, 2014		Soil	B14-Oc06633	X	X
MB04 1	Sep 30, 2014		Soil	B14-Oc06634	X	X
MB04 2.5	Sep 30, 2014		Soil	B14-Oc06635	X	X
MB04 3	Sep 30, 2014		Soil	B14-Oc06636	X	X
MB04 5.5	Sep 30, 2014		Soil	B14-Oc06637	X	X
SB01 0.5	Sep 30, 2014		Soil	B14-Oc06638	X	X
SB01 2	Sep 30, 2014		Soil	B14-Oc06639	X	X
SB01 3.5	Sep 30, 2014		Soil	B14-Oc06640	X	X
SB02 0.5	Sep 30, 2014		Soil	B14-Oc06641	X	X
SB02 1.5	Sep 30, 2014		Soil	B14-Oc06642	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 9:00 AM
Address:	239 Adelaide Terrace	**Report #:**	434818	**Due:**	Oct 9, 2014
	Perth	**Phone:**	08 6222 8222	**Priority:**	Same day
	WA 6004	**Fax:**	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	WEST BYFORD - SCHOOLS PPP				
Project ID:	61/321027/05				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
SB02 3	Sep 30, 2014		Soil	B14-Oc06643	X	X
SB02 4.5	Sep 30, 2014		Soil	B14-Oc06644	X	X
SB03 0.5	Sep 30, 2014		Soil	B14-Oc06645	X	X
SB03 2	Sep 30, 2014		Soil	B14-Oc06646	X	X
SB03 5	Sep 30, 2014		Soil	B14-Oc06647	X	X
SB04 0.5	Sep 30, 2014		Soil	B14-Oc06648	X	X
SB04 2	Sep 30, 2014		Soil	B14-Oc06649	X	X
SB04 2.5	Sep 30, 2014		Soil	B14-Oc06650	X	X
SB04 3.5	Sep 30, 2014		Soil	B14-Oc06651	X	X
SB04 4.5	Sep 30, 2014		Soil	B14-Oc06652	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 9:00 AM
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434818	**Due:**	Oct 9, 2014
		Phone:	08 6222 8222	**Priority:**	Same day
		Fax:	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	WEST BYFORD - SCHOOLS PPP				
Project ID:	61/321027/05				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
SB05 0.5	Sep 30, 2014		Soil	B14-Oc06653	X	X
SB05 1.5	Sep 30, 2014		Soil	B14-Oc06654	X	X
SB05 3	Sep 30, 2014		Soil	B14-Oc06655	X	X
SB05 4.5	Sep 30, 2014		Soil	B14-Oc06656	X	X

eurofins | mgt

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

GHD Pty Ltd WA
239 Adelaide Terrace
Perth
WA 6004

Attention: **Joanna Stegena**

Report **434818-S**
Project name WEST BYFORD - SCHOOLS PPP
Project ID 61/321027/05
Received Date Oct 09, 2014

Client Sample ID			**MB01 0.5**	**MB01 1.5**	**MB01 3**	**MB01 8**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins | mgt Sample No.			**B14-Oc06624**	**B14-Oc06625**	**B14-Oc06626**	**B14-Oc06627**
Date Sampled			**Sep 30, 2014**	**Sep 30, 2014**	**Sep 30, 2014**	**Sep 30, 2014**
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	< 10	< 10	< 10
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
pH-KCL	0.1	pH Units	6.8	6.9	6.2	6.1
Acid trail - Titratable Actual Acidity	2	mol H+/t	< 2	< 2	3.0	3.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	0.14	0.34	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	29	68	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	0.05	0.11	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
% Moisture	0.1	%	4.1	6.5	3.5	13

Client Sample ID			MB02 1	MB02 2	MB02 2.5	MB02 4
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06628	B14-Oc06629	B14-Oc06630	B14-Oc06631
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	4.0	9.0	2.0
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	54	110	20
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	0.09	0.18	0.03
pH-KCL	0.1	pH Units	6.0	4.7	4.4	5.3
Acid trail - Titratable Actual Acidity	2	mol H+/t	3.0	54	100	20
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	0.09	0.16	0.03
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	< 0.02	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	0.02	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	0.02	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	11	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	0.09	0.02	0.03
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	0.09	0.18	0.03
Net Acidity (Acidity Units)	10	mol H+/t	< 10	54	110	20
Liming Rate[S01]	1	kg CaCO3/t	< 1	4.0	9.0	2.0
% Moisture	0.1	%	4.6	11	15	20

Client Sample ID			MB03 1	MB03 3.5	MB04 1	MB04 2.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06632	B14-Oc06633	B14-Oc06634	B14-Oc06635
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	< 1	< 1	3.0
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	< 10	< 10	34
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	< 0.02	< 0.02	0.05
pH-KCL	0.1	pH Units	5.8	5.8	5.4	5.1
Acid trail - Titratable Actual Acidity	2	mol H+/t	4.0	5.0	7.0	34
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	0.05
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3

Client Sample ID			MB03 1	MB03 3.5	MB04 1	MB04 2.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06632	B14-Oc06633	B14-Oc06634	B14-Oc06635
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Chromium Suite (Minus WA)						
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	< 0.02	< 0.02	0.05
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	0.05
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	34
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	3.0
% Moisture	0.1	%	2.1	17	1.6	5.9

Client Sample ID			MB04 3	MB04 5.5	SB01 0.5	SB01 2
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06636	B14-Oc06637	B14-Oc06638	B14-Oc06639
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	1.0	< 1	< 1
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	13	< 10	< 10
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	0.02	< 0.02	< 0.02
pH-KCL	0.1	pH Units	5.2	5.6	5.8	5.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	6.0	9.0	5.0	6.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	0.006	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	4.0	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	13	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	1.0	< 1	< 1

Client Sample ID			MB04 3	MB04 5.5	SB01 0.5	SB01 2
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06636	B14-Oc06637	B14-Oc06638	B14-Oc06639
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
% Moisture	0.1	%	15	18	3.3	3.4

Client Sample ID			SB01 3.5	SB02 0.5	SB02 1.5	SB02 3
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06640	B14-Oc06641	B14-Oc06642	B14-Oc06643
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	< 1	< 1	< 1
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	< 10	< 10	< 10
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
pH-KCL	0.1	pH Units	5.8	6.0	5.9	6.0
Acid trail - Titratable Actual Acidity	2	mol H+/t	5.0	3.0	3.0	4.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	< 1	< 1
% Moisture	0.1	%	3.9	3.3	4.1	3.0

Client Sample ID			SB02 4.5	SB03 0.5	SB03 2	SB03 5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06644	B14-Oc06645	B14-Oc06646	B14-Oc06647
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1

Client Sample ID			SB02 4.5	SB03 0.5	SB03 2	SB03 5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06644	B14-Oc06645	B14-Oc06646	B14-Oc06647
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	< 1	1.0	1.0
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	< 10	< 10	< 10
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
pH-KCL	0.1	pH Units	5.8	5.6	5.7	5.2
Acid trail - Titratable Actual Acidity	2	mol H+/t	5.0	6.0	8.0	7.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	< 10	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	< 1	< 1	1.0	1.0
% Moisture	0.1	%	7.2	4.0	4.0	16

Client Sample ID			SB04 0.5	SB04 2	SB04 2.5	SB04 3.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06648	B14-Oc06649	B14-Oc06650	B14-Oc06651
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	< 1	1.0	1.0	4.0
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	< 10	15	12	54
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	< 0.02	0.02	0.02	0.09
pH-KCL	0.1	pH Units	5.6	5.3	4.9	4.9
Acid trail - Titratable Actual Acidity	2	mol H+/t	6.0	6.0	12	54
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	< 0.02	< 0.02	0.02	0.09
Chromium Reducible Sulfur[S04]	0.005	% S	< 0.005	0.014	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	< 3	9.0	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	< 0.02	0.02	0.02	0.09

Client Sample ID			SB04 0.5	SB04 2	SB04 2.5	SB04 3.5
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06648	B14-Oc06649	B14-Oc06650	B14-Oc06651
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Chromium Suite (Minus WA)						
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	< 0.02	0.02	0.02	0.09
Net Acidity (Acidity Units)	10	mol H+/t	< 10	15	12	54
Liming Rate[S01]	1	kg CaCO3/t	< 1	1.0	1.0	4.0
% Moisture	0.1	%	2.8	10	13	16

Client Sample ID			SB04 4.5	SB05 0.5	SB05 1.5	SB05 3
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins | mgt Sample No.			B14-Oc06652	B14-Oc06653	B14-Oc06654	B14-Oc06655
Date Sampled			Sep 30, 2014	Sep 30, 2014	Sep 30, 2014	Sep 30, 2014
Test/Reference	LOR	Unit				
Extraneous Material						
<2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
>2mm Fraction	0.005	g	n/a	n/a	n/a	n/a
Analysed Material	0.1	%	100	100	100	100
Extraneous Material	0.1	%	< 0.1	< 0.1	< 0.1	< 0.1
Chromium Suite (Minus WA)						
Liming Rate Minus ANC	1	kg CaCO3/t	1.0	< 1	1.0	< 1
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	19	< 10	< 10	< 10
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
pH-KCL	0.1	pH Units	5.1	5.7	5.5	5.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	11	4.0	9.0	7.0
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	0.02	< 0.02	< 0.02	< 0.02
Chromium Reducible Sulfur[S04]	0.005	% S	0.012	< 0.005	< 0.005	< 0.005
Chromium Reducible Sulfur -acidity units	3	mol H+/t	8.0	< 3	< 3	< 3
Sulfur - KCl Extractable	0.02	% S	n/a	n/a	n/a	n/a
HCl Extractable Sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur	0.02	% S	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a	n/a	n/a	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a	n/a	n/a	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a	n/a	n/a	n/a
ANC Fineness Factor			1.5	1.5	1.5	1.5
Net Acidity (Sulfur Units)	0.02	% S	0.03	< 0.02	< 0.02	< 0.02
Net Acidity (Acidity Units)	10	mol H+/t	19	< 10	< 10	< 10
Liming Rate[S01]	1	kg CaCO3/t	1.0	< 1	1.0	< 1
% Moisture	0.1	%	14	3.7	4.7	4.3

Client Sample ID			SB05 4.5
Sample Matrix			Soil
Eurofins | mgt Sample No.			B14-Oc06656
Date Sampled			Sep 30, 2014
Test/Reference	LOR	Unit	
Extraneous Material			
<2mm Fraction	0.005	g	n/a
>2mm Fraction	0.005	g	n/a
Analysed Material	0.1	%	100
Extraneous Material	0.1	%	< 0.1
Chromium Suite (Minus WA)			
Liming Rate Minus ANC	1	kg CaCO3/t	5.0
Net Acidity (Acidity Units) Minus ANC	10	mol H+/t	67
Net Acidity (Sulfur Units) Minus ANC	0.02	% S	0.11
pH-KCL	0.1	pH Units	4.8
Acid trail - Titratable Actual Acidity	2	mol H+/t	53
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	0.02	% pyrite S	0.08
Chromium Reducible Sulfur[S04]	0.005	% S	0.022
Chromium Reducible Sulfur -acidity units	3	mol H+/t	14
Sulfur - KCl Extractable	0.02	% S	n/a
HCl Extractable Sulfur	0.02	% S	n/a
Net Acid soluble sulfur	0.02	% S	n/a
Net Acid soluble sulfur - acidity units	10	mol H+/t	n/a
Net Acid soluble sulfur - equivalent S% pyrite[S02]	0.02	% S	0.11
Acid Neutralising Capacity (ANCbt)	0.01	%CaCO3	n/a
Acid Neutralising Capacity - acidity (ANCbt)	2	mol H+/t	n/a
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)[S03]	0.02	% S	n/a
ANC Fineness Factor			1.5
Net Acidity (Sulfur Units)	0.02	% S	0.11
Net Acidity (Acidity Units)	10	mol H+/t	67
Liming Rate[S01]	1	kg CaCO3/t	5.0
% Moisture	0.1	%	14

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results (regarding both quality and NATA accreditation).

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Extraneous Material	Brisbane	Oct 10, 2014	0 Day
Chromium Suite (Minus WA)	Brisbane	Oct 10, 2014	6 Week
- Method: LTM-GEN-7070			
% Moisture	Brisbane	Oct 09, 2014	14 Day
- Method: Method 102 - ANZECC - % Moisture			

Company Name:	GHD Pty Ltd WA	**Order No.:**		**Received:**	Oct 9, 2014 9:00 AM
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434818	**Due:**	Oct 13, 2014
		Phone:	08 6222 8222	**Priority:**	2 Day
		Fax:	08 9429 6555	**Contact Name:**	Joanna Stegena
Project Name:	WEST BYFORD - SCHOOLS PPP				
Project ID:	61/321027/05				

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite (Minus WA)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
Sample ID	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**		
MB01 0.5	Sep 30, 2014		Soil	B14-Oc06624	X	X
MB01 1.5	Sep 30, 2014		Soil	B14-Oc06625	X	X
MB01 3	Sep 30, 2014		Soil	B14-Oc06626	X	X
MB01 8	Sep 30, 2014		Soil	B14-Oc06627	X	X
MB02 1	Sep 30, 2014		Soil	B14-Oc06628	X	X
MB02 2	Sep 30, 2014		Soil	B14-Oc06629	X	X
MB02 2.5	Sep 30, 2014		Soil	B14-Oc06630	X	X
MB02 4	Sep 30, 2014		Soil	B14-Oc06631	X	X
MB03 1	Sep 30, 2014		Soil	B14-Oc06632	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:** **Phone:** **Fax:**	434818 08 6222 8222 08 9429 6555
Project Name:	WEST BYFORD - SCHOOLS PPP		
Project ID:	61/321027/05		

Received:	Oct 9, 2014 9:00 AM	
Due:	Oct 13, 2014	
Priority:	2 Day	
Contact Name:	Joanna Stegena	

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite (Minus WA)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
MB03 3.5	Sep 30, 2014		Soil	B14-Oc06633	X	X
MB04 1	Sep 30, 2014		Soil	B14-Oc06634	X	X
MB04 2.5	Sep 30, 2014		Soil	B14-Oc06635	X	X
MB04 3	Sep 30, 2014		Soil	B14-Oc06636	X	X
MB04 5.5	Sep 30, 2014		Soil	B14-Oc06637	X	X
SB01 0.5	Sep 30, 2014		Soil	B14-Oc06638	X	X
SB01 2	Sep 30, 2014		Soil	B14-Oc06639	X	X
SB01 3.5	Sep 30, 2014		Soil	B14-Oc06640	X	X
SB02 0.5	Sep 30, 2014		Soil	B14-Oc06641	X	X
SB02 1.5	Sep 30, 2014		Soil	B14-Oc06642	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434818
		Phone:	08 6222 8222
		Fax:	08 9429 6555
Project Name:	WEST BYFORD - SCHOOLS PPP		
Project ID:	61/321027/05		

Received:	Oct 9, 2014 9:00 AM
Due:	Oct 13, 2014
Priority:	2 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite (Minus WA)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
SB02 3	Sep 30, 2014		Soil	B14-Oc06643	X	X
SB02 4.5	Sep 30, 2014		Soil	B14-Oc06644	X	X
SB03 0.5	Sep 30, 2014		Soil	B14-Oc06645	X	X
SB03 2	Sep 30, 2014		Soil	B14-Oc06646	X	X
SB03 5	Sep 30, 2014		Soil	B14-Oc06647	X	X
SB04 0.5	Sep 30, 2014		Soil	B14-Oc06648	X	X
SB04 2	Sep 30, 2014		Soil	B14-Oc06649	X	X
SB04 2.5	Sep 30, 2014		Soil	B14-Oc06650	X	X
SB04 3.5	Sep 30, 2014		Soil	B14-Oc06651	X	X
SB04 4.5	Sep 30, 2014		Soil	B14-Oc06652	X	X

eurofins | mgt

ABN – 50 005 085 521 e.mail : EnviroSales@eurofins.com.au web : www.eurofins.com.au

Melbourne
3-5 Kingston Town Close
Oakleigh VIC 3166
Phone : +61 3 8564 5000
NATA # 1261
Site # 1254 & 14271

Sydney
Unit F6, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

Brisbane
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

Company Name:	GHD Pty Ltd WA	**Order No.:**	
Address:	239 Adelaide Terrace Perth WA 6004	**Report #:**	434818
		Phone:	08 6222 8222
		Fax:	08 9429 6555
Project Name:	WEST BYFORD - SCHOOLS PPP		
Project ID:	61/321027/05		

Received:	Oct 9, 2014 9:00 AM
Due:	Oct 13, 2014
Priority:	2 Day
Contact Name:	Joanna Stegena

Eurofins | mgt Client Manager: Natalie Krasselt

Sample Detail					% Moisture	Chromium Suite (Minus WA)
Laboratory where analysis is conducted						
Melbourne Laboratory - NATA Site # 1254 & 14271						
Sydney Laboratory - NATA Site # 18217						
Brisbane Laboratory - NATA Site # 20794					X	X
External Laboratory						
SB05 0.5	Sep 30, 2014		Soil	B14-Oc06653	X	X
SB05 1.5	Sep 30, 2014		Soil	B14-Oc06654	X	X
SB05 3	Sep 30, 2014		Soil	B14-Oc06655	X	X
SB05 4.5	Sep 30, 2014		Soil	B14-Oc06656	X	X

Eurofins | mgt Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
4. Results are uncorrected for matrix spikes or surrogate recoveries.
5. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
6. Samples were analysed on an 'as received' basis. 7. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the Sample Receipt Advice.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

****NOTE:** pH duplicates are reported as a range NOT as RPD

UNITS

mg/kg: milligrams per Kilogram

ug/l: micrograms per litre

ppb: Parts per billion

org/100ml: Organisms per 100 millilitres

MPN/100mL: Most Probable Number of organisms per 100 millilitres

mg/l: milligrams per litre

ppm: Parts per million

%: Percentage

NTU: Nephelometric Turbidity Units

TERMS

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery
CRM	Certified Reference Material - reported as percent recovery
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands. In the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
Batch Duplicate	A second piece of analysis from a sample outside of the clients batch of samples but run within the laboratory batch of analysis.
Batch SPIKE	Spike recovery reported on a sample from outside of the clients batch of samples but run within the laboratory batch of analysis.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
ASLP	Australian Standard Leaching Procedure (AS4439.3)
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within
TEQ	Toxic Equivalency Quotient

QC - ACCEPTANCE CRITERIA

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries : Recoveries must lie between 50-150% - Phenols 20-130%.

QC DATA GENERAL COMMENTS

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxophene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxophene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Arochlor 1260 in Matrix Spikes and LCS's.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPD's are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Chromium Suite (Minus WA)				Result 1	Result 2	RPD			
Liming Rate Minus ANC	B14-Oc06624	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Net Acidity (Acidity Units) Minus ANC	B14-Oc06624	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Net Acidity (Sulfur Units) Minus ANC	B14-Oc06624	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
pH-KCL	B14-Oc06624	CP	pH Units	6.8	6.9	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-Oc06624	CP	mol H+/t	< 2	< 2	<1	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-Oc06624	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B14-Oc06624	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B14-Oc06624	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
Acid Neutralising Capacity (ANCbt)	B14-Oc06624	CP	%CaCO3	0.14	0.14	<1	30%	Pass	
Acid Neutralising Capacity - equivalent S% pyrite (s-ANCbt)	B14-Oc06624	CP	% S	0.05	0.05	<1	30%	Pass	
ANC Fineness Factor	B14-Oc06624	CP		1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B14-Oc06624	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B14-Oc06624	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B14-Oc06624	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
Chromium Suite (Minus WA)				Result 1	Result 2	RPD			
Liming Rate Minus ANC	B14-Oc06634	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Net Acidity (Acidity Units) Minus ANC	B14-Oc06634	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Net Acidity (Sulfur Units) Minus ANC	B14-Oc06634	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
pH-KCL	B14-Oc06634	CP	pH Units	5.4	5.4	<1	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-Oc06634	CP	mol H+/t	7.0	6.0	2.0	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-Oc06634	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B14-Oc06634	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B14-Oc06634	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
ANC Fineness Factor	B14-Oc06634	CP		1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B14-Oc06634	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B14-Oc06634	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B14-Oc06634	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Duplicate									
Chromium Suite (Minus WA)				Result 1	Result 2	RPD			
Liming Rate Minus ANC	B14-Oc06644	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	
Net Acidity (Acidity Units) Minus ANC	B14-Oc06644	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Net Acidity (Sulfur Units) Minus ANC	B14-Oc06644	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
pH-KCL	B14-Oc06644	CP	pH Units	5.8	5.9	2.0	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-Oc06644	CP	mol H+/t	5.0	4.0	10	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-Oc06644	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B14-Oc06644	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B14-Oc06644	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
ANC Fineness Factor	B14-Oc06644	CP		1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B14-Oc06644	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B14-Oc06644	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B14-Oc06644	CP	kg CaCO3/t	< 1	< 1	<1	30%	Pass	

Duplicate									
Chromium Suite (Minus WA)				Result 1	Result 2	RPD			
Liming Rate Minus ANC	B14-Oc06654	CP	kg CaCO3/t	1.0	1.0	5.0	30%	Pass	
Net Acidity (Acidity Units) Minus ANC	B14-Oc06654	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Net Acidity (Sulfur Units) Minus ANC	B14-Oc06654	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
pH-KCL	B14-Oc06654	CP	pH Units	5.5	5.7	3.0	30%	Pass	
Acid trail - Titratable Actual Acidity	B14-Oc06654	CP	mol H+/t	9.0	9.0	5.0	30%	Pass	
sulfidic - Titratable Actual Acidity - equivalent S% pyrite	B14-Oc06654	CP	% pyrite S	< 0.02	< 0.02	<1	30%	Pass	
Chromium Reducible Sulfur	B14-Oc06654	CP	% S	< 0.005	< 0.005	<1	30%	Pass	
Chromium Reducible Sulfur -acidity units	B14-Oc06654	CP	mol H+/t	< 3	< 3	<1	30%	Pass	
ANC Fineness Factor	B14-Oc06654	CP		1.5	1.5	<1	30%	Pass	
Net Acidity (Sulfur Units)	B14-Oc06654	CP	% S	< 0.02	< 0.02	<1	30%	Pass	
Net Acidity (Acidity Units)	B14-Oc06654	CP	mol H+/t	< 10	< 10	<1	30%	Pass	
Liming Rate	B14-Oc06654	CP	kg CaCO3/t	1.0	1.0	5.0	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
S01	Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil' multiply 'reported results' x 'wet bulk density of soil in t/m3'
S02	Retained Acidity is Reported when the pHKCl is less than pH 4.5
S03	Acid Neutralising Capacity is only required if the pHKCl if greater than or equal to pH 6.5
S04	Acid Sulfate Soil Samples have a 24 hour holding time unless frozen or dried within that period

Authorised By

Natalie Krasselt	Client Services
Richard Corner	Senior Analyst-Inorganic (QLD)

Glenn Jackson
Laboratory Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Uncertainty data is available on request

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS | PEOPLE | PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: ALS
Address: 10 Hod Way Malaga

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	Analyses: 8 Metals	Analyses: OC/OP Pesticides	Analyses: Hold	Comment
(1) QA02	1	30/09/2014		SOIL	JAR		✔	✔		
QA04	—	30/09/2014		SOIL	BAG	✔				
QA06	—	30/09/2014		SOIL	BAG	✔				
QA08	—	30/09/2014		SOIL	BAG	✔				
QA10	—	30/09/2014		SOIL	BAG	✔				
QA12	—	30/09/2014		SOIL	BAG	✔				
QA14	—	30/09/2014		SOIL	BAG	✔				
QA16	—	30/09/2014		SOIL	BAG	✔				

Environmental Division
Melbourne
Work Order
EM1410267

Telephone : +61-3-8549 9600

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:

Received by: Bharathi (ALS)
02/10/14 8.35 am

Received by:
Date: 1/10/14
Time: 1430

ALS Environmental

ĀÀ !"#"Ā$!À%&#%$'$()*'"*

+,-.%&-/0-	1À23435678	*Ä+"	, -#/ #0
5 6"73	, 9:;%<!)%(!;	1Ä2.(Ä3.(4	, 8796(.7:"73Ä #;696!6.7#<" 2.)(7"
5.73Ä=3	, *8'8>#'?118@	5.73Ä=3	, AB6("4#1"5.(7)
CDD("!!	, E$F#C;81C?;8#'8>>C58 *8>'G#HC#I&&J	CDD("!!	, J#H"!3À #>D#AK(67+9À "#L?5#C)!3(À 6À#$-M-
8N:Ä6	, NNNN	8N:Ä6	, !B6("4% "=.(7)OÄ !"796(.%=.:
'" "KB.7"	, PI-#&Q#IEEE#QEEE	'" "KB.7"	, PI-N$NQ0JF#FI$&
ĀÄ=!6:6 "	, PI-#&Q#FJEF#I000	ĀÄ=!6:6 "	, PI-N$NQ0JF#FI&-
*(.R"=3	, I-#$-&EM##GÀ::.7D#*Ä(S#A=B.. !#***	T5#1"9"	, U8*<#E&-$##A=B"D) "#VW$X#Ä7D#C1A#T5A$#("Y)6(":"73
Z(D"(#7):2"(	, NNNN		
5NZN5#7):2"(	, NNNN	;Ä3"#AÄ:K "!#>"="69"D	, &ENZ5'NE&-J
AÄ:K "(	, [A	?!!)"#;Ä3"	, &MNZ5'NE&-J
A63"	, NNNN		
		U.%#./#!Ä:K "!#("="69"D	, -
T).3"#7):2"(	, 8U\&&0\-J	U.%#./#!Ä:K "!#Ä7Ä 4!"D	, -

'B6!# ("K.(3# !)K"(!"D"!# Ä74#K("96.)!# ("K.(3WX#]63B#3B6!#"/"("7 ="%#>"!) 3!# ÀKK 4#3# 3B"#!Ä:K " W!XÄ!# !)2:633"D%#€ # KÀ+"!# . /# 3B6!#("K.(3# BÄ9"# 2""7# =B"=S"D#Ä7D#ÄKK(.9"D# /. ((" "Ä!"%#

'B6!#5"(36/6=Ä3"#./#C7Ä 4!6!#=.73Ä67!#3B"#/. .]67+#67/.(:Ä36.7

- ^"7"(Ä #5.::"73!
- C7Ä 436=Ä #>"!) 3!
- A)((.+Ä3"#5.73(. #16:63!

NATA WORLD RECOGNISED ACCREDITATION

UC'C#C==("D63"D#1Ä2.(Ä3.(4#QE0 # C==("D63"D#/.(#=.:K 6Ä7="#]63B# ?AZ\?85#-M&E0%

ĀÀ !"#$%À&'

'B6!# D.=):"73# BÄ!# 2""7# " "=3(.76=À 4#! 6+7"D#24# 3B"# Ä)3B.(6_"D#!6+7Ä3.(6"!# 67D6=Ä3"D# .]%# 8 "=3(.76=#! 6+767+#BÄ!# 2""7 =Ä((6"D#.)3#67#=.:K 6Ä7="#]63B#K(.="D)("!#!K"=6/6"D#67#E-#BÄ3#*%

ĀÄ !"#$%Ä&'	*.$'Ä#Ä$!*	*())%&*Ä#"#Ä$!+,"#& $%-*
8(6=#5BÄ)	<"3Ä !#"'Ä:#1"ÄD"(	<" 2.)(7"#?7.(+Ä76=!
UÄ7=4#HÄ7+	A"76.(#A":69. Ä36 "#?7!3():"73#5B":6!3	<" 2.)(7"#Z(+Ä76=!

ĀÀ À!"#$%&"À ()

'B"# À7À 436=ÀK(.="D)("!#)!"D# 24# 3B"# 8796(.7:"73À # ;696!6.7# BÀ9"# 2""7# D"9" .K"D# /(.:# " !3À2 6!B"D# 673"(7À36.7À 4# =.+76_"D# K(.="D)("!# !)=B# À!# 3B.!"# K)2 6!B"D# 24# 3B"# `A8*Ca# C*GCa# CA# À7D#U8 *<%# ?7# B.)!"# D"9" .K"D#K(.="D)("!#À("#":K .4"D#67#3B"#À2!"7="#./#D.=):"73"D# !3À7DÀ(D!#.(#24#= 6"73#("Y)"!3%

HB"("#:.6!3)("#D"3"(:67À36.7#BÀ!#2""7#K"(/.(:"Da#("!) 3!#À("#(" K.(3"D#.7#À#D(4#]"6+B3#2À!6!%

HB"("#À#("K.(3"D# "!!#3BÀ7#WbX#("!) 3#6!#B6+B"(#3BÀ7#3B"#1Z>Àa#2"#D)"#3.#K(6:À(4#!À:K "#"c3(À=3\D6+"!3À3"#D6)36.7#À7D\/6=6"73#!À:K "#/.(#À7À 4!6!%

HB"("#3B"#1Z>#./#À#("K.(3"D#("!) 3#D6//"(!#/(.:#!3À7DÀ(D#1Z>a#3B#:À4#2"#D)"#3.#B6+B#:.6!3)("#=.73"73a#67!)//6=6"73#!À:K "#W/D#]"6+B3#":K .4"DX#.(#:À3(6c#673"(/"("7="%

HB"7#!À:K 67+#36:"#67/.(:À36.7#6!#7.3#K(.96D"D#24#3B"#= 6"73a#!À:K 67+#DÀ3"!#À("#!B.]7#]63B.)3#À#36:"#=.:K.7"73%##?7#3B"!"#67!3À7="!a#3B"#36:"#=.:K.7"73#BÀ!#2""7#À!!):"D#24#3B"#À2.(À3.(4#/.(#K(.="!!67+#K)(K.!"!%

HB"("#À#("!) 3#6!#("Y)6("D#3.#:""3#=.:K 6À7="# 6:63!#3B"#À!!.=6À3"D#)7="(3À6734#:)!3#2"#=.7!6D"("D%#>"/"(#3.#3B"#C1A#5.73À=3#/.(#D"3À6 !%

e"4#, 5CA#U):2"(#d#5CA#("+6!3(4#7):2"(#/(.:#DÀ3À2À!"#:À673À67"D#24#5B":6=À #C2!3(À=3!#A"(96="!%#'B"#5B":6=À #C2!3(À=3!#A"(96="#6!#À#D696!6.7#./#3B"#C:"(6=À7#5B":6=À #A.=6"34%
1Z>#d#16:63#./#("K.(367+
J#d#'B6!#("!) 3#6!#=.:K)3"D#/(.:#67D696D)À #À7À 43"#D"3"=36.7#À2.9"#3B"# "9" #./#("K.(367+

- **Ä955C!1À2343563AK47%/LMIGFEN0%OEGI0/%O,-%Ã,MM0-%/L0%N,%0-EDMI0GRST%!PG=%PE=%U00R%F,ROG-H0/%US%-0@/GQ0=EISOR%ER/%-0@ER**
- **Ä955C!1À2343563AK47%/LMIGFEN0%OEGI0/%O,-%VGRF%/L0%N,%0-EDMI0GRST%!PG=%PE=%U00R%F,ROG-H0/%US%-0@/GQ0=NS,G%ER/%-0@EREI**

*Ä+" , $#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , ^G;#"@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

* "#+(,-"#$.À)/#()

A)2N<Ä3(6Œ%*&"(%Ä3(6Œ%*&"(Y			,/Ä&!#+'"01/&+23	W$56	NNNN	NNNN	NNNN	NNNN
			,/Ä&!#+'"01/Ä! +*'#&+4+#Ä0&	$&NA8*NE&-J#-0,&&	NNNN	NNNN	NNNN	NNNN
,$0 1$:!*	,(Ã+9:0;&	ç 678	5!Ä#	Ä23435678@553	@@@@	@@@@	@@@@	@@@@
Ä$5CC1%2,G=NL-0%Ã,RN0RN								
2,G=NL-0%Ã,RN0RN%X/-G0/%Z%35A[ÃY	NNNN	-%&	f	AT5	NNNN	NNNN	NNNN	NNNN
Ä955C!1%!,NEI%20NEI=S%ÚÃ<@$Ä*								
$-=0RGF	MJJ&N$QNE	0	:+\S+	b0	NNNN	NNNN	NNNN	NNNN
ÃE/HGLH	MJJ&NJ$NF	-	:+\S+	b-	NNNN	NNNN	NNNN	NNNN
ÃP-,HGLH	MJJ&NJMN$	E	:+\S+	8	NNNN	NNNN	NNNN	NNNN
Ã,MM0-	MJJ&N0&NQ	0	:+\S+	b0	NNNN	NNNN	NNNN	NNNN
(0E/	MJ$FNFEN-	0	:+\S+	b0	NNNN	NNNN	NNNN	NNNN
'GF.0I	MJJ&N&EN&	E	:+\S+	bE	NNNN	NNNN	NNNN	NNNN
VGRF	MJJ&NIINI	0	:+\S+	b0	NNNN	NNNN	NNNN	NNNN
Ä95AC!1%%!,NEI% 0F,\0-EUI0%20-F%%#"2*								
20-FL-S	MJ$FNFMNI	&%-	:+\S+	b&%-	NNNN	NNNN	NNNN	NNNN
Ä<57B$1%&QER,FPI,-GR0%<0=NGFG%ÃÃ%								
EIMPE@]:Ã	$-FNQJNI	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
:0^EFPI,-,U0R_0R0%X:Ã]Y	--QNMJN-	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
U0NE@]:Ã	$-FNQ0NM	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
QEHHE@]:Ã	0QNQFNF	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
/0INE@]:Ã	$-FNQINQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
:0MNEFPI,-	MINJJNQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
$I/-GR	$&FN&&NE	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
:0MNEFPI,-%0M,^G/0	-&EJN0MN$	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
g#,NEI%ÃPI,-/ER0%X=LHY	NNNN	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
N-ER=@ÃPI,-/ER0	0-&$NMJNE	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
EIMPE@ÀR/,=LIOER	F0FNFQNQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
FG=@ÃPI,-/ER0	0-&$NM-NF	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
;G0I/-GR	I&N0MN-	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
4T4`@;;À	MEN00NF	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ÀR/-GR	MENE&NQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
U0NE@ÀR/,=LIOER	$$E-$NI0NF	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
g#ÀR/,=LIOER%X=LHY	--0NEFNM	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
4T4`@;;;	MEN0JNQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ÀR/-GR%EI/0PS/0	MJE-NF$NJ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ÀR/,=LIOER%=LIOEN0	-&$-N&MNQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
4T4`@;;!	0&NEFN$	&%E	:+\S+	b&%E	NNNN	NNNN	NNNN	NNNN

*Ä+" , J#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , ^G;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

* "#+(,-"#$.À)/#()

A)2N<Ä3(6[illegible]%*&"(%Ä3(6[illegible]%*&"(Y			,/Ä&!#+'"01/&+23	W$56	NNNN	NNNN	NNNN	NNNN
			,/Ä&!#+'"01/Ä! +*'#&+4+#Ä0&	$&NA8*NE&-J#-0,&&	NNNN	NNNN	NNNN	NNNN
,$0 1$:!*	,(Ã+9:0;&	9 678	5!Ä#	Ä23435678@553	@@@@	@@@@	@@@@	@@@@
Ä<57B$1%&QER,FPI,-GR0%<0=NGFG[illegible]%@%Ã,RNGRL0/								
ÄR/-GR%.0N,R0	0$JFJNM&N0	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
20NP,^SFPI,-	MENJ$N0	&%E	:+\S+	b&%E	NNNN	NNNN	NNNN	NNNN
g#*LH%,O%$I/-GR%?%;G0I/-GR	$&FN&&NE\I&N0MN-	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
g#*LH%,O%;;;%?%;;Ä%?%;;!	NNNN	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
Ä<57B]1%&QER,MP,= MP,-L=%<0=NGFG/0[illegible]%Y								
;GFPI,-\,=	IENM$NM	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
;0H0N,R@*@H0NPSI	F-FNQINQ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
2,R,F-,N,MP,=	IFE$NEENJ	&%E	:+\S+	b&%E	NNNN	NNNN	NNNN	NNNN
;GH0NP,EN0	I&N0-N0	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
;GE_GR,R	$$$NJ-N0	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ĀPI,-MS-GO,=@H0NPSI	00FQN-$N&	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
<E-ENPG,R@H0NPSI	EFQN&&N&	&%E	:+\S+	b&%E	NNNN	NNNN	NNNN	NNNN
2EIENPG,R	-E-NM0N0	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
#0RNPG,R	00N$QNF	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ĀPI,-MS-GO,=	EFE-NQQNE	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
<E-ENPG,R	0IN$QNE	&%E	:+\S+	b&%E	NNNN	NNNN	NNNN	NNNN
<G-GHMP,=@0NPSI	E$0&0NJ-N-	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ĀPI,-O0R\GRMP,=	JM&NF&NI	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
]-,H,MP,=@0NPSI	JQEJNMQNI	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
#0REHGMP,=	EEEEJNFENI	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
<-,NPG,O,=	JIJNJINJ	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ĀNPG,R	0I$N-ENE	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
ĀE-U,MP0R,NPG,R	MQIN-FNI	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
$_GRMP,=%20NPSI	QIN0&N&	&%&0	:+\S+	b&%&0	NNNN	NNNN	NNNN	NNNN
Ä<57B*1%&QER,FPI,-GR0%<0=NGFG/0%*[illegible]N0								
;GU-,H,@;;Ä	E-I00NM$NE	&%-	f	BDT6	NNNN	NNNN	NNNN	NNNN
Ä<57B!1%&QER,MP,= MP,-L=%<0=NGFG/0%*L[illegible]N0								
;Ä#	MQNJQNQ	&%-	f	D4T8	NNNN	NNNN	NNNN	NNNN

0/!!&1"(À$%& (!&#$2,',()

A)2N<Ä3(6%*&"(		.Ä-&3Ä!+$2,',() $456	
,$0 1$:!*	,(Ä+9:0;&	2&7	8,19
Ä<57B*1%&QER,FPI,-GR0%<0=NGFG/0%*QE,N0			
;GU-,H,@;;Ä	E-I00NM$NE	$Q	-EQ
Ä<57B!1%&QER,MP,= MP,-L=%<0=NGFG/0%*LQE,N0			
;Ä#	MQNJQNQ	$$	- $F

Environmental

ĀÀ !"#$%&'(#)'!%)*+')#

,-./%'.01.	2*34546789	*Ä+"	, - #/ #0
5 6"73	, :;<%+#$%!#<	1Ä2.(Ä3.(4	, 8796(.7:"73À #;696!6.7#<" 2.)(7"
5.73Ä=3	, *8'8>#'?118@	5.73Ä=3	, AB6("4#1"5.(7)
CDD("!!	, E$F#C;81C?;8#'8>>C58 *8>'G#HC#I&&J	CDD("!!	, J#H"!3À #>D#AK(67+9À "#L?5#C)!3(À 6Ä#$-M-
8N:Ä6	, NNNN	8N:Ä6	, !B6("4% "=.(7)OÄ !"796(.%=.:
"' "KB.7"	, PI-#&0#IEEE#0EEE	"' "KB.7"	, PI-N$N0QJF#FI$&
ĀÄ=!6:6 "	, PI-#&0#FJEF#IQQQ	ĀÄ=!6:6 "	, PI-N$N0QJF#FI&-
*(.R"=3	, I-#$-&EM##GÀ::.7D#*Ä(S#A=B.. !#***	T5#1"9"	, U8*<#E&-$##A=B"D) "#VW$X#Ä7D#C1A#T5A$#("Y)6(":"73
A63"	, NNNN		
5NZN5#7):2"(	, NNNN	;Ä3"#AÄ:K "!#>"="69"D	, &ENZ5'NE&-J
AÄ:K "(	, [A	?!!)"#;Ä3"	, &MNZ5'NE&-J
Z(D"(#7):2"(	, NNNN		
		U.%#./#!Ä:K "!#("="69"D	, -
T).3"#7):2"(	, 8U\&&Q\-J	U.%#./#!Ä:K "!#Ä7Ä 4!"D	, -

'B6!# ("K.(3# !)K"(!"D"!# Ä74#K("96.)!# ("K.(3WX#]63B#3B6!#"/"("7 ="%#>"!) 3!# ÀKK 4#3# 3B"#!À:K " W!XÄ!# !)2:633"D%#€ #KÀ+"!# . /# 3B6!#("K.(3# BÄ9"# 2""7# =B"=S"D#Ä7D#ÀKK(.9"D#/. ((" "Ä!"%#

'B6!#T)Ä 634#5.73(. #>"K.(3#=.73Ä67!#3B"#/. .]67+#67/.(:Ä36.7,

- 1Ä2.(Ä3.(4#;)K 6=Ä3"#W;^*X#>"K.(3#" Ä369"#*"(="73Ä+"#;6//"("7="#W>*;X#Ä7D#C=="K3Ä7="#16:63!
- <"3B.D#V Ä7S#W<VX#Ä7D#1Ä2.(Ä3.(4#5.73(. #AK6S"#W15AX#"=K9"?4#Ä7D#C=="K3Ä7="#16:63!
- <Ä3(6`#AK6S"#W<AX#>"K#"3.9"(4#Ä7D#C=="K3Ä7="#16:63!

UC'C#C==("D63"D# 1Ä2.(Ä3.(4#0EQ # C==("D63"D#/.(# =.:K 6Ä7="#]63B# ?AZ\?85#-M&EQ%

ĀÀ !"#$%À&'

'B6!# D.=):"73# BÄ!# 2""7# " "=3(.76=Ä 4#! 6+7"D#24# 3B"# À)3B.(6a"D#!6+7À3.(6"!# 6"D6=À3"D#2" .]%# 8 "=3(.76=#! 6+767+#BÄ!# 2""7# =À((6D# .)3# 6" =.:K 6Ä7="#]63B#K(.="D)("!#!K"=6/6"D#67#E-#5Ā>#*Ä(3#--%

ĀÀ !"#$%À&'	*.$'Ä#Ä$!*	*())%&*Ä#"#Ä$!+,"#& $%-*
8(6=#5BÄ)	<"3Ä !#"'Ä:#1"ÄD"(	< " 2.)(7"#?7.(+Ä76=!
UÄ7=4#HÄ7+	A"76.(#A":69. Ä36 "#?7!3():"73#5B":6!3	< " 2.)(7"#Z(+Ä7 6=!

*Ä+" , E#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

ĀÀ À!"#$%&"À ()

'B"# Ä7À 436=ÄK(.="D)("!#) !"D# 24#3B"# 8796(.7:"73À # ;696!6.7#BÄ9"# 2""7# D"9" .K"D# /(.:# " !3À2 6!B"D#673"(7À36.7À 4(#=.+76a"D# K(.="D)("!# !)=B# À!# 3B.!"# K)2 6!B"D#24#3B"# ^A8*Cc# C*GCd# CA#Ä7D#U8*<%#7# B.)!"# D"9" .K"D#K(.="D)("!#À("#":K .4"D#67#3B"#À2!"7="#./#D.=):"73"D# !3Ä7DÄ(D!#.(#24#= 6"73#("Y)"!3%

HB"("#:.6!3)("#D"3"(:67À36.7#BÀ!#2""7#K"(/.(:"Dc#("!) 3!#Ä("#(" K.(3"D#.7#À#D(4#]"6+B3#2Ä!6!%

HB"("#À#("K.(3"D# "!!#3BÀ7#WdX#("!) 3#6!#B6+B"(#3BÄ7#3B[illegible]"#D)"#3.#K(6:À(4#!À:K "#"`3(À=3\D6+"!3Ä3"#D6)36.7(#67D//6=6"73#!À:K "#/.(#Ä7À 4!6!%

HB"("#3B"#1Z>#./#À#("K.(3"D#("!) 3#D6//"(!#/(.:#!3Ä7DÄ(D#1Z>#3:Ä4#2"#D)"#3.#B6+B#:.6!3)("#=.73"73c#67!)//6=6"73#!À:K"D#W(#]"6+B3#":K .4"DX#.(#:Ä3(6`#673"(/"("7="%

g"4#, C7.74:.)!#e#>"/"(!#3.#!Ä:K "!#]B6=B#À("#7.3#!K"=6/6=À 4#KÀ(3##3B6!#].(S#.(D"(#2)3#/.(:"D#KÄ(3#./#3B"#T5#K(.="!!# .3
5CA#U):2"(#e#5CA#("+6!3(4#7):2"(#/(.:#DÄ3Ä2À!"#:Ä673À67"D#24#5B6=À #C2!3(À=3!#A"(96="!%#'B"#5B":6=À #C2!3(À=3!#A"(96="[illegible]8.7#./#3B"#C:"(6=Ä7#5B":6=À #A.=6"34%#
1Z>#e#16:63#./#("K.(367+#
>*;#e#>" Ä369"#*"(="73À+"#;6//"("7="
f##e#?7D6=Ä3"!#/À6 "D#T5

*Ä+" , $#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

*"+&!"(&!,$-./#01"(À$2-345$6À/&!(

'B"# Y)À 634#.73(. # 3"(:# 1À2.(À3.(4# ;)K 6=À3"#("/"(!# 3.# À# (À7D.: 4# !" "=3"D# 673(À À2.(À3.(4#K 63%#À2.(À3.(4# D)K 6=À3"!#K(.96D"# 67/.(:À36.7# ("+À(D67+#"3B.D# K("=6!6.7# À7D#!À:K "# B"3"(.+"7" 634%#B"# K"(:633"D#(À7+"!# /.(# 3B"#>" Ä369"#"(="73# ;"96À36.7#W>*;X#./# 1À2.(À3.(4#;)K 6=À3'!# À("# ! K"=6/6"D#7#C1A#<"3B.D# TH? N8U\$0#À7D#À("# D"K"7D"73#. 7#3B"# :À+763)D"# ./# ("!) 3!# 67#=.:KÀ(6!.7# 3.#3B"# "9" # . /#("K.(367+#>"!) 3# d# - &#86:"!# 1Z> ,# U.#16:63_#>"!) 3#2"3]""7#-&#À7D#E&#36:"!#1Z>,#&h#N#Q&h_#>#E&#36:"!#1Z>,#&h#N#E&h%

A)2N<Ä3(62K'"!

				*"+&!"(&!,$-./#01"(À$2-345$6À/&!(					
*"+&!"(&!,$)"'/#À$:-	%#0À ($)"'/#À$:-	; Ä(<&=>%& /&, =	%?@$A.'+À!	*76	3 0(	7!080 "#$6À).#(	-./#01"(À$6À).#(	6 4-$295	6À1&BÀ! $*0'0()$2 5
* 6CC2%3-H=LM.1%&-NL1NL%%OÃ&%!-L2%A8CD9AAP									
8<-J-&E-QN&$J	C7.74:.)!	8C&QQN-&$,#<.6!3)("#5.73"73#WD(6"D#O#-&$j5X	NNNN	-%&	h	d-%&	d-%&	&%&	U.#16:63
8<-J-&$&$N&&I	C7.74:.)!	8C&QQN-&$,#<.6!3)("#5.73"73#WD(6"D#O#-&$j5X	NNNN	-%&	h	-F%M	-M%0	-&%-	&h#N#Q&h
*:66C#2%#-LFJ%31LFJ=%QR%"&+@ *K%%OÃ&%!-L2%A8CD89DP									
8<-J-&E-$N&E-	C7.74:.)!	8b&&Q',#5ÄD:6):	MJJ&NJ$NF	-	:+\S+	d-	d-	&%&	U.#16:63
		8b&&Q',#5B(.:6):	MJJ&NJMN$	E	:+\S+	M	I	&%&	U.#16:63
		8b&&Q',#U6=S"	MJJ&N&EN&	E	:+\S+	dE	dE	&%&	U.#16:63
		8b&&Q',#C(!"76=	MJJ&N$0NE	Q	:+\S+	dQ	dQ	&%&	U.#16:63
		8b&&Q',#5.KK"(	MJJ&NQ&N0	Q	:+\S+	dQ	dQ	&%&	U.#16:63
		8b&&Q',#1"ÄD	MJ$FNFEN-	Q	:+\S+	0	F	&%&	U.#16:63
		8b&&Q',#k67=	MJJ&NIINI	Q	:+\S+	dQ	dQ	&%&	U.#16:63
8<-J-&E-$N&JI	C7.74:.)!	8b&&Q',#5ÄD:6):	MJJ&NJ$NF	-	:+\S+	d-	d-	&%&	U.#16:63
		8b&&Q',#5B(.:6):	MJJ&NJMN$	E	:+\S+	-$	-I	E&%-	U.#16:63
		8b&&Q',#U6=S"	MJJ&N&EN&	E	:+\S+	J	J	&%&	U.#16:63
		8b&&Q',#C(!"76=	MJJ&N$0NE	Q	:+\S+	I E	I Q	J%0	&h#N#Q&h
		8b&&Q',#5.KK"(	MJJ&NQ&N0	Q	:+\S+	$I	-&I	f#F0%E	&h#N#E&h
		8b&&Q',#1"ÄD	MJ$FNFEN-	Q	:+\S+	-MJ	-MI	-%M	&h#N#E&h
		8b&&Q',#k67=	MJJ&NIINI	Q	:+\S+	Q&	F&	f#QI%E	&h#N#Q&h
*:6AC#2%%#-LFJ%)1G-S1.FQJ1%31.GM.R%QR%E"3K%%OÃ&%!-L2%A8CD8B6P									
8<-J-&E-$N&E-	C7.74:.)!	8b&$Q',#<"(=)(4	MJ$FNFMNI	&%-	:+\S+	d&%-	d&%-	&%&	U.#16:63
8<-J-&E-$N&JI	C7.74:.)!	8b&$Q',#<"(=)(4	MJ$FNFMNI	&%-	:+\S+	-%I	-%Q	M%I	&h#N#Q&h
*+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&%!-L2%A8CD8B4P									
8<-J-&&QFN&&E	C7.74:.)!	8*&I0,#À KBÀNVG5	$-FN0JNI	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#G"`À=B .(.2"7a"7"#WG5VX	--0NMJN-	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#2"3ÀNVG5	$-FN0QNM	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#+Ä::ÄNVG5	Q0N0FNF	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#D" 3ÀNVG5	$-FN0IN0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#G"K3À=B .(	MINJJN0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#C D(67	$&FN&&NE	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#G"K3À=B .(#"K.`6D"	-&EJNQMN$	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#3(À7!N5B .(DÀ7"	Q-&$NMJNE	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#À KBÀN87D.!) /À7	FQFNF0N0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#=6!N5B .(DÀ7"	Q-&$NM-NF	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#;6" D(67	I&NQMN-	&%&Q	:+\S+	-%$M	-%-I	-M%&	&h#N#E&h
		8*&I0,#J%JIN;;8	MENQQNF	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#87D(67	MENE&N0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#2"3ÀN87D.!) /À7	$$E-$NIQNF	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63

*Ä+" , J#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

A)2N<Ä3(62K'"!

*"+&!"(&!,$)"'/#Ä$:-	%#0Ä ($)"'/#Ä$:-	; Ä(<&=>%& /&. =	%?@$A.'+Ä!	*"+&!"(&!,$-./#01"(Ä$2-345$6Ä/&!(*76	3 0(	7!080 "#$6Ä).#(	-./#01"(Ä$6Ä).#(	6 4-$295	6Ä1&BÄ! $*0'0()$29 5
*+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&%!-L2%A[illegible]%%@%G-									
8<-J-&&QFN&&E	C7.74:.)!	8*&I0,#J%JIN;:;	MENQJN0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#87D(67#Ä D"B4D"	MJE-NF$NJ	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#87D.!) /Ä7#!) /Ä3"	-&$-N&MN0	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#87D(67#S"3.7"	Q$JFJNM&NQ	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#J%JIN;;'	Q&NEFN$	&%E	: +\S+	d&%E	d&%E	&%&	U.#16:63
		8*&I0,#<"3B.`4=B .(	MENJ$NQ	&%E	: +\S+	d&%E	d&%E	&%&	U.#16:63
*+68BV2%'.TFN-WU-=WU-.M=%+1=LHGH01=%O'+P%%OÃ&%!-L2%A8CD8B4P									
8<-J-&&QFN&&E	C7.74:.)!	8*&I0,#;6=B .(9.!	IENM$NM	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#;":"3.7NAN:"3B4	F-FN0IN0	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#;6:"3B.Ä3"	I&NQ-NQ	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#;6Äa67.7	$$$NJ-NQ	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#5B .(K4(6/.!N:"3B4	QQF0N-$N&	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#<Ä Ä3B6.7	-E-NMQNQ	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#Ä"73B6.7	QQN$0NF	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#5B .(K4(6/.!	EFE-N00NE	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#*6(6:KB.!N"3B4	E$Q&QNJ-N-	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#5B .(/"7967KB.!	JM&NF&NI	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#V(.:.KB.!N"3B4	J0EJNM0NI	&%&Q	: +\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#Ä"7Ä:6KB.!	EEEEJNFENI	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#*(.3B6./.!	JIJNJINJ	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#83B6.7	QI$N-ENE	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#5Ä(2.KB"7.3B6.7	M0IN-FNI	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#Ca67KB.!#<"3B4	0INQ&N&	&%&Q	:+\S+	d&%&Q	d&%&Q	&%&	U.#16:63
		8*&I0,#<.7.=(.3.KB.!	IFE$NEENJ	&%E	:+\S+	d&%E	d&%E	&%&	U.#16:63
		8*&I0,#*Ä(Ä3B6.7N:"3B4	EF0N&&N&	&%E	: +\S+	d&%E	d&%E	&%&	U.#16:63
		8*&I0,#*Ä(Ä3B6.7	QIN$0NE	&%E	: +\S+	d&%E	d&%E	&%&	U.#16:63

*Ä+" , Q#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

;À(<&=$C#" D$2;C5$" =$*"+&!"(&!,$%& (!&#$@/0DÀ$2*%@5$6À/&!(

'B"# Y)À 634#.73(. # 3"(:# <"3B.D# \#1À2.(À3.(4#V Ä7S#("/"(!# 3.#Ä7#Ä7À 43"#("'"# :Ä3(6`#3#]B6=B#À #("À+"73!# À("# ÀDD"D#67#3B"#À: "# 9.):"!# . (#K(.K.(36.7!# À!#)!"D# 67#3Ä7DÄ(D#Ä:K "# K("KÄ(Ä36.7%#B"# K)(K.!"# ./# 3B6!#T5# KÄ(Ä:"3"(# 6# 3.# : .763.(# K.3"736À #Ä2.(Ä3.(4# =.73Ä:67À36.7%#B"# Y)Ä 634#-.73(. # 3"(:# 1À2.(À3.(4# 5.73(. # AK6S"#W15AX#'/"(!# 3.# À# ="(36/6"D#'/"("7="# :Ä3"(6À c#. (# À# S7.]7# 673"(/"("7="# /(""# :À 3(6`# K6S"D#]63B#3À(+"3# Ä7À 43"!%#'B"#K)(K.!"#./#3B6!#T5#KÄ(Ä:"3"(#6!#3.#:.763.(#:"3B#K("=6!6.7#Ä7D#Ä==)(Ä=4#67D"K"7D"73#./#!Ä:K "#:Ä3(6`%#;47Ä'€.9#(4#16:63!#Ä("#2Ä!"D#.7#!3À36!36=Ä #"9Ä)À36.7#./#K(.=#!"5A%

A)2N<Ä3(62K'"!

; Ä(<&=>%& /&. =	%?@$A.'+Ä!	*76	3 0(	;Ä(<&=$C#" D$2;C5$ 6Ä/&!(	*"+&!"(&!,$%& (!&#$@/0DÄ$2*%@5$6Ä/&!(			
				6Ä).#(	@/0DÄ %& 1Ä (!"(0&	@0DÄ$6Ä1&BÄ!,$295 *%@	6Ä1&BÄ!,$*0'0()$295 *&F	E08<
***:66C#2%#-LFJ%31LFJ=%QR%"&+@ *K%%OÃ&!-L2%A8CD89DP**								
8b&&Q',#C(!"76=	MJJ&N$0NE	Q	: +\S+	dQ	E-%M#:+\S+	FM%&	MF	--$
8b&&Q',#5ÄD:6):	MJJ&NJ$NF	-	: +\S+	d-	J%IJ#:+\S+	F0%I	0M	- -Q
8b&&Q',#5B(.:6):	MJJ&NJMN$	E	: +\S+	dE	J$%F#:+\S+	-&&	0F	--$
8b&&Q',#5.KK"(	MJJ&NQ&N0	Q	: +\S+	dQ	$E%&#:+\S+	FF%$	F&	--I
8b&&Q',#1"ÄD	MJ$FNFEN-	Q	: +\S+	dQ	J&%&#:+\S+	FI%E	0Q	-&M
8b&&Q',#U6=S"	MJJ&N&EN&	E	: +\S+	dE	QQ%&#:+\S+	FF%0	0F	---
8b&&Q',#k67=	MJJ&NIINI	Q	: +\S+	dQ	I&%0#:+\S+	-&-	0F	---
***:6AC#2%%#-LFJ%)1G-S1.FQJ1%31.GM.R%QR%E"3K%%OÃ&!-L2%A8CD8B6P**								
8b&$Q',#<"(=)(4	MJ$FNFMNI	&%-	: +\S+	d&%-	E%QM#:+\S+	0F%0	M&	- $&
***+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&!-L2%A8CD8B4P**								
8*&I0,#Ä KBÄNVG5	$-FN0JNI	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	F-%-	J0	- EI
8*&I0,#G"`À=B .(.2"7a"7"#WG5VX	--0NMJN-	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	FM%$	JM	- EQ
8*&I0,#2"3ÀNVG5	$-FN0QNM	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	FE%M	JM	- $-
8*&I0,#+À::ÀNVG5	Q0N0FNF	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&M	J0	- EI
8*&I0,#D" 3ÀNVG5	$-FN0IN0	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	0Q%-	Q-	- EM
8*&I0,#G"K3Ä=B .(	MINJJN0	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FE%E	J0	- EJ
8*&I0,#C D(67	$&FN&&NE	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	FF%J	QJ	- EJ
8*&I0,#G"K3À=B .(#"K.`6D"	-&EJNQMN$	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FI%I	QQ	- EM
8*&I0,#3(Ä7!N5B .(DÄ7"	Q-&$NMJNE	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FF%&	QJ	- EI
8*&I0,#Ä KBÄN87D.!) /Ä7	FQFNF0N0	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	- &J	QQ	- EF
8*&I0,#=6!N5B .(DÄ7"	Q-&$NM-NF	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	--F	QJ	- EI
8*&I0,#;6" D(67	I&NQMN-	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FQ%0	Q-	- EF
8*&I0,#J%JIN;;8	MENQQNF	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	MF%E	Q$	- EM
8*&I0,#87D(67	MENE&N0	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FQ%Q	$&%M	- $M
8*&I0,#2"3ÄN87D.!) /Ä7	$$E-$NIQNF	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&M	Q$	- EF
8*&I0,#J%JIN;;;	MENQJN0	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&J	Q$	- $-
8*&I0,#87D(67#Ä D"B4D"	MJE-NF$NJ	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&Q	JE	- $E
8*&I0,#87D.!) /Ä7#!) /Ä3"	-&$-N&MN0	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&-	J$	- $$
8*&I0,#J%JIN;;'	Q&NEFN$	&%E	: +\S+	d&%E	&%Q#:+\S+	FQ%F	$M	- $M
8*&I0,#87D(67#S"3.7"	Q$JFJNM&NQ	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	-&$	Q&	- $J
8*&I0,#<"3B.`4=B .(	MENJ$NQ	&%E	: +\S+	d&%E	&%Q#:+\S+	FM%F	$$	- $M
***+68BV2%'.TFN-WU-=WU-.M=%+1=LHGH01=%O'+P%%OÃ&!-L2%A8CD8B4P**								
8*&I0,#;6=B .(9.!	IENM$NM	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	M&%Q	EI%I	- EF
8*&I0,#;":"3.7NAN:"3B4	F-FN0IN0	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	- &E	E0%F	- J$

A)2N<À3(62%K"'!

; À<&=>%& /&. =	%?@$A.'+À!	*76	3 0(	;À(<&=$C#" D$2;C5$ 6À/&!(6À).#(	*"+&!"(&!,$%& (!&#$@/0DÀ$2*%@5$6À/&!(@/0DÀ %& 1À (!"(0&	@0DÀ$6À1&BÀ!,$295 *%@	6À1&BÀ!,$*0'0()$295 *&F	E08<
***+68BV2%'.TFN-WU-=WU-.M=%+1=LHGH01=%O'+P%%OĀ&!-L2%A8CD8B4P%%@%G**								
8*&I0,#<.7.=(.3.KB.!	IFE$NEENJ	&%E	: +\S+	d&%E	&%Q#:+\S+	IQ%J	$$	- M-
8*&I0,#;6:"3B.À3"	I&NQ-NQ	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	F-%&	E0	- QJ
8*&I0,#;6Àa67.7	$$$NJ-NQ	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	- &I	Q$	- EF
8*&I0,#5B .(K4(6/.!N:"3B4	QQF0N-$N&	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FJ%$	Q-	- EM
8*&I0,#*À(À3B6.7N:"3B4	EF0N&&N&	&%E	:+\S+	d&%E	&%Q#:+\S+	0Q%-	JI	- $&
8*&I0,#<À À3B6.7	-E-NMQNQ	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	FJ%E	J&	- $I
8*&I0,#À"73B6.7	QQN$0NF	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FM%0	QQ	- EF
8*&I0,#5B .(K4(6/.!	EFE-N00NE	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FM%&	QJ	- E0
8*&I0,#*À(À3B6.7	QIN$0NE	&%E	: +\S+	d&%E	&%Q#:+\S+	F-%E	QE	- $&
8*&I0,#*6(6:KB.!N"3B4	E$Q&QNJ-N-	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	0E%&	QE	- $&
8*&I0,#5B .(/"7967KB.!	JM&NF&NI	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	FI%J	$M	- QM
8*&I0,#V(.:.KB.!N"3B4	J0EJNM0NI	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FI%0	QQ	- $$
8*&I0,#À"7À:6KB.!	EEEEJNFENI	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FI%$	$E	- $0
8*&I0,#*(.3B6./.!	JIJNJINJ	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	FM%M	Q$	- EF
8*&I0,#83B6.7	QI$N-ENE	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	F0%&	JF	- $$
8*&I0,#5À(2.KB"7.3B6.7	M0IN-FNI	&%&Q	: +\S+	d&%&Q	&%Q#:+\S+	- &0	JF	- $-
8*&I0,#Ca67KB.!#<"3B4	0INQ&N&	&%&Q	:+\S+	d&%&Q	&%Q#:+\S+	$F%&	-J%J	- IE

;"(!0G$@/0DÀ$2;@5$6À/&!(

'B"# Y)À 634#.73(. # 3"(:# <À3(6`#AK6S"#W<AX#'/"(!# 3.# À7#673(À2À(À3.(4# !K 63#À:K "# !K6S"D#63B#À#("K("!"73À369"#!"3# ./# 3À(+"3#À7À 43"!%#B"# K)(K.!"# ./# 3B6!#T 5# KÀ(À:"3"(# 6!#3# :.763.(# K.3"736À #À3(6`#" //"=3!# .7# À7À 43"#("=.9"(6"!%#A3À36=#>"=.9"(4#16:63!#À!#K"(# À2.(À33À#7À 634#Z2R"=369"!#W;TZ!X%#?D"À #("=.9"(4#(À7+"!#!3À3"D#À6#D#67#3B"#"9"73#./#!À:K "#:À3(6`#673"(/"("7="%

A)2N<À3(62%K"'!

*"+&!"(&!,$)"'/#À$:-	%#0À ($)"'/#À$:-	; À<&=>%& /&. =	%?@$A.'+À!	;"(!0G$@/0DÀ$2;@5$6À/&!(@/0DÀ$ %& 1À (!"(0&	@/0DÀ6À1&BÀ!,295 ;@	6À1&BÀ!,$*0'0()$295 *&F	E08<
***:66C#2%#-LFJ%31LFJ=%QR%"&+@ *K%%OĀ&!-L2%A8CD89DP**							
8<-J-&E-$N&EE	C7.74:.)!	8b&&Q',#C(!"76=	MJJ&N$0NE	Q&#:+\S+	-&-	0&	- -I
		8b&&Q',#5ÀD:6):	MJJ&NJ$NF	Q&#:+\S+	F&%-	0Q	- -Q
		8b&&Q',#5B(.:6):	MJJ&NJMN$	Q&#:+\S+	F&%$	MF	- -F
		8b&&Q',#5.KK"(	MJJ&NQ&N0	Q&#:+\S+	-&-	0$	- -F
		8b&&Q',#1"ÀD	MJ$FNFEN-	Q&#:+\S+	f#U.3# ;"3"(:67"D	MF	- -M
		8b&&Q',#U6=S"	MJJ&N&EN&	Q&#:+\S+	0J%M	MF	- -M
		8b&&Q',#k67=	MJJ&NIINI	Q&#:+\S+	f#U.3# ;"3"(:67"D	MQ	- E-
***:6AC#2%%#-LFJ%)1G-S1.FQJ1%31.GM.R%QR%E"3K%%OĀ&!-L2%A8CD8B6P**							
8<-J-&E-$N&EE	C7.74:.)!	8b&$Q',#<"(=)(4	MJ$FNFMNI	Q%&#:+\S+	FJ%$	MI	- -I
***+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OĀ&!-L2%A8CD8B4P**							

*Ä+" , M‰/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

A)2N<Ä3(62K'"!

				;"(!0G$@/0DÄ$2;@5$6Ä/&!(			
				@/0DÄ$	@/0DÄ6Ä1&BÄ!,295	6Ä1&BÄ!,$*0'0()$295	
*"'+&!"(&!,$)"'/#Ä$:-	%#0Ä ($)"'/#Ä$:-	; Ä<&=>%& /&. =	%?@$A.'+Ä!	%& 1Ä (!"(0&	;@	*&F	E08<
*+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&!-L2%A8CD8B4P%@%G-N							
8<-J-&EIMN&&-	TC&E	8*&I0,#+Ä::ÄNVG5	Q0N0FNF	&%Q#:+\S+	0J%E	EE%Q	- EF
		8*&I0,#G"K3Ä=B .(	MINJJN0	&%Q#:+\S+	0&%M	-I%0	- $$
		8*&I0,#C D(67	$&FN&&NE	&%Q#:+\S+	FE%I	E$	- $$
		8*&I0,#;6" D(67	I&NQMN-	&%Q#:+\S+	0F%0	J$	- $Q
		8*&I0,#87D(67	MENE&N0	&%Q#:+\S+	M0%E	E-%-	- QQ
		8*&I0,#J%JIN;;'	Q&NEFN$	&%Q#:+\S+	IE%0	E-%0	- JE
*+68BV2%'.TFN-WU-=WU-.M=%+1=LHGH01=%O'+P%%OÃ&!-L2%A8CD8B4P							
8<-J-&EIMN&&-	TC&E	8*&I0,#;6Ãa67.7	$$$NJ-NQ	&%Q#:+\S+	-&J	JM	- $-
		8*&I0,#5B .(K4(6/.!N:"3B4	QQF0N-$N&	&%Q#:+\S+	MM%-	J-	- EQ
		8*&I0,#*6(6:KB.!N"3B4	E$Q&QNJ-N-	&%Q#:+\S+	F-%0	JI	- E0
		8*&I0,#V(.:.KB.!N"3B4	J0EJNM0NI	&%Q#:+\S+	0Q%E	JM	- EM
		8*&I0,#*(.3B6./.!	JIJNJINJ	&%Q#:+\S+	0Q%0	JE	- EJ

;"(!0G$@/0DÄ$2;@5$" =$;"(!0G$@/0DÄ$-./#01"(Ä$2;@-5$6Ä/&!(

'B"# Y)Ä 634#.73(. # 3"(:# <Ä3(6`#AK6S"#W<AX#Ä7D#<Ä3(6`#AK6S"#)K 6=Ä3"#W<A;X#("/"(!# 3.# 673(Ä Ä2.(Ä3.(4#K 63# Ä:K "!# ! K6S"D#63B#Ä#("K("!"73Ä369"#! "3#. /# 3Ä(+"3#Ä7Ä 43"!%# B"# K)(K.!"# . /# 3B"!" # T 5# KÄ(Ä:"3"(!# Ä("# 3.# :.763.(#K.3"736Ä #:Ä3(6`#"//"=3!#.7#Ä7Ä 43"#("=.9"(6"!%#A3Ä3(6`#"#16:63!#Ä!#K"(# Ä2.(Ä3.(4#;Ä3Ä#T)Ä 634#Z2R"=369"!#W<A;X#?D"Ä #("=.9"(4#(Ä7+"!#!3Ä3"D#:Ä4#2"#]Ä69"D#67#3B"#"9Ä7K###3(6`#673"(/"("7="%

A)2N<Ä3(62K'"!

				;"(!0G$@/0DÄ$2;@5$" =$;"(!0G$@/0DÄ$-./#01"(Ä$2;@-5$6Ä/&!(						
				@/0DÄ$	@/0DÄ$6Ä1&BÄ!,$295		6Ä1&BÄ!,$*0'0()$295		64-)$295	
*"'+&!"(&!,$)"'/#Ä$:-	%#0Ä ($)"'/#Ä$:-	; Ä<&=>%& /&. =	%?@$A.'+Ä!	%& 1Ä (!"(0&	;@	;@-	*&F	E08<	H"#.Ä	%& (!&#$*0'0(
*:66C#2%#-LFJ%31LFJ=%QR%"&+@ *K%%OÃ&!-L2%A8CD89DP										
8<-J-&E-$N&EE	C7.74:.)!	8b&&Q',#C(!"76=	MJJ&N$0NE	Q&#:+\S+	-&-	NNNN	0&	- -I	NNNN	NNNN
		8b&&Q',#5ÄD:6):	MJJ&NJ$NF	Q&#:+\S+	F&%-	NNNN	0Q	- -Q	NNNN	NNNN
		8b&&Q',#5B(.:6):	MJJ&NJMN$	Q&#:+\S+	F&%$	NNNN	MF	- -F	NNNN	NNNN
		8b&&Q',#5.KK"(	MJJ&NQ&N0	Q&#:+\S+	-&-	NNNN	0$	- -F	NNNN	NNNN
		8b&&Q',#1"ÄD	MJ$FNFEN-	Q&#:+\S+	f#U.3# ;"3"(:67"D	NNNN	MF	- -M	NNNN	NNNN
		8b&&Q',#U6=S"	MJJ&N&EN&	Q&#:+\S+	0J%M	NNNN	MF	- -M	NNNN	NNNN
		8b&&Q',#k67=	MJJ&NIINI	Q&#:+\S+	f#U.3# ;"3"(:67"D	NNNN	MQ	- E-	NNNN	NNNN
*:6AC#2%%#-LFJ%)1G-S1.FQJ1%31.GM.R%QR%E"3K%%OÃ&!-L2%A8CD8B6P										
8<-J-&E-$N&EE	C7.74:.)!	8b&$Q',#<"(=)(4	MJ$FNFMNI	Q%&#:+\S+	FJ%$	NNNN	MI	- -I	NNNN	NNNN
*+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&!-L2%A8CD8B4P										
8<-J-&EIMN&&-	TC&E	8*&I0,#+Ä::ÄNVG5	Q0N0FNF	&%Q#:+\S+	0J%E	NNNN	EE%Q	- EF	NNNN	NNNN
		8*&I0,#G"K3Ä=B .(	MINJJN0	&%Q#:+\S+	0&%M	NNNN	-I%0	- $$	NNNN	NNNN
		8*&I0,#C D(67	$&FN&&NE	&%Q#:+\S+	FE%I	NNNN	E$	- $$	NNNN	NNNN
		8*&I0,#;6" D(67	I&NQMN-	&%Q#:+\S+	0F%0	NNNN	J$	- $Q	NNNN	NNNN
		8*&I0,#87D(67	MENE&N0	&%Q#:+\S+	M0%E	NNNN	E-%-	- QQ	NNNN	NNNN

*Ä+" , 0#/ #0
H.(S#Z(D"(, 8<-J-&EIM
5 6"73 , bG;#*'@#1';
*(.R"=3 , I-#$-&EM##GÄ::.7D#*Ä(S#A=B.. !#***

A)2N<Ä3(62K'"!

				;"(!0G$@/0DÄ$2;@5$" =$;"(!0G$@/0DÄ$-./#01"(Ä$2;@-5$6Ä/&!(						
				@/0DÄ$	@/0DÄ$6Ä1&BÄ!,$295		6Ä1&BÄ!,$*0'0()$295		64-)$295	
*"+&!"(&!,$)"'/#Ä$:-	%#0Ä ($)"'/#Ä$:-	; Ä(<&=>%& /&. =	%?@$A.'+Ä!	%& 1Ä (!"(0&	;@	;@-	*&F	E08<	H"#.Ä	%& (!&#$*0'0(
*+68B 2%'.TFN-GUJ-.HN1%+1=LHGH01=%O'&P%%OÃ&!-L2%A8CD[illegible]%@%G-N										
8<-J-&EIMN&&-	TC&E	8*&I0,#J%JIN;;'	Q&NEFN$	&%Q#:+\S+	IE%0	NNNN	E-%0	- JE	NNNN	NNNN
*+68BV2%'.TFN-WU-=WU-.M=%+1=LHGH01=%O'+P%%OÃ&!-L2%A8CD8B4P										
8<-J-&EIMN&&-	TC&E	8*&I0,#;6Äa67.7	$$$NJ-NQ	&%Q#:+\S+	-&J	NNNN	JM	- $-	NNNN	NNNN
		8*&I0,#5B .(K4(6/.!N:"3B4	QQF0N-$N&	&%Q#:+\S+	MM%-	NNNN	J-	- EQ	NNNN	NNNN
		8*&I0,#*6(6:KB.!N"3B4	E$Q&QNJ-N-	&%Q#:+\S+	F-%0	NNNN	JI	- E0	NNNN	NNNN
		8*&I0,#V(.:.KB.!N"3B4	J0EJNM0NI	&%Q#:+\S+	0Q%E	NNNN	JM	- EM	NNNN	NNNN
		8*&I0,#*(.3B6./.!	JIJNJINJ	&%Q#:+\S+	0Q%0	NNNN	JE	- EJ	NNNN	NNNN

ALS Environmental

ĀÀ !"#"! Ā$!% &'()Ā *%+,À ",)%"!#,"

-./0%,/12/	3!4565789:	"#$!	%&'() '*
/01!2-	%9:6"'Ā;'+Ā6	+#,(Ä#-(Ä.	%3241À(25!2-#0'614171(2'8!0,(Ä2!
/(2-#<-	%"3Ā3='Ā>++3;	/(2-#<-	%?@1À0!.'+!/(Ä2
ABBÀ!77	%CDE'A63+A>63'Ā3==A/3 "3=Ā:'FA'GHHI	ABBÀ!77	%I'F!7-#00'=B'?JÀ12$4#0!'K>/'A 7-Ä#01#'D&L&
3M5#10	%MMMM	3M5#10	%7@1À0!.N0!<(Ä2 O#07!241À(N<(5
Ā!0!J@(2!	%PG&'HQ'GCCC'QCCC	Ā!0!J@(2!	%PG&MDMQ*IE'EGDH
R#<71510!	%PG&'HQ'EICE'G***	R#<71510!	%PG&MDMQ*IE'EGH&
"Ä(S!<-	%G&'D&HCL":#55(2B'"#ÀT'?<@((07"""	U/'+!4!0	%V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ä!Z 1À!5!2-
?1-!	%MMMM		
/M[M/'2 5,!Ä	%MMMM	6#-!'?#5J0!7'=!<!14!B	%HCM[/ĀMCH&I
?#5J0!À	%I?	>77 !'6#-!	%HLM[/ĀMCH&I
[ÄB!Ä'2 5,!Ä	%MMMM		
		V(N'()'7#5J0!7'À!<!14!B	%&
U (-!'2 5,!Ä	%3V]HH*]&I	V(N'()'7#5J0!7'#2#0.7!B	%&

Ā@17'À!J(Ä-'7 J!Ä7!B!7'#2.'JÄ!41(7'À!J(Ä-X7Y'^1-@'-@17'À!)%ÄN2=!7 0-7'#JJ0.'-('-@!'7#5J0!X7Y'#7'7 ,51--!BN'A00'J#$!7'()'-@17'À!J(Ä-'@#4!',!!2'<@!<T!B'#2B'#JJÄ(4!B')(À'Ä!0!#7!N

Ā@17'>2-!ÄJÄ!-14!'U #01-.'/(2-Ä(0'=!J(Ä-'<(2-#127'-@!')(00(^12%)(Ä5#-1(2%

- A2#0.717':(0B12$'Ā15!'/(5J01#2<!
- U #01-.'/(2-Ä(0'"#Ä#5!-!À'RÄ!Z !2<.'/(5J01#2<!
- WÀ1!)'8!-@(B'? 55#À1!7
- ? 55#Ä.'()'[-01!À7

"#$!	%C( ) '*
F(ÄT'[ÄB!Ä	%38&I&HCGL
/01!2-	%9:6"'Ã;'+Ã6
"Ä(S!<-	%G&'D&HCL":#55(2B"'#ÄT'?<@((07"""

ĀÀ !"#$#%&'!($À)%*$+,%-'+.!$ À/,

Ã@17ÄJ(À-' 7 55#À1_!7' !`-Ä#<-1(2' ]' JÀ!J#À#-1(2'#2B' #2#0.717'-5!7' #2B' <(5J#À!7' ! #<@'^1-@'À!<(55!2B!B' @(0B12$'15!7' Xa?3"A' ?F' QIGb' A":A b A?' #2B' V3"8Y' ,#7!B' (2' -@!' 7#5J0!' <(2-#12!À' JÀ(41B!B'N' 6#-!7' Ä!J(Ä-!B'Ä!JÀ!7!2-')1Ä7-'B#-!'()'!`-Ä#<-1(2'(Ä'#2#0.717'#2B'JÀ!0 B!'7 ,7!Z !2-'B10 -1(27'#2B'À!Ä 27N'A'017-12$'()',À!#<@!7'X#2.Y'17'JÀ(41B!B'@!Ä!12N

:(0B12$' -15!')(À' 0#<@#-!' 5!-@(B7' XN$N Ā/+"Y' 4#À.' #<<(ÀB12$-(' -@!' #2#0.-!7' À!J(Ä-!BN'' A77!775!2-' <(5J#Ä!7' -@!' 0!#<@'B#-!' ^1-@'-@!' 7@(Ä-!7-'#2#0.-!' @0B12$'-15!')(À' -@!' !Z 14#0!2-' 7(10'5!- @(BNĀ@!7!' #À!%' (À$#21<7' &I'B#.7b'5!À< À.'CQ'B#.7'c'(-@!À'5!-#07'&QH'B#.7N''A'À!<(ÀB!B', À!#<@'B(!7'2(-'$ #À#2-!!'#',À!#<@')(À'#00'2(2M4(0#-10!'J#À#5!-Ä7N

:(0B12$' -15!7')(À' ***01-% $Ä%'$!#*** 4#À.' #<<(ÀB12$-(' #2#0.-!7' ()' 12-!À!7-N' K12.0'/@0(Ä1B!'#2B' ?-.À!2!' @0B12$'-15!' 7' L'B#.7 d (-@!Ä7'&I'B#.7 N ' A' À!<(ÀB!B' ,À!#<@'B(!7' 2(-' $ #Ä#2-!!' #' , À!#<@')(À' #00K[/' #2#0.-!7' #2B' 7@(0B','4!Ä1)1!B'12'<#7!'-@!'À!J(Ä-!B',À!#<@'17'#')#07!'J(7!4!' (Ä'K12.0'/@0(Ä1B!'#2B'?-.Ä!2!'#Ä!'2(-'T!.'#2#0.-!7'()'12-!Ä !7-]<(2<!Ä2N

8#-Ä13%,Ā) 34#0 #-1(2%"e':(0B12$'-15!',À!#<@'d'✓'e'F1-@12'@(0B12$'-15!N'

5,46'(	*2 +.!,%3 4,*	*%&'( )'$*Ä+,+-(./ ('$*Ä*			*ĀÄ !"#$#*		
-'Ä4 $Ä,8%9%$.Ä'+5 6/!.+728#9		*3 4,%,748 /4,(*	*21.+3*(+.&'( )'$*Ä*	*%0 !1 '$*Ä*	*3 4,% Ä !"#,(*	*21.+3*(+ Ä !"#$#*	*%0 !1 '$*Ä*
!(7BB3%4.G;KL/2%+.MK2MK							
J.GI%NIE;;%OE/%P'/2M/Q21%R(7BB?57@$ UAHC	**@7?J!#?8756**	**????**	MMMM	MMMM	**7@?,+ ?8756**	&IM[/ĀMCH&I	✓
!N77B 3% .KEI%42KEI;%TU%Ā+#?(!J							
J.GI%NIE;;%OE/%P'/2M/Q21%RN77B S UAHC	**@7?J!#?8756**	**7@?,+ ?8756**	CEM8A=MCH&*	✓	**79?,+ ?8756**	CEM8A=MCH&*	✓
!N7@B 3%% .KEI%"2F.Q2/ETI2%42/FL/U%TU%DĀ4J							
J.GI%NIE;;%OE/%P'/2M/Q21%RN7@B S UAHC	**@7?J!#?8756**	**7@?,+ ?8756**	CQM[/ĀMCH&I	✓	**79?,+ ?8756**	CQM[/ĀMCH&I	✓
!#79A(3%,/VEM.FWI./GM2%#2;KGFG12;%R,+S							
J.GI%NIE;;%OE/%P'/2M/Q21%R#79A S UAHC	**@7?J!#?8756**	**7@?,+ ?8756**	&IM[/ĀMCH&I	✓	**79?,+ ?8756**	&CMV[KMCH&I	✓
!#79AX3%,/VEM.PW.;PW./L;%#2;KGFG12;%R,#S							
J.GI%NIE;;%OE/%P'/2M/Q21%R#79A S UAHC	**@7?J!#?8756**	**7@?,+ ?8756**	&IM[/ĀMCH&I	✓	**79?,+ ?8756**	&CMV[KMCH&I	✓

:; !$4"%-'À48'!%< 8 +,4,8%=8,>;,Ã/"%-'+.!$ Ã/,

Ã@!')(00(^12$'Ã!J(Ã-'7 55#À17!7'-@!')Ã!Z !2<.'()'0#,(Ã#-(Ã.'U/' 7#5J0!7'#2#0.7!B'^1-@12'-@!'#2#0.-1<#0'0(-X7Y'12'^@1<@'-@!'B'5#5J0!X7Y'^#7X^@!Ã!Y'JÃ(<!77!BN'A<- #0'Ã#-!'7@(0B',!'$Ã!Ã'-@#2'(Ã'!Z #0'-(' -@!'!`J!<-!B'Ã#-!N'A'017-12$'()',Ã!#<@!7'17'JÃ(41B!B'12'-@!'?5#Ã.'()'[-01!Ã7N

8#-Ã13,Ã)

34#0 #-1(2% 'e'U #01- '/(2-Ã(0')Ã! Z !2< . '2(-'^1-@12'J!<1)1<#-1(2' ✓ 'e'U #01- '/(2-Ã(0')Ã! Z !2< . '^1-@12'J!<1)1<#-1(2N'

U #01-.'/(2-Ã(0'?#5J0!Ã.J!		4*1Ã'		; '.+ 8= 9			:1 !$'"+4*Ã'(*!+5/.)$3$) '$*Ã
ÃÃ !"'$) !+>.'?*@#	>.'?*@	:4	:.<1! (	Ã/4: !	?7../4.(	%0 !1 '$*Ã	
+#,(Ã#-(Ã.'6 J01<#-!7'X6a"Y							
8(17- Ã!'/(2-!2-	3AH**M&HD	C	CH	%%57Y7	%%57Y7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
"!7-1<1B!7',.'9/8?	3"HGQ	&	C	%%B7Y7	%%57Y7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!Ã< Ã.',.'R>8?	39HD*Ã	C	&I	%%56Y@	%%57Y7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!-#07',.'>/"MA3?	39HH*Ã	C	&G	%%58YB	%%57Y7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
+#,(Ã#-(Ã.'/(2-Ã(0'?#5J0!7'X+/?Y							
"!7-1<1B!7',.'9/8?	3"HGQ	&	C	%%B7Y7	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!Ã< Ã.',.'R>8?	39HD*Ã	&	&I	%%%:Y5	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!-#07',.'>/"MA3?	39HH*Ã	&	&G	%%%9Y@	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
8!-@(B'W0#2T7'X8WY							
"!7-1<1B!7',.'9/8?	3"HGQ	&	C	%%B7Y7	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!Ã< Ã.',.'R>8?	39HD*Ã	&	&I	%%%:Y5	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!-#07',.'>/"MA3?	39HH*Ã	&	&G	%%%9Y@	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
8#-Ã1`'?J1T!7'X8?Y							
"!7-1<1B!7',.'9/8?	3"HGQ	&	C	%%B7Y7	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!Ã< Ã.',.'R>8?	39HD*Ã	&	&I	%%%:Y5	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-
Ã(-#0'8!-#07',.'>/"MA3?	39HH*Ã	&	&G	%%%9Y@	%%%BY7	✓	V3"8'CH&D"?<@!B 0!'WXDY'#2B'A+?'U/?D'Ã!Z 1Ã!5!2-

"#$!	%I '() '*
F(ÄT'[ÄB!Ä	%38&I&HCGL
/01!2-	%9:6"'Ä;'+Ä6
"Ä(S!<-	%G&'D&HCL":#55(2B"'#ÄT'?<@((07""""

@8$,A%5,46'(%2;++ 8$,#

Ã@!'#2#0.-1<#0'JÄ(<!B Ä!7' 7!B',.'-@!'3241Ä(25!2-#0'614171(2'@#,!!2'B!4!0(J!B')Ä(5'!7-#,017@!B'12-!Ä2#-1(2#00.'Ä!<($21_!B'J Ä(<!B Ä!7'7 <@'#7'-@(7!'J ,017@!B',.'-@!'a?'3"Ab'A":Ab'A?'#2B'V 3"8N'>2'@(7!' B!4!0(J!B'JÄ(<!B Ä!7'#Ä!'!5J0(.!B'12'-@!'#,7!2<!'()'B(< 5!2-!B' 7-#2B#ÄB7'(Ä',.'<01!2-'Ä!Z !7-N'Ã@!')(00(^12$'Ä!J(Ä-'JÄ(41B!Ä1!)'B!7<Ä1J-1(27'()'-@!'#2#0.-1<#0'JÄ(<!B Ä!7'!5J0(.!B')(Ä'Ä!0-7'Ä!J(Ä-!B'12'-@!' /!Ä-1)1<#-!'()'A2#0.717N'?(Ä<!7')Ä(5'^@1<@'A+?'5!-@(B7'@#4!',!2'B!4!0(J!B'#Ä!'JÄ(41B!B'^1-@12'-@!'8!-@(B'6!7<Ä1J-1(27N

ÄÄ !'"$) !+>.'?*@#	>.'?*@	> '($&	>.'?*@+2.#)($/'$*Ä#
8(17- Ä!'/(2-!2-	3AH**M&HD	?[>+	A'$Ä#415!-Ä1<'JÄ(<!B Ä!',#7!B'(2'^!1$@-'0(77'(4!Ä'#'&C'@(Ä'BÄ12$'J!Ä1(B'#-'&HDM&H*'B!$Ä!!7'/N"Ã@17'5!-@(B' 17'<(5J01#2-'^1-@'V3"8'XCH&DY'?<@!B 0!'WXDY'?!<-1(2'LN&'#2B'Ã#,&I'B#.'@(0B12$'-15!YN
Ã(-#0'8!-#07',.'>/"MA3?	39HH*Ä	?[>+	XA":A'C&7-'!BNb'D&CHd'a?3"A'?F'QIG'M'GH&HY'X>/"A3?'Y'8!-#07'#Ä!'-!Ä512!B')(00(^12$'#2'#JJÄ(JÄ1#-!'#<1B' B1$!7-1(2'()'-@!'7(10N"Ã@!>/"A3?'-!<@21Z !'1(217!7'7#5J0!7'12'#'J0#75#b'!51--12$'#'<@#Ä#<-!Ä17-1<'7J!<-Ä 5' ,#7!B'(2'5!-#07'JÄ!7!2-N">2-!271-1!7'#-'7!0!<-!B'^#4!0!2$-@7'# Ä!'<(5J#Ä!B'#$#127-'-@(7!'()'5#-Ä1`'5#-<@!B' 7-#2B#ÄB7N'Ã@17'5!-@(B'17'<(5J01#2-'^1-@'V3"8'XCH&DY'?<@!B 0!'WXDY'W
Ã(-#0'8!Ä< Ä.',.'R>8?	39HD*Ä	?[>+	A?'D**Hb'A":A'C&7-'!BNb"D&&C':$'M'W'XR0(^M12S!<-1(2'X?2/0C)8XK#J(Ä'$!2!Ä#-1(2Y'AA?Y"R>8MAA?'17'#2' # -(5#-!B')0#5!0!77'#-(51<'#,7(ÄJ-1(2'-!<@21Z !N'8!Ä< Ä.'12'7(0 1B7'#Ä!'B!-!Ä512!B')(00(^12$'#2'#JJÄ(JÄ1#-!' #<1B'B1$!7-1(2N'>2(21<'5!Ä< Ä.'17'Ä!B <!B'(2012!'-('#-(51<'5!Ä< Ä.'4#J(Ä',.'?2/0C'^@1<@'17'-@!2'J Ä$!B'12-('#' @!#-!B'Z #Ä-_'<!00N"U #2-1)1<#-1(2'17',.'<(5J#Ä12$'#,7(Ä,#2<!'#$#127-'#'<#01,Ä#-1(2'< Ä4!N'Ã@17'5!-@(B'17' <(5J01#2-'^1-@'V3"8'XCH&DY'?<@!B 0!'WXDY
"!7-1<1B!7',.'9/8?	3"HGQ	?[>+	Xa?3"A'?F'QIG'M'QCLHWY'3'-Ä#<-7'#Ä!'#2#0.7!B',.'/#J100#Ä.'9/]8? '#2B'Z #2-1)1<#-1(2'17',.'<(5J#Ä17(2'#$#127-' #2'!7-#,017@!B'*'J(12-'<#01,Ä#-1(2'< Ä4!N'Ã@17'-!<@21Z !'17'<(5J01#2-'^1-@'V3"8'XCH&DY'?<@!B 0!'WXDY'X8!-@(B' *HIb*H*Y

-(./ ('$*Ä+>.'?*@#	>.'?*@	> '($&	>.'?*@+2.#)($/'$*Ä#
Ã 5,0!Ä'3`-Ä#<-1(2'()'?(01B7	[=9&L	?[>+	>2M@(7!'b'8!<@#21<#0'#$1-#-1(2'X- 5,0!ÄYN'&H$'()'7#5J0!'b'V#G#2B'7 ÄÄ($#-!'#Ä!'!`-Ä#<-!B'^1-@'DH5+'&%&' 6/8]A<!-(2!',.'!2B'(4!Ä'!2B'- 5,0!N"Ã@!'7(04!2-'17'B!<#2-!Bb'B !@.BÄ#-!B'#2B'<(2<!2-Ä#-!B'X,.'f6Y'-('-@!' B!71Ä!B'4(0 5!')(Ä'#2#0.717N

2;++ 8"%'A%1;4!$,8#

1;4!$,8#%B%:; !$4"%-'À48'!%2 +.!,#

Ā@!')(00(^12$' ÄJ(Ä-' @1$@01$@-0'1!Ä7')0#$$!B' 12' -@!' U #01-.' /(2-Ä(0' XU/Y' =!J(Ä- N ? ÄÄ($#-!' Ä<(4!Ä.' 0151-7#Ä!' 7-#-1<'#2B' ,#7!B' (2' a?3"A' ?F QIG'(Ä' A+?MUF>]3V]DQ'2' -@!' #,7!2<!' ( )' 7J!<1)1<'a?3"A' 0151-7YĀ@17' Ä!J(Ä-'B17J0#.7'U/'[-01!Ä7'X,Ä!#<@!7Y'(20.N

3;.!$/ 4,#C%5,46'(%@! ÀD#C%E F'8 4'8"%-'À48'!%2 +.!,#% À(%5 48$'%2.$D,#

8#-Ä13%Ā)

/(5J(2B'9Ä(J'V#5!	+#,(À#-(Ä.'?#5J0!'>6	/01!2-'?#5J0!'>6	(MEIUK2	/A?'V 5,!Ä	6#-#	+151-7	+.HH2MK
ZLPIGFEK2%RZ'#S%"#Z;%							
39HH*Ā%'Ā(-#0'8!-#07',.'>/"MA3?	38&I&HC&DMHIG	A2(2.5(7	**+.PP2/**	LIIHM*HMQ	EQNC'g	HMCHg	**"#Z%2[F221;%),"%TE;21%IGHGK;**
39HH*Ā%'Ā(-#0'8!-#07',.'>/"MA3?	38&I&HC&DMHIG	A2(2.5(7	**\GMF**	LIIHMGGMG	*GNC'g	HM*Hg	**"#Z%2[F221;%),"%TE;21%IGHGK;**
4EK/G[%JPG02%R4JS%"2F.Q2/G2;%							
39HH*Ā%'Ā(-#0'8!-#07',.'>/"MA3?	38&I&HC&DMHCC	A2(2.5(7	**)2E1**	LIDEMECM&	V(-' 6!-!Ä512!B	MMMM	**4J%/2F.Q2/U%M.K%12K2/HGM21]% TEF0V/.LM1%I2Q2I%V/2EK2/%KWEM%./% 2^LEI%K.%%6[%;PG02%I2Q2IY**
39HH*Ā%'Ā(-#0'8!-#07',.'>/"MA3?	38&I&HC&DMHCC	A2(2.5(7	**\GMF**	LIIHMGGMG	V(-' 6!-!Ä512!B	MMMM	**4J%/2F.Q2/U%M.K%12K2/HGM21]% TEF0V/.LM1%I2Q2I%V/2EK2/%KWEM%./% 2^LEI%K.%%6[%;PG02%I2Q2IY**

- **D./%EII%HEK/GF2;]%M.%42KW.1%XIEM0%QEIL2%.LKIG2/;%.FFL/Y**
- **D./%EII%HEK/GF2;]%M.%)ET./EK./U%+.MK/.I%.LKIG2/;%.FFL/Y**

G,);! 8%2 +.!,%2;88') 4,#

- **D./%EII%/2VLIE/%;EHPI2%HEK/GF2;]%M.%;L//.VEK2%/2F.Q2/U%.EKIG2/;**

1;4!$,8#%B%ĀÀ !"#$#%&'!($À)%*$+,%-'+.!$ À/,

Ā@17'Ä!J(Ä-'B17J0#.7':(0B12$'Ā15!',Ä!#<@!7'(20.N'[20.'-@!'Ä!7ȣ14!'3`-Ä#<-1(2']"'Ä!J#Ä#-1(2'#2B](Ä'A2#0.717'<(5J(2!2-'17]#ÄB17J0#.!BN

- **À.%(MEIU;G;%=.I1GMV% GH2%,LKIG2/;%2[G;KY**

1;4!$,8#%B%=8,>;,À/"%'A%:; !$4"%-'À48'!%2 +.!,#

Ā@!')(00(^12$'Ä!J(Ä-'@1$@01$@-7',Ä!#<@!7'12'-@!'RÄ!Z !2<.#(01.'/(2-Ä(0'?#5J0!7N

- **À.%&LEIGKU%+.MK/.I%JEHPI2%D/2^L2MFU%,LKIG2/;%2[G;KY**

CHAIN OF CUSTODY RECORD AND ANALYSIS REQUEST

GHD | CLIENTS | PEOPLE | PERFORMANCE

GHD House
239 Adelaide Terrace
Perth WA 6004

PO Box Y3106
Perth WA 6832
T 6222 8222
F 6222 8555

Project: Hammond Park Schools PPP
Client: Department of Finance
Job Manager: Peter Tilley
Invoicing:

Job Number: 61/31027
E-mail Address (Results): joanna.stegena@ghd.com
Turnaround: 3 days

Laboratory: ALS
Address: 10 Hod Way Malaga

GHD Sample ID	Laboratory Sample ID	Date	Time	Sample Matrix	Container	Analyses: pHF/pHFOX	8 Metals	OC/OP Pesticides	Hold	Comment
QA02	4 –	30/09/2014		SOIL	JAR		✓	✓		
QA04	1	30/09/2014		SOIL	BAG	✓				
QA06	2	30/09/2014		SOIL	BAG	✓				
QA08	– SNR	30/09/2014		SOIL	BAG	✓				
QA10	3	30/09/2014		SOIL	BAG	✓				
QA12	4	30/09/2014		SOIL	BAG	✓				
QA14	5	30/09/2014		SOIL	BAG	✓				
QA16	6	30/09/2014		SOIL	BAG	✓				

Environmental Division
Perth
Work Order
EP1407979

Telephone : +61-8-9209 7655

Sampled By: Joanna Stegena
Date: 30/09/2014
Time:

Relinquished by:
Date:
Time:

Received by:
Date: 1/10/14
Time: 1430

ALS Environmental

ĀÀ !"#"Ā$!À%&#%$'$()*'"*

+,-.%&-/0-	1À23456767	*Ä+"	, $#. #
4 5"62	, 89:%2!)%(!:	0Ä1-(Ä2-(3	, 7685(-69"62À #:585!5-6#*"(2;
4-62Ä<2	, *7'7=#'>007?	4-62Ä<2	, @<-22#AÀ9"!
BCC("!!	, DEF#B:70B>:7#'7==B47 *7='G#HB#I&&/	BCC("!!	, $&#G-C#HÀ3#JÀ À+À#HB#B)!2(Ä 5À#I&F&
7K9Ä5	, KKKK	7K9Ä5	, L"(2;%"685(-%!"(85<"!MÀ !+ -1À %<-9
'" "L;-6"	, NI$#&O#IDDD#ODDD	'" "L;-6"	, NI$KOKFD&F#PIQQ
ĀÄ<!595 "	, NI$#&O#F/DF#IQQQ	ĀÄ<!595 "	, NI$KOKFD&F#PI&&
*(-R"<2	, I$#E$&DP#GÀ99-6C#*Ä(S#@<;-- !#***	T4#0"8"	, U7*J#D&$E##@<;"C) "#VWEX#À6C#B0@#T4@E#("Y)5("9"62
Z(C"(#6)91"(	, KKKK		
4KZK4#6)91"(	, KKKK	:Ä2"#@Ä9L "!#="<"58"C	, &$KZ4'KD&$/
@Ä9L "(	, A%@%	>!!)"#:Ä2"	, &DKZ4'KD&$/
@52"	, KKKK		
		U-%#-.#!Ä9L "!#("<"58"C	, I
T)-2"#6)91"(	, 7U[&&Q[$/	U-%#-.#!Ä9L "!#À6Ä 3!"C	, I

';5!# ("L-(2# !)L"(!"C"!# Ä63#L("85-)!# ("L-(2WX# \52;# 2;5!#("."("6 <"%#="!) 2!# ÀLL 3#2# 2;"# !Ä9L " W!XÄ!# !)19522"C%# #LÄ+"!# - .# 25!# ("L-(2# ;Ä8"# 1""6# <;"<S"C# Ä6C#ÀLL(-8"C# .- (" "À!"%#

';5!#4"(25.5<Ä2"#-.#B6Ä 3!5!#<-62Ä56!#2;"#.- -\56+#56.-(9Ä25-6

-]"6"(Ä #4-99"62!
- B6Ä 325<Ä #="!) 2!

NATA
WORLD RECOGNISED ACCREDITATION

UB'B#B<<("C52"C#0Ä1-(Ä2-(3#ODQ #
B<<("C52"C#.-(#<-9L 5Ä6<"#\52;# >@Z[>74#$P&DQ%

ĀÀ !"#$%À&'

';5!# C-<)9"62# ;À!# 1""6# " "<2(-65<À 3#! 5+6"C#13# 2"# À)2;-(5^"C# !5+6Ä2-(5"!# 56C5<Ä2"C# -\%# 7 "<2(-65<#! 5+656+#À!# 1""6 <À((5"C#-)2#56#<-9L 5Ä6<"#\52;#L(-<"C)("!#!L"<5.5"C#56#D$#ÄÄ2#$%

ĀÄ !"#$%Ä&'	*.$'Ä#Ä$!*	*())%&*Ä#"#Ä$!+,"#& $%-*
0"À66"#4À("3	B<5C#@) .Ä2"#@-5 !#@)L"(85!-(	*"(2;#B@@

ĀÀ À!"#$%&"À ()

';"# À6À 325<À!#L(-<"C)("!#)!"C# 13#2"# 7685(-69"62À # :585!5-6#; À8"# 1""6# C"8" -L"C# .(-9# " !2À1 5!;"C# 562"(6À25-6À 3!#-+65^"C# L(-<"C)("!# !)<;# À!# 2;-!"# L)1 5!;"C# 13#2"# _@7*B`# B*GB`# B@#À6C#U7*J%# >6# ;-)!"# C"8" -L"C#L(-<"C)("!#À("#"9L -3"C#56#2;"#À1!"6<"#-.#C-<)9"62"C# !2À6CÀ(C!#-(#13#< 5"62#("Y)"!2%

H;"("#9-5!2)("#C"2"(956À25-6#;À!#1""6#L"(.-(9"C`#("!) 2!#À("# L-(2"C#-6#À#C(3#\"5+;2#1À!5!%

H;"("#À#("L-(2"C# "!!#2;À6#WaX#("!) 2#5!#;5+;"(#2;À6#2;"#0Z=5#2#9À3#1"#C)"#2-#L(59À(3#!À9L "#"b2(À<2[C5+"!2À2"#C5)25-6#/6C.5<5"62#!À9L "#.-(#À6À 3!5!%

H;"("#2;"#0Z=#-.#À#("L-(2"C#("!) 2#C5.."(!#.(-9#!2À6CÀ(C#0Z=`#2#9À3#1"#C)"#2-#;5+;#9-5!2)("#<-62"62`#56!)..5<5"62#!À9L"#À\À5 À1 "#!À9L -3"CX#-(#9À2(5b#562"(."("6<"%

H;"6#!À9L 56+#259"#56.-(9À25-6#5!#6-2#L(-85C"C#13#2;"#< 5"62`#!À9L 56+#CÀ2"!#À("#!;-\6#\52;-)2#À#259"#<-9L-6"62%##>6#2;"!"#56!2À6<"!`#2;"#259"#<-9L-6"62#;À!#1""6#À!!)9"C#13#2;"# À1-(À2-(3#.-(#L(-<"!!56+#L)(L-!"!%

H;"("#À#("!) 2#5!#("Y)5("C#2-#9""2#<-9L 5À6<"#5952!#2;"#À!!-<5À2"C#)6<"(2À5623#9)!2#1"#<-6!5C"("C%#=".(#2-#2;"#B0@#4-6À!"2À5 !%

d"3#, 4B@#U)91"(#c#4B@#("+5!2(3#6)91"(#.(-9#CÀ2À1À!"#9À562À56"C#13#4;"95<À #B1!2(À<2!#@"(85<"!%#;"#4;"95<À #B1!2(À<2!#@"(85<"#5!#À#C585!5-6#-.#2;"#B9"(5<À6#4;"95<À #@-<5"23%
0Z=#c#05952#-.#("L-(256+
H#c#';5!#("!) 2#5!#<-9L)2"C#.(-9#56C585C)À #À6À 32"#C"2"<25-6!#À1-8"#2;"#"8"#-.#("L-(256+

- $**1%À$5I6%J CKE/%#E0G/%CL/%#J,MN%;D-00LELON1%K9%#J,MNF01%DP3E/2%*GEOQPR%A%?%S,/0-CP0R%I%?%*P-,LOR%4%?%ÀMP-0F0
- À$5I6%$**%#E0G/%*D-00LELO1%'$!$%CDD-0/EPCPE,L%/,0;%L,P%D,TE%LE0%,U%PQE;%;0-TED0V

*Ä+"	,	E#. #/
H-(S#Z(C"(	,	7*$/&PFPF
4 5"62	,	]G:#*'?#0':
*(-R"<2	,	I$#E$&DP#GÄ99-6C#*Ä(S#@<;-- !#***

* "#+(,-"#$.À)/#()

@)1KJÀ2(5I **%*&"(%** JÀ2(5I **%*&"(N**

,/À&!#+'"01/&+23				W$54	W$5>	W$35	W$3A	W$34
,/À&!#+'"01/À! +*'"#&+4+#À0&				E&K@7*KD&$/#$Q,&&	E&K@7*KD&$/#$Q,&&	E&K@7*KD&$/#$Q,&&	E&K@7*KD&$/#$Q,&&	E&K@7*KD&$/#$Q,&&
,$0 1$:!*	,(Ā+9:0;& 9	678	5!À#	**À23456767?553**	**À23456767?55A**	**À23456767?55I**	**À23456767?554**	**À23456767?55B**
À$5I61%%$;;%#E0G/%*D-00/EILCG;E;								
K9%J#N	KKKK	&%$	LG#_652	**BV3**	**BV@**	**BV3**	**BV>**	**4V@**
K9%J#,MN	KKKK	&%$	LG#_652	**BV5**	**BV3**	**4V7**	**4V6**	**4VI**
0CDPE,L% CP0	KKKK	$	K	***GEOQP**	***GEOQP**	***GEOQP**	***GEOQP**	**S ,/0-CP0**

*Ä+" , / #. #/
H-(S#Z(C"(, 7*$/&PFPF
4 5"62 ,]G:#*'?#0':
*(-R"<2 , I$#E$&DP#GÄ99-6C#*Ä(S#@<;-- !#***

* "#+(,-"#$.À)/#()

@)1KJÄ2(5 %*&"(%Ä2(5 %*&"(N	,/À&!#+'"01/&+23	W$3>	KKKK	KKKK	KKKK	KKKK
	,/À&!#+'"01/À! +*'#&+4+#Ä0&	E&K@7*KD&$/#$Q,&&	KKKK	KKKK	KKKK	KKKK
,$0 1$:!* ,(Ã+9:0;& ç	678	5!À#	Ä23456767?55>	????	????	????	????
Ä$5I61%%$;;%#E0G/%*D-00ÆLOÇE;							
K9%J#N KKKK	&%$	LG#_652	BV7	KKKK	KKKK	KKKK	KKKK
K9%J#,MN KKKK	&%$	LG#_652	4V3	KKKK	KKKK	KKKK	KKKK
0CDPE,L% CP0 KKKK	$	K	S,/0-CP0	KKKK	KKKK	KKKK	KKKK

Environmental

ĀÀ !"#$%&'(#)'!%)*+')#

,-./%'.01.	2*+3456767	*Ä+"	, $#. #
4 5"62	, 89:%+#$%!#:	0Ä1-(Ä2-(3	, 7685(-69"62Ä #:585!5-6#*"(2;
4-62Ä<2	, *7'7=#'>007?	4-62Ä<2	, @<-22#AÀ9"!
BCC("!!	, DEF#B:70B>:7#'7==B47 *7='G#HB#I&&/	BCC("!!	, $&#G-C#HÀ3#JÀ Ä+Ä#HB#B)!2(Ä 5Ä#I&F&
7K9Ä5	, KKKK	7K9Ä5	, L"(2;%"685(-%!"(85<"!MÀ !+ -1Ä %<-9
"' "L;-6"	, NI$#&O#IDDD#ODDD	"' "L;-6"	, NI$KOKFD&F#PIQQ
ĀÄ<!595 "	, NI$#&O#F/DF#IQQQ	ĀÄ<!595 "	, NI$KOKFD&F#PI&&
*(-R"<2	, I$#E$&DP#GÄ99-6C#*Ä(S#@<;-- !#***	T4#0"8"	, U7*J#D&$E##@<;"C) "#VWEX#À6C#B0@#T4@E#("Y)5("9"62
@52"	, KKKK		
4KZK4#6)91"(	, KKKK	:Ä2"#@Ä9L "!#="<"58"C	, &$KZ4'KD&$/
@Ä9L "(	, A%@%	>!!)"#:Ä2"	, &DKZ4'KD&$/
Z(C"(#6)91"(	, KKKK		
		U-%#-.#!Ä9L "!#("<"58"C	, I
T)-2"#6)91"(	, 7U[&&Q[$/	U-%#-.#!Ä9L "!#À6Ä 3!"C	, I

';5!# ("L-(2# !)L"(!"C"!# À63#L("85-)!# ("L-(2WX#\52;# 2;5!#("."("6 <"%#="!) 2!# ÀLL 3#2# 2;"# !À9L " W!XÀ!# !)19522"C%# #LÄ+"!# - .# 25!# ("L-(2# ;Ä8"# 1""6# <;"<S"C# À6C#ÀLL(-8"C# .- (" "Ä!"%#

';5!#T)Ä 523#4-62(- #="L-(2#<-62Ä56!#2;"#.- -\56+#56.-(9Ä25-6,

- 0Ä1-(Ä2-(3#:)L 5<Ä2"#W:]*X#="L-(2#" Ä258"#*"(<"62Ä+"#:5.."("6<"#W=*:X#Ä6C#B<<"L2Ä6<"#05952!
- J"2;-C#V Ä6S#WJVX#Ä6C#0Ä1-(Ä2-(3#4-62(- #@L5S"#W04@X#="-8'(3#Ä6C#B<<"L2Ä6<"#05952!
- JÀ2(5_#@L5S"#WJ@X#="-(28"(3#Ä6C#B<<"L2Ä6<"#05952!

NATA
WORLD RECOGNISED
ACCREDITATION

UB'B#B<<("C52"C# 0Ä1-(Ä2-(3#ODQ# B<<("C52"C#.-(# <-9L 5Ä6<"#\52;# >@Z[>74#$P&DQ%

ĀÀ !"#$%À&'

';5!# C-<)9"62# ; À!# 1""6# " "<2(-65<À 3#! 5+6"C#13# 2;"# À)2;-(5`"C# !5+6À2-(5"!# 5C5<À2"C#" -\%# 7 "<2(-65<#! 5+656+#À!# 1""6# <À((5C# -)2# 5 <-9L 5Ä6<"#\52;#L(-<"C)("!#!L"<5.5"C#56#D$#4Ā=#*Ä(2#$$%

ĀÄ !"#$%À&'	*.$'Ä#Ä$!*	*())%&*Ä#"#Ä$!+,'#& $%-*
0"Ä66"#4Ä("3	B<5C#@) .Ä2"#@-5 !#@)L"(85!-(	* "(2;#B@@

*Ä+" , D#. #
H-(S#Z(C"(, 7*$/&PFPF
4 5"62 , aG:#*'?#0':
*(-R"<2 , I$#E$&DP#GÄ99-6C#*Ä(S#@<;-- !#***

ĀÀ À!"#$%&"À ()

';"# Ä6Ä 325<ÄL#(-<"C)("!#) !"C# 13# 2"# 7685(-69"62Ä # :585!5-6#; Ä8"# 1""6# C"8" -L"C# .(-9# " !2Ä1 5!;"C# 562"(6Ä25-6Ä 3#<-+65`"C# L(-<"C)("!# !)<;# Ä!# 2-!"# L)1 5!;"C# 13# 2"#]@7*Bb# B*GB b# B@#Ä6C#U7*J%# >6# ;-)!"# C"8" -L"C#L(-<"C)("!#Ä("#"9L -3"C#56#2;"#Ä1!"6<"#-.#C-<)9"62"C# !2Ä6CÄ(C!#-(#13#< 5"62#("Y)"!2%

H;"("#9-5!2)("#C"2"(956Ä25-6#;Ä!#1""6#L"(.-(9"Cb#("!) 2!#Ä("#(" L-(2"C#-6#Ä#C(3#\"5+;2#1Ä!5!%

H;"("#Ä#("L-(2"C# "!!#2;Ä6#WcX#("!) 2#5!#;5+;"(#2;Ä6#2;"#0Z=b#2;"#9Ä3#1"#C)"#2-#L(59Ä(3#!Ä9L "#"_2(Ä<2[C5+"!2Ä2"#C5)25-6#Ä6C[-(#<5<5"62#!Ä9L "#.-(#Ä6Ä 3!5!%

H;"("#2;"#0Z=#-.#Ä#("L-(2"C#("!) 2#C5.."(!#.(-9#!2Ä6CÄ(C#0Z=b#2;"#9Ä3#1"#C)"#2-#;5+;#9-5!2)("#<-62"62b#56!)..5<5"62#!Ä9L "#WXV(C#\"5+;2#"9L -3"CX#-(#9Ä2(5_#562"(.""("6<"%

f"3#, B6-639-)!#d#="."(!#2-#!Ä9L "!#\;5<;#Ä("#6-2#!L"<5.5<Ä 3#LÄ(2#-.#2;5!#\-(S#-(C"(#1)2#.-(9"C#LÄ(2#-.#2;"#T4#L(-<"!!# -2
4B@#U)91"(#d#4B@#("+5!2(3#6)91"(#.(-9#CÄ2Ä1Ä!"#9Ä562Ä56"C#13#4;"95<Ä #B1!2(Ä<2!#@"(85<"!%#';"#4;"95<Ä #B1!2(Ä<2!#@"(85<"#5!#Ä#C585!5-6#-.#2;"#B9"(5<Ä6#4;"95<Ä #@-<5"23%#
0Z=#d#05952#-.#("L-(256+#
=*:#d#=" Ä258"#*"(<"62Ä+"#:5.."("6<"
e##d#>6C5<Ä2"!#.Ä5 "C#T4

*Ä+" , E#. #
H-(S#Z(C"(, 7*$/&PFPF
4 5"62 , aG:#*'?#0':
*(-R"<2 , I$#E$&DP#GÄ99-6C#*Ä(S#@<;-- !#***

*"+&!"(&!,$-./#01"(Ä$2-345$6À/&!(

';"# Y)Ä 523#-62(- # 2"(9# 0Å1-(Ä2-(3#:)L 5<Ä2"# ("."(!# 2-# Ä# (Ä6C-9 3# !" "<2"C# 562(Ä Ä1-(Ä2-(3#L 52%#Å1-(Ä2-(3#C)L 5<Ä2"!#L(-85C"# 56.-(9Å25-6#("+Ä(C56+#9"2;-C# L("<5!5-6#Ä6C#!Ä9L "# ;"2"(-+"6" 523%#'# L"(9522"C#(Ä6+"!# .-(# 2;"# =" Ä258"#*"(<"62# :"85Å25-6#W=*:X#-.# 0Å1-(Ä2-(3#:)L 5<Ä2'!# Ä("# ! L"<5.5"C#56#B0@#J"2;-C# TH> K7U[EO#6C#Ä("# C"L"6C"62#- 6#2,"# 9Ä+652)C"#-.# ("!) 2!# 56#<-9LÄ(5!-6# 2-#2,"# "8" # - .#("L-(256+;#="!) 2# c# $&#259"!# 0Z= ,# U-#05952^#="!) 2#1"2\""6#$&#Ä6C#D&#259"!#0Z=,#&g#K#Q&g^#=#D)&#259"!#0Z=,#&g#K#D&g%

@)1KJÄ2(9**1**"!

				*"+&!"(&!,$-./#01"(Ä$2-345$6Ä/&!(					
*"+&!"(&!,$)"'/#Ä$:-	%#0Ä ($)"'/#Ä$:-	: Ä<&=>%& /&. =	%?@$A.'+Ä!	*76	3 0(	7!080 "#$6Ä).#(	-./#01"(Ä$6Ä).#(	6 4-$295	6Ä1&BÄ! $*0'0()$29 5
* 5J62%% ;;%CF1H0%IE.11KFKL% KDHM;F;%%NÃ&%!-O2%J>B@B3>P									
7*$/&PFPFK&&$	TB&/	7B&EP,#LG#WÃX	KKKK	&%$	LG#]652	Q%$	Q%/	Q%Q	&g#K#D&g
		7B&EP,#LG#WÃ-_X	KKKK	&%$	LG#]652	Q%&	/ %O	D%O	&g#K#D&g

;Ä(<&=$C#" D$2;C5$" =$*"+&!"(&!,$%& (!&#$@/0DÄ$2*%@5$6Ä/&!(

';"# Y)Ä 523#-62(- # 2"(9# J"2;-C# [#0Ä1-(Ä2-(3#V Ä6S#"."(!# 2-#Ä6#Ä6Ä 32"#("" # 9Ä2(5_#2# \;5<;# Ä #("Ä+"62!# Ä("# ÄCC"C#56#2;"# !Ä9 "# 8-)9"!# - (#L(-L-(25-6!# Ä!#)!"C# 56#2Ä6CÄ(C#Ä9L "# L("LÄ(Ä25-6%#"# L)(L-!"# -.# 25!# T4# LÄ(Ä9"2"(# 5# 2-# 9 -652-(#L-2"625Ä #Ä1-(Ä2-(3#<-62Ä956Ä25-6%#' # Y)Ä 523#-62(- # 2"(9# 0Ä1-(Ä2-(3# 4-62(- # @L5S"#W04@X#"."(!# 2-# Ä# <"(25.5"C#"."("6<"# 9Ä2"(5Ä b# (# Ä# S6-\6# 562"(."("6<"# .(""# 9Ä 2(5_#L5S"C#52;# 2Ä(+"2# Ä6Ä 32"!%#';"#L)(L-!"#-.#2;5!#T4#LÄ(Ä9"2"(#5!#2-#9-652-(#9"2;-C#L("<5!5-6#Ä6C#Ä<<)(Ä<3#56C"L"6C"62#-.#!Ä9L "#9Ä2(5_%#:36Ä98"(#05952!#Ä("#1Ä!"C#-6#!2Ä25!25<Ä #"8Ä)Ä25-6#-.#L(-#01"@%
KKKK

- **(-%Q1OR-0%SHDK/%NQSP%-.%!DT-.DO-.M%&-KO.-H%IUF/1%N!&D.1%1;WHO;%0%O-%T1%.1U-.O10X**

;"(!0E$@/0DÄ$2;@5$6Ä/&!(

';"# Y)Ä 523#-62(- # 2"(9# JÄ2(5_#@L5S"#WJ@X#"."(!# 2-#Ä6#562(Ä Ä(Ä2-(3# !L 52# Ä9L "# !L5S"C#52;# Ä#("L("!"62Ä258"# !"2# -.# 2Ä(+"2#Ä6Ä 32"!%#;"# L)(L-!"# -.# 25!# T4# LÄ(Ä9"2"(# 5!#2# 9-652-(# L-2"625Ä #9Ä2(5_# .."<2!# -6# Ä6Ä 32"#("<-8"(5"!%#@2Ä25<#="<-8"(3#05952!#Ä!#L"(# Ä1-(Ä2-(3#T4#Y)Ä 523#Z1R"<258"!#W:TZ!X%#>C"Ä #("<-8"(3#(Ä6+"!#!2Ä2"C#56#2;"#"8"62#-.#!Ä9L "#9Ä2(5_#562"(."("6<"%

- **(-%QDO.FY%IUF/1%NQIP%)1;VHO;%D.1%.1WVF.10%O-%T1%.1U-.O10X**

;"(!0E$@/0DÄ$2;@5$" =$;"(!0E$@/0DÄ$-./#01"(Ä$2;@-5$6Ä/&!(

';"# Y)Ä 523#-62(- # 2"(9# JÄ2(5_#@L5S"#WJ@X#6C#JÄ2(5_#@L5S"#)L 5<Ä2"#WJ@:X#"."(!# 2-# 52(Ä Ä1-(Ä2-(3#L 52# Ä9L "!# !L5S"C#52# Ä#("L("!"62Ä258"# !"2#-.# 2Ä(+"2#Ä6Ä 32"!%#;"# L)(L-!"# -.# 2;"!"# T4# LÄ(Ä9"2"(!# Ä("# 2-# 9-652-(#L-2"625Ä #9Ä2(5_#.."<2!#-6#Ä6Ä 32"#("<-8"(5"!%#@2Ä25<#="<-8"(3#05952!#Ä!#L"(#Ä1-(Ä2-(3#T)Ä 523#Z1R"<258"!#W:TZ!X%#>C"Ä #("<-8"(3#(Ä6+"!#!2Ä2"C#9Ä3#1"#\Ä58"C#56#2;"#"8"62#-.#9Ä2(5_#562"(."("6<"%

- **(-%QDO.FY%IUF/1%NQIP%-.%QDO.FY%IUF/1%:VUHFEDO1%NQIP%)1;VHO;%D.1%.1WVF.10%O-%T1%.1U-.O10X**

Environmental

ĀÀ !"#"! Ā$!% &'()Ā *%+,À ",)%"!#,"

-./0%,/12/	3!#4567878	"#$!	%&'() '*
/01!2-	%9:6'"Ā;'+Ā6	+#,(Ä#-(Ä.	%3241À(25!2-#0'614171(2""!À-8
/(2-#<-	%'3Ā3='Ā>++3;	/(2-#<-	%?<(--'@#5!7
ABBÀ!77	%CDE'A63+A>63'Ā3==A/3 "3=Ā:'FA'GHHI	ABBÀ!77	%&H':(B'F#.'J#0#$#'FA'A 7-Ä#01#'GHEH
3K5#10	%KKKK	3K5#10	%L!À-8M!241À(M7!À41<!7N#07$0(,#0M<(5
Ā!0!L8(2!	%OG&'HP'GCCC'PCCC	Ā!0!L8(2!	%OG&KPKECHE'QG**
R#<71510!	%OG&'HP'EICE'G***	R#<71510!	%OG&KPKECHE'QGHH
"Ä(S!<-	%G&'D&HCQ':#55(2B'"#ÀT'?<8((07"""""	U/'+!4!0	%V3"J'CH&D"?<8!B 0!'WXDY'#2B'A+?'U/?D'À!Z 1À!5!2-
?1-!	%KKKK		
/K[K/'2 5,!Ä	%KKKK	6#-!'?#5L0!7'=!<!14!B	%H&K[/ĀKCH&I
?#5L0!À	%@M?M	>77 !'6#-!	%HCK[/ĀKCH&I
[ÄB!Ä'2 5,!Ä	%KKKK		
		V(M'()'7#5L0!7'Ä!<!14!B	%G
U (-!'2 5,!Ä	%3V\HH*\&I	V(M'()'7#5L0!7'#2#0.7!B	%G

Ā817'À!L(Ä-'7 L!À7!B!7'#2.'LÀ!41(7'À!L(Ä-X7Y']1-8'-817'Ä!)!Ä!2!M'=!7 0-7'#LL0.'-('-8!'7#5L0!X7Y'#7'7 ,51--!BM'A00'L#$!7'()'-817'À!L(Ä-'8#4!',!!2'<8!<T!B'#2B'#LLÄ(4!B')(Ä'À!0!#7!M

Ā817'>2-!ÄLÄ!-14!'U #01-.'/(2-Ä(0'=!L(Ä-'<(2-#127'-8!')(00(]12$!2)(Ä5#-1(2%

- A2#0.717':(0B12$'Ā15!'/(5L01#2<!
- U #01-.'/(2-Ä(0'"#Ä#5!-!Ä'RÄ!Z !2<.'/(5L01#2<!
- WÀ1!)'J!-8(B'? 55#À1!7
- ? 55#Ä.'()'[-01!À7

''#$! %C() '*
F(ÄT'[ÄB!Ä %3''&IHQEQE
/01!2- %9:6'''Ä;'+Ä6
''Ä(S!<- %G&'D&HCQ':#55(2B'''#ÄT'?<8((07''''''

ĀÄ !''#$#%&'!($Ä)%*$+,%-'+.!$ Ä/,

Ä817'ÄL(Ä-' 7 55#Ä1^!7' !_-Ä#<-1(2'\' LÄ!L#Ä#-1(2'#2B' #2#0.717'-5!7' #2B' <(5L#Ä!7' !#<8']1-8' Ä!<(55!2B!B' 8(0B12$'-15!7' X?3''A' ?F' PIGa' A'':A á A?' #2B' V3''JY' ,#7!B' (2' -8!' 7#5L0!' <(2-#12!Ä' LÄ(41B!BM 6#-!7' Ä!L(Ä-!B'Ä!LÄ!7!2-')1Ä7-'B#-!'()'!_-Ä#<-1(2'(Ä'#2#0.717'#2B'LÄ0 B!'7 ,7!Z !2-'B10 -1(27'#2B'Ä!Ä 27M'A'017-12$'()',Ä!#<8!7'X)'#2.Y'17'LÄ(41B!B'8!Ä!12M

:(0B12$' -15!')(Ä' 0#<8#-!' 5!-8(B7' XM$M Ä/+''Y' 4#Ä.' #<<(ÄB12$-(' -8!' #2#0.-!7' Ä!L(Ä-!BM' A77!775!2-' <(5L#Ä!7' -8!' 0!#<8' B#-!']1-8' -8!' 78(Ä-!7-' #2#0.-!' 8(0B12$'-15!')(Ä' -8!' !Z 14#0!2-' 7(10'5!- 8(BM'Ä8!7!' #Ä!%' (Ä$#21<7' &I'B#.7a'5!Ä< Ä.'CP'B#.7'b'(-8!Ä'5!-#07'&PH'B#.7M''A'Ä!<(ÄB!B', Ä!#<8'B(!7'2(-'$ #Ä#2-!!'#',Ä!#<8')(Ä'#00'2(2K4(0#-10!'L#Ä#5!-! Ä7M

:(0B12$' -15!7')(Ä' 01-% $Ä%#'$!#' 4#Ä.' #<<(ÄB12$-(' #2#0.-!7' ()' 12-!Ä!7-M' c12.0'/80(Ä1B!' #2B' ?-.Ä!2!' 8(0B12$'-15!' 17' Q'B#.7d (-8!Ä7' &I'B#.7 M' A' Ä!<(ÄB!B' ,Ä!#<8' B(!7' 2(-' $ #Ä#2-!!' #' , Ä!#<8')(Ä' #00c[/' #2#0.-!7' #2B' 78(0B',!'4!Ä1)1!B'12'<#7!'-8!'Ä!L(Ä-!B',Ä!#<8'17'#')#07!'L(71- 14!' (Ä'c12.0'/80(Ä1B!'#2B'?-.Ä!2!'#Ä!'2(-'T!.'#2#0.-!7'()'12-!Ä !7-\<(2<!Ä2M

J#-Ä1 3H,Ä) 34#0 #-1(2%''e':(0B12$'-15!',Ä!#<8'd' ✓'e'F1-812'8(0B12$'-15!M'

5,46'(	2 +.!,%3 4,	%&'( )'$*Ä+,+-(./ ('$*Ä			ĀÄ !''#$#		
-'Ä4 $Ä,8%9#%$.Ä'+5 6/!.+728#9		3 4,%,748 /4,(	21.+3*(+.&'( )'$*Ä	%0 !1 '$*Ä	3 4,% Ä !''#,(	21.+3*(+ Ä !''#$#	%0 !1 '$*Ä
!(6I73%%(99%BE2G1%HD/22JEJK%(JCGL9E9							
HJCM%).D0%NC%>%O/.PQ(B7 R UAHIa UAHGa UA&Ha UA&Ca UA&Ia UA&G	I6>H!#>@645	64>,+ >@645	CEKJA=KCH&*	✓	6@>,+ >@645	CEKJA=KCH&*	✓

.; !$4"%-'À48'!%< 8 +,4,8%=8,>;,À/"%-'+.!$ À/,

Ã8!')(00(]12$'À!L(À-'7 55#À17!7'-8!')Ä!Z !2<.'()'0#,(À#-(À.'U/' 7#5L0!7'#2#0.7!B']1-812'-8!'#2#0.-1<#0'0(-X7Y'12']81<8'-8!'7 ,51--!B'7#5L0!X7Y']#7X]8!À!Y'LÀ(<!77!BM'A<- #0'À#-!'78(0B',!'$À!#-!À'-8#2'(À!Z #0'-('
-8!'!_L!<-!B'À#-!M'A'017-12$'()',À!#<8!7'17'LÀ(41B!B'12'-8!'? 5 5#À.'()'[-01!Ä7M

J#-Ä13Ħ,Ã) 34#0 #-1(2%'e'U #01-'/(2-À(0')Ä! Z !2< . '2(-']1-812'7L!<1)1<#-1(2'e'U #01-'/(2-À(0')Ä! Z !2< . ']1-812'7L!<1)1<#-1(2M'

U #01-.'/(2-Ä(0'?#5L0!'Ã.L!		4*1Ä'		; '.+ 8= 9			:1 !$'"+4*Ä'(*!+5/.)$3$) '$*Ä
ĀÄ !"'$) !+>.'?*@#	>.'?*@	:4	:.<1! (	Ā/4: !	?7../4.(	%0 !1 '$*Ä	
+#,(Ä#-(Ä.'6 L01<#-!7'X6`"Y							
A??'R1!0B'?<Ä!!212$'A2#0.717	3AHDQ	&	G	%%4=S7	%%46S6	✓	V3"J'CH&D"?<8!B 0!'WXDY'#2B'A+?'U/?D'Ä!Z 1Ä!5!2-

@8$,A%5,46'(%2;++ 8$,#

Ã8!'#2#0.-1<#0'LÀ(<!B À!7' 7!B',.'-8!'3241À(25!2-#0'614171(2'8# 4!',!!2'B!4!0(L!B')Ä(5'!7-#,0178!B'12-!Ä2#-1(2#00.'Ä!<($21^!B'L Ä(<!B Ä!7'7 <8'#7'-8(7!'L ,0178!B',.'-8!'`?'3"Aa'A":Aa'A?'#2B'V 3"JM'>2'8(7!' B!4!0(L!B'LÀ(<!B Ä!7'#À!'!5L0(.!B'12'-8!'#,7!2<!'()'B(< 5!2-!B' 7-#2B#ÄB7'(À',.'<01!2-'Ä!Z !7-M'Ã8!')(00(]12$'Ä!L(Ä-'LÀ(41B!7Ä1!)'B!7<Ä1L-1(27'()'-8!'#2#0.-1<#0'LÀ(<!B Ä!7'!5L0(.!B')(Ä'Ä!70-7'Ä!L(Ä-!B'12'-8!' /!Ä-1)1<#-!'()'A2#0.717M'?(Ä<!7')Ä(5']81<8'A+?'5!-8(B7'8#4!',! !2'B!4!0(L!B'#Ä!'LÀ(41B!B']1-812'-8!'J!-8(B'6!7<Ä1L-1(27M

ĀÄ !'"$) !+>.'?@#*	*>.'?*@*	*> '($&*	*>.'?*@+2.#)($/'$*Ä#*
A??'R1!0B'?<Ä!!212$'A2#0.717	3AHDQ	?[>+	A<1B'? 0)#-!'?(107'+#,(Ä#-(Ä.'J!-8(B7'9 1B!012!7a'4!Ä71(2'CM&'@'CHHIM"A7'Ä!<!14!B'7#5L0!7'#Ä!'-!7-!B')(Ä'L:')1!0B'#2B'L:')(_'#2B'#77!77!B')(Ä'#'Ä!#<-1(2'Ä#-12$M

2;++ 8"%'A%1;4!$,8#

1;4!$,8#%B%:; !$4"%-'À48'!%2 +.!,#

Ā8!')(00(]12$' ÄL(Ä-' 81$801$8-7('-01!Ä7')0#$$!B' 12' -8!' U #01-.' /(2-Ä(0' XU/Y' =!L(Ä-'M ? ÄÄ($#-!' Ä<(4!Ä.' 0151-7#Ä!' 7-#-1<'#2B' ,#7!B' (2' `?3"A' ?F PIG'(Ä' A+?KUF>\3\V\DP'X2' -8!' #,7!2<!' ( )' 7L!<1)1<'` ?3"A' 0151-7YĀB17' Ä!L(Ä-'B17L0#.7'U/'[-01!Ä7'X,Ä!#<8!7Y'(20.M

3;.!$/ 4,#C%5,46'(%@! ÀD#C%E F'8 4'8"%-'À48'!%2 +.!,#% À(%5 48$'%2.$D,#

- **B./%CGG%FCT/ED29U%J.%V2TW.1%NGCJ0%XCGY2%.YTGE2/9%.DDY/S**
- **B./%CGG%FCT/ED29U%J.%ZYMGEDCT2%.YTGE2/9%.DDY/S**
- **B./%CGG%FCT/ED29U%J.%)C[./CT./L%+.JT/.G%.YTGE2/9%.DDY/S**
- **B./%CGG%FCT/ED29U%J.%VCT/E\%HME02%.YTGE2/9%.DDY/S**

G,);! 8%2 +.!,%2;88') 4,#

- **B./%CGG%/2KYGC/%9CFMG2%FCT/ED29U%J.%9Y//.KCT2%/2D%XDLY%SYTGE2/9**

1;4!$,8#%B%ĀÀ !"#$#%&'!($À)%*$+,%-'+.!$ À/,

Ā817'Ä!L(Ä-'B17L0#.7':(0B12$'Ā15!',Ä!#<8!7'(20.M'[20.'-8!'Ä!7L! <-14!'3_-À#<-1(2'\"'Ä!L#À#-1(2'#2B\(Ä'A2#0.717'<(5L(2!2-'17\#ĀB17L0#.!BM

- **À.%(JCGL9E9%;.G1EJK% EF2%,YTGE2/9%2\E9TS**

1;4!$,8#%B%=8,>;,À/"%'A%:; !$4"%-'À48'!%2 +.!,#

Ā8!')(00(]12$'Ä!L(Ä-'81$801$8-7',Ä!#<8!7'12'-8!'RÄ!Z !2<.'()'U #01-.'/(2-Ä(0'?#5L0!7M

- **À.%&YCGETL%+.JT/.G%HCFMG2%B/2]Y2JDL%,YTGE2/9%2\E9TS**

ALS Group

Environmental Division

ĀÀ !"#$%#&#'!($)*('+'&À('*)$,Ā%)-

Comprehensive Report

./01$*0230 **4#!5678989**

&'()*$	Ā:;<$!(=$"(<	À !"# $"#%	Ā+*,(#"*-)*$ './(,(0("*.1)#$2
&"*$ 3$	Ā1+4+5.46ÀÀ+7	&"*$ 3$	Ā83"$$.9 -)0
:;;#)00	Ā<=>.:/+À:6/+.4+55:&+ 1+54?.@:.ABBC	: ;;#)00	ĀDB.?";.@ %.E ' F .@:.:G0$# '(.AB>B
+H- ('	ĀHHHH	+H- ('	ĀI)#$2J)*,(#"J0)#,(3)0K '0F""! 'J3"-
4)')I2"*)	ĀLAD.BM.A<<<.M<<<	4)')I2"*)	ĀLADHMH><B>.NAOO
P 30(-(')	ĀLAD.BM.>C<>.AOOO	P 30(-(')	ĀLADHMH><B>.NABB
1#"Q)3$	ĀAD.=DB<N.? --"*;.1 #R.832""0.111	1 F)	ĀD."S.<
T#;)#.*G-!)#	ĀHHHH		
&HTH&.*G-!)#	ĀHHHH	UG"$).*G-!)#	Ā+8<BDCV?/8+5BNAO.W+XYBBOYDCZ
8($)	ĀHHHH		
8 -I')#	Ā9J8J	U&.À),)'	ĀX+1E. <BD=..832);G'). [W=Z. *;. :À8 U&8=.#)\G(#)-)*$

ĀÀ !"

/ $).8 -I')0.5)3)(,);	ĀBDHT&4H<BDC	600G)./ $)	ĀBDHT&4H<BDC.DNĀOA
&'()*$.5)\G)0$);./G)./ $)	ĀBAHT&4H<BDC	832);G');.5)I"#$(*F./ $)	Ā**7>?*&(?@756**

Ā!#$%!&'(Ā! À$#"

E";)."S./)'(,)#%	Ā& ##()#	4)-I)# $G#)	ĀD=JM.H.63).!#(3R0.I#)0)*$
X"J."S.3""")#0Y!"])0	ĀD.-);(G-.2 #;.)0R%	X"J."S.0 -I')0.#)3)(,);	ĀA
8)3G#($%.8) '	Ā6*$ 3$J	X"J."S.0 -I')0. * '%0);	ĀA

)!*!&À#(+,--!* "

- 42(0.#)I"#$.3"*$ (*0.$2).S""^(*F.(*S"#- $("*Ā
  - H 8 -I').&"*$ (*)#W0ZY1#)0)#, $("*.X"*H&"-I'(*3)0
  - H 8G-- #%."S.8 -I')W0Z. *;.5)\G)0$);.:* '%0(0
  - H 1#" 3$(,).?"";(*F.4(-).5)I"#$
  - H 5)\G)0$);./)'(,)# !')0
- 8 -I')0.#)3)(,);.(*. II#"I#($)'%.I#)$#) $);. *;.I#)0)#,);.3"*$ (*)#0J
- 1') 0).0)).03 **);.&T&.S"#.0 -I').;(03#)I)*3()0Ā.)]$# .0 -I')0. _.0 -I')0.*"$.#)3)(,);...)$3J
- **ĀABCD3E$03F3GH32$GI$ACC0/C0GAJ3DK$C03J03AJ32$AI2$C03GB0HE12$F/IJ**
- **C;$AIADKEGE$EM/ND2$O3$F/I2NFJ32$PGJMGI$>$M/N0E$/Q$EABCDGIRL**
- :* '%$(3 '.^"#R.S"#.$2(0.^"#R."#;)#.^(".!).3"*;G3$);. $.:À8.+* ,(#"*-)*$ '.1)#$2J
- 1') 0).;(#)3$. *%.$G#* #"G*;.Y.$)32*(3 '.\G)#()0.$".$2).' !"# $ "#%.3"*$ 3$.;)0(F* $);. !",)J
- 1') 0).;(#)3$. *%.\G)#()0.#)' $);.$".0 -I').3"*;($("*.Y.*G-!)#(*F.Y.!#) R F)0.$".8 -I').5)3)(I$.W8 -I')01)#$2K '0)*,(#"J3"-Z
- 8 -I')./(0I"0 '.H.:\G)"G0.WDC.; %0Z_.8"'(;.WAB.; %0Z.S#"-.; $). "S.3"-I')$("*."S.@"#R.T#;)#J

600G)./ $) ĀBDHT&4H<BDC.DNĀOA
1 F) Ā<."S<
@"#R.T#;)# Ā+1DCBN>N>
&'()*$ ĀV?/.147.Ä4/

.À-/#!(+,* Ä$*!&0"123&!"!&%À $,*(4,*5+,-/#$À*6!"

: ".3"-I #(0"*0. #).- ;). F (*0$.I#)$#) $-)*$YI#)0)#, $("*.:8_.: 1?:_.`8+1:.0$ *; #;0J

-)/$EABCD3$F/IJAGI30WC03E30HAJG/I$I/I?F/BCDGAIF3$3XGEJEL

.7--Ä&'(,8(.À-/#!0"1(Ä*9(:!;7!" !9(<*À#'"$"

8"-). ($)-0. ;)03#(!);. !)'"^. - %. !). I #$. "S. . ' !"# $"#%
I#"3)00. *)3)00 #%. S"#. $2).)])3G$("*. "S. 3'()*$. #)\G)0$);
$ 0R0J.1 3R F)0. - %. 3"*$ (*. ;;($("* '. * '%0)0_. 0G32. 0
$2). ;)$)#-(* $("*. "S. - "(0$G#). 3"*$)*$. *;. I#)I # $("*
$ 0R0_.$2 $. #).(*3'G;);.(*.$2).I 3R F)J
6S.*". 0 -I'(*F. $(-). (0. I#",(;);_. $2). 0 -I'(*F. $(-). ^("
;)S G'$. $'. DOĀBB."*$2). ; $). "S. 0 -I'(*FJ. . 6S.*". 0 -I'(*F
; $). (0. I #",(;);_. $2). 0 -I'(*F. ; $). ^(". !). 00G-);. !%. $2)
' !"# $"#%. S"#. I#"3)00(*F. IG#I"0)0. *;. ^(". !). 02"^*
!# 3R)$);.^($2"G$. .$(-).3"-I'"*)*$J

E $#(]4Ā*""

>Ä?,&Ä ,&'("Ä-/#!(=Ā	+#$!* ("Ä-/#$*@(9Ä !(2($-!	+#$!* ("Ä-/#!(=Ā	SOIL - EA037 %ĀÄ")*+,-."Ä./+-0*01"%02,34*4
+1DCBN>N>HBBD	=BH8+1H<BDC.DOĀBB	BC	✓
+1DCBN>N>HBB<	=BH8+1H<BDC.DOĀBB	BA	✓
+1DCBN>N>HBB=	=BH8+1H<BDC.DOĀBB	DB	✓
+1DCBN>N>HBBC	=BH8+1H<BDC.DOĀBB	D<	✓
+1DCBN>N>HBBO	=BH8+1H<BDC.DOĀBB	DC	✓
+1DCBN>N>HBBA	=BH8+1H<BDC.DOĀBB	DA	✓

3&,À6 $%!(A,#9$@B$-!(:! / ,&

8 -I')W0Z.2 ,).!))*.#)3)(,);.^($2(*.$2).#)3"--)*;);.2"';(*F.$(-)0.S"#.$2).#)\G)0$);. * '%0(0J

:!;7!" !9(Ā!#$%!&À?#!"

Ā$Y*À))À$Ā(#:#)À

H a:`.&)#$(S(3 $)."S.:* '%0(0.H.X:4:.W.&T:.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H a:`.6*$)#I#)$(,).U&.5)I"#$.H./+P:`À4.W:*"'*.U&6.5)IZ.W.U&6.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H a:`.U&.5)I"#$.H./+P:`À4.W:*"'*.U&.5)IZ.H.X:4:.W.U&.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H :C.H.:`.8 -I').5)3)(I$.X"$(S(3 $("*.H.+*,(#"*-)*$ '.?4.W.85X.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H &2 (*."S.&G0$";%.W&"&Z.W.&T&.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H +/6.P"#- $.H.+XE5V..W.+XE5V.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H +/6.P"#- $.H.+8/:4.V?/.W.+8/:4bV?/.Z	+- ('	Q" ** J0$)F)* KF2;J3"-
H +/6.P"#- $.H.c4 !.W.c4:[.Z	+- ('	Q" ** J0$)F)* KF2;J3"-

(;#$Ä&&*Z)(Ā$!Ä=Ä["#$,[0GEOAI3-

H :C.H.:`.4].6*,"(3).W.6Xd.Z	+- ('	IHS00KF2;J3"-

Appendix F – RPD Calculations

Soil
Relative Percentage Difference

Department of Treasury
Hammond Park Senior High School
Schools PPP

Field Duplicates (SOIL)
Filter: ALL

Chem_Grc	ChemNam	Units	EQL	SDG	10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	10/03/2014		10/03/2014	Interlab_D		10/03/2014	Interlab_D
				Field_ID	HPMB01_0.1	QA01	RPD	HPSB03_2.0	QA03	RPD	HPSB03_4.0	QA05	RPD	HPSB03_0.1	QA07	RPD	HPMB03_3.0	QA09	RPD	HPMB03_5.0	QA11	RPD	HPMB02_2.0	QA13	RPD	HPMB04_1.5	QA15	RPD	HPSB03_2.0	QA04	RPD	HPSB03_4.0	QA06
				Sampled_Date-Time	30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014
ASS - Fielc	Reaction	-						0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	0.0E0	0	0.0E0	1	200	0.0E0	1
Field	pH (Field)	pH units	0.1					5.5	5.5	0	5.9	6.5	10	6.3	6.1	3	4.9	5.1	4	5.9	6.1	3	4.8	5.3	10	5.8	5.6	4	5.5	5.1	8	5.9	5.8
Inorganics	Moisture C	%	0.1		**3.4**	**8.7**	**88**																									
Metals	Arsenic	mg/kg	2		<2	<2	0																									
	Cadmium	mg/kg	0.4		<0.4	<0.4	0																									
	Chromium	mg/kg	5		<5	<5	0																									
	Copper	mg/kg	5		<5	<5	0																									
	Lead	mg/kg	5		<5	<5	0																									
	Mercury	mg/kg	0.1		<0.1	<0.1	0																									
	Nickel	mg/kg	5		<5	<5	0																									
	Zinc	mg/kg	5		<5	<5	0																									
OC Pesticic	4,4-DDE	mg/kg	0.05		<0.05	<0.05	0																									
	a-BHC	mg/kg	0.05		<0.05	<0.05	0																									
	Aldrin	mg/kg	0.05		<0.05	<0.05	0																									
	b-BHC	mg/kg	0.05		<0.05	<0.05	0																									
	chlordane	mg/kg	0.1		<0.1	<0.1	0																									
	d-BHC	mg/kg	0.05		<0.05	<0.05	0																									
	4,4 DDD	mg/kg	0.05		<0.05	<0.05	0																									
	4,4 DDT	mg/kg	0.05		<0.05	<0.05	0																									
	Dieldrin	mg/kg	0.05		<0.05	<0.05	0																									
	Endosulfar	mg/kg	0.05		<0.05	<0.05	0																									
	Endosulfar	mg/kg	0.05		<0.05	<0.05	0																									
	Endosulfar	mg/kg	0.05		<0.05	<0.05	0																									
	Endrin	mg/kg	0.05		<0.05	<0.05	0																									
	Endrin alde	mg/kg	0.05		<0.05	<0.05	0																									
	Endrin ketc	mg/kg	0.05		<0.05	<0.05	0																									
	g-BHC (Lin	mg/kg	0.05		<0.05	<0.05	0																									
	Heptachlor	mg/kg	0.05		<0.05	<0.05	0																									
	Heptachlor	mg/kg	0.05		<0.05	<0.05	0																									
	Hexachlorc	mg/kg	0.05		<0.05	<0.05	0																									
	Methoxych	mg/kg	0.05		<0.05	<0.05	0																									
	Toxaphene	mg/kg	1		<1	<1	0																									
OP Pesticic	Azinophos	mg/kg	0.2		<0.2	<0.2	0																									
	Bolstar (Su	mg/kg	0.2		<0.2	<0.2	0																									
	Chlorpyrifo	mg/kg	0.2		<0.2	<0.2	0																									
	Demeton-C	mg/kg	0.2		<0.2	<0.2	0																									
	Diazinon	mg/kg	0.2		<0.2	<0.2	0																									
	Dichlorvos	mg/kg	0.2		<0.2	<0.2	0																									
	Disulfoton	mg/kg	0.2		<0.2	<0.2	0																									
	Ethion	mg/kg	0.2		<0.2	<0.2	0																									
	Ethoprop	mg/kg	0.2		<0.2	<0.2	0																									
	Fenitrothio	mg/kg	0.2		<0.2	<0.2	0																									
	Fensulfoth	mg/kg	0.2		<0.2	<0.2	0																									
	Fenthion	mg/kg	0.2		<0.2	<0.2	0																									
	Merphos	mg/kg	0.2		<0.2	<0.2	0																									
	Methyl par	mg/kg	0.2		<0.2	<0.2	0																									
	Mevinphos	mg/kg	0.2		<0.2	<0.2	0																									
	Naled (Dib	mg/kg	0.5		<0.5	<0.5	0																									
	Phorate	mg/kg	0.2		<0.2	<0.2	0																									
	Ronnel	mg/kg	0.2		<0.2	<0.2	0																									
	Trichlorona	mg/kg	0.2		<0.2	<0.2	0																									
SPOCAS	pH (Ox)	pH units	0.1					3.3	3.6	9	3.8	4.2	10	3.4	3.3	3	2.9	3.5	19	3.2	3.2	0	3.5	3.6	3	3.1	3.3	6	3.3	5	41	3.8	5.1
Unassigne	Tokuthion	mg/kg	0.2		<0.2	<0.2	0																									

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-5 x EQL); 50 (5-30 x EQL); 50 (> 30 x EQL))
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Soil
Relative Percentage Difference

Field Duplicates (SOIL)
Filter: ALL

SDG		10/03/2014	Interlab_D		10/03/2014	Interlab_D		10/03/2014	Interlab_D		10/03/2014	Interlab_D	
Field_ID	RPD	HPMB03_3.0	QA10	RPD	HPMB03_5.0	QA12	RPD	HPMB02_2.0	QA14	RPD	HPMB04_1.5	QA16	RPD
Sampled_Date-Time		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014		30/09/2014	30/09/2014	
Chem_Grc ChemNam Units	EQL												
ASS - Fielc Reaction -		200	0.0E0	1	200	0.0E0	1	200	0.0E0	1	200	0.0E0	1	200
Field pH (Field) pH units	0.1	2	4.9	5.1	4	5.9	5.6	5	4.8	4.8	0	5.8	5.9	2
Inorganics Moisture C %	0.1													
Metals Arsenic mg/kg	2													
Cadmium mg/kg	0.4													
Chromium mg/kg	5													
Copper mg/kg	5													
Lead mg/kg	5													
Mercury mg/kg	0.1													
Nickel mg/kg	5													
Zinc mg/kg	5													
OC Pesticic 4,4-DDE mg/kg	0.05													
a-BHC mg/kg	0.05													
Aldrin mg/kg	0.05													
b-BHC mg/kg	0.05													
chlordane mg/kg	0.1													
d-BHC mg/kg	0.05													
4,4 DDD mg/kg	0.05													
4,4 DDT mg/kg	0.05													
Dieldrin mg/kg	0.05													
Endosulfar mg/kg	0.05													
Endosulfar mg/kg	0.05													
Endosulfar mg/kg	0.05													
Endrin mg/kg	0.05													
Endrin alde mg/kg	0.05													
Endrin keto mg/kg	0.05													
g-BHC (Lin mg/kg	0.05													
Heptachlor mg/kg	0.05													
Heptachlor mg/kg	0.05													
Hexachlorc mg/kg	0.05													
Methoxych mg/kg	0.05													
Toxaphene mg/kg	1													
des														
OP Pesticic Azinophos mg/kg	0.2													
Bolstar (Su mg/kg	0.2													
Chlorpyrifo mg/kg	0.2													
Demeton-C mg/kg	0.2													
Diazinon mg/kg	0.2													
Dichlorvos mg/kg	0.2													
Disulfoton mg/kg	0.2													
Ethion mg/kg	0.2													
Ethoprop mg/kg	0.2													
Fenitrothio mg/kg	0.2													
Fensulfoth mg/kg	0.2													
Fenthion mg/kg	0.2													
Merphos mg/kg	0.2													
Methyl pari mg/kg	0.2													
Mevinphos mg/kg	0.2													
Naled (Dib mg/kg	0.5													
Phorate mg/kg	0.2													
Ronnel mg/kg	0.2													
Trichlorona mg/kg	0.2													
des														
SPOCAS pH (Ox) pH units	0.1	29	**2.9**	**4.9**	**51**	3.2	4.7	38	3.5	4.3	21	3.1	4.1	28
Unassigne Tokuthion mg/kg	0.2													

*RPDs have only been considered where a concentration i
**High RPDs are in bold (Acceptable RPDs for each EQL r
***Interlab Duplicates are matched on a per compound bas

Water
Relative Percentage Difference

Department of Treasury
Hammond Park Senior High School
Schools PPP

Field Duplicates (WATER)
Filter: ALL

SDG	10/09/2014	10/09/2014	
Field_ID	MB01	QA01	**RPD**
Sampled_Date-Time	7/10/2014	7/10/2014	

Chem_Gr	ChemNam	Units	EQL			
Alkalinity	Alkalinity (t	mg/l	20	<20	<20	0
Inorganics	Electrical c	µS/cm	10	390	390	0
	Total Kjeld	mg/l	0.2	**0.4**	**0.7**	**55**
	pH (Lab)	pH units	0.1	5.8	5.8	0
	Total Disso	mg/l	10	220	230	4
Major Ions	Chloride	mg/l	1	83	82	1
	Sodium	mg/l	0.5	43	40	7
Metals	Aluminium	mg/l	0.05	0.35	0.35	0
	Aluminium	mg/l	0.05	0.1	0.11	10
	Arsenic (Fi	mg/l	0.001	<0.001	<0.001	0
	Cadmium (	mg/l	0.0002	<0.0002	<0.0002	0
	Chromium	mg/l	0.001	<0.001	<0.001	0
	Iron	mg/l	0.05	0.52	0.52	0
	Iron (Filtere	mg/l	0.05	0.43	0.43	0
	Manganese	mg/l	0.005	<0.005	<0.005	0
	Nickel (Filt	mg/l	0.001	0.002	0.002	0
	Selenium (	mg/l	0.001	<0.001	0.001	0
	Zinc (Filter	mg/l	0.001	0.038	0.04	5
Nutrients	Ammonia a	mg/l	0.01	0.04	0.05	22
	Nitrogen (T	mg/l	0.05	<0.05	<0.05	0
	Nitrogen (T	mg/l	0.2	**0.4**	**0.7**	**55**
	Phosphoru	mg/l	0.5	<0.5	<0.5	0
	Sulphate a	mg/l	5	14	13	7
Unassigne	Phosphoro	mg/l	0.05	<0.05	<0.05	0
	Acidity (as	µg/l	10000	43000	43000	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 50 (1-5 x EQ
***Interlab Duplicates are matched on a per compound basis as methods vary between labo

Appendix G – Bore Logs

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore No.: MB01
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 9.500
Diameter (mm): 50

Easting: 391811.4
Northing: 6439618.7
Grid Ref: GDA94_MGA_zone_50
Collar RL: 29.741 **Elevation:** 29.079
Logged by: J Stegena **Checked by:** JS

B.C.L. No.: **Casing:** Class 18 PVC **Screen:** **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
											29.08
0.0			HPMB01_0.1		Bentonite		Silty Sand Medium to Coarse, Red to Brown	D D			0.00 28.68
			QA01								
			HPMB01_0.5				Sand Medium to Coarse, Light Grey	D			0.40 28.08
1.0			HPMB01_1.0				Sand Medium to Coarse, Dark Grey with Yellow	D			1.00 27.58
			HPMB01_1.5				Sand Coarse with some Medium, Yellow with Dark Grey At 1.5m, traces of charcoal.	M			1.50 27.08
2.0			HPMB01_2.0				Sand Medium to Coarse, Dark Grey Sand Medium to Coarse, Yellow	M			2.00
			HPMB01_2.5								
3.0			HPMB01_3.0								
			HPMB01_3.5								
4.0			HPMB01_4.0								
			HPMB01_4.5								
5.0			HPMB01_5.0								
6.0			HPMB01_6.0								22.08
7.0			HPMB01_7.0		Filter Pack		Sand Medium to Coarse, White	W			7.00
			HPMB01_7.0								
8.0			HPMB01_8.0								
9.0			HPMB01_9.0								19.58
											9.50
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore No.: MB02
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.500
Diameter (mm): 50

Easting: 391777.386
Northing: 6439930.625
Grid Ref: GDA94_MGA_zone_50
Collar RL: 24.722 **Elevation:** 24.053
Logged by: J Stegena **Checked by:** JS

B.C.L. No.: **Casing:** Class 18 PVC **Screen:** **Surface Completion:**

DRILLING					Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water							
											24.05
0.0			HPMB02_0.1		Bentonite		Sand Coarse with minor Fine, Black	D D			0.00
			HPMB02_0.5				Sand Coarse with minor Fine, Light Grey to White				
1.0			HPMB02_1.0								22.55
			HPMB02_1.5				Silty Sand Fine to Coarse, Dark Orange to Brown	M	MD		1.50 22.05
2.0			HPMB02_2.0				Clay High plasticity, Fine to Medium, Dark Orange to Brown	M	F		2.00 21.55
			QA13								
			HPMB02_2.5				Clayey Sand Fine to Medium, Dark Orange to Brown Indurated sands and weakly cemented coffee rock	M	MD		2.50 21.05
3.0			HPMB02_3.0		Filter Pack		Silty Sand Fine to Coarse, Black Indurated sands and weakly cemented coffee rock	W	MD	Strong odour	3.00
			HPMB02_3.5								
4.0			HPMB02_4.0								
			HPMB02_4.5								
5.0			HPMB02_5.0								18.55
			HPMB02_5.5								5.50
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore No.: MB03
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391567.158
Northing: 6439926.899
Grid Ref: GDA94_MGA_zone_50
Collar RL: 24.479 **Elevation:** 23.822
Logged by: J Stegena **Checked by:** JS

B.C.L. No.: **Casing:** Class 18 PVC **Screen:** **Surface Completion:**

DRILLING							LITHOLOGICAL DESCRIPTION			COMMENTS/	
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
											23.82
0.0			HPMB03_0.1		Bentonite		Silty Sand Fine to Coarse, Black Minor organic content (roots)	D			0.00
			HPMB03_0.5				Silty Sand Fine and Coarse, Grey	D			22.82
1.0			HPMB03_1.0				Silty Sand Fine to Coarse, White to Light Grey	M		Strong odour	1.00
			HPMB03_1.5								
2.0			HPMB03_2.0								
			HPMB03_2.5								
3.0			HPMB03_3.0		Filter Pack						
			QA09								
			HPMB03_3.5								
4.0			HPMB03_4.0								
			HPMB03_4.5								
5.0			HPMB03_5.0								18.82 5.00
			QA11								
			QA12								
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - GROUNDWATER

Bore No.: MB04
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.500
Diameter (mm): 50

Easting: 391576.639
Northing: 6439697.617
Grid Ref: GDA94_MGA_zone_50
Collar RL: 23.557 **Elevation:** 22.939
Logged by: J Stegena **Checked by:** JS

B.C.L. No.: **Casing:** Class 18 PVC **Screen:** **Surface Completion:**

DRILLING											
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Well Details	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
											22.94
0.0			HPMB04_0.1		Bentonite		Silty Sand Fine to Coarse, Black	D			0.00 22.64
			HPMB04_0.5				Silty Sand Medium to Coarse, White	D			0.30
1.0			HPMB04_1.0								
			HPMB04_1.5								
			QA15								
2.0			HPMB04_2.0								20.69
			HPMB04_2.5				Silty Sand Fine to Medium, Black	D			2.25 20.19
							Clayey Sand Low plasticity, Fine to Medium, White	M			2.75 19.69
3.0			HPMB04_3.0								
			HPMB04_3.5		Filter Pack		Clay High plasticity, Fine, White Traces of Sand	M			3.25
4.0			HPMB04_4.0								18.44
			HPMB04_4.5				Sandy Clay Medium plasticity, Fine to Medium, White	W			4.50 17.94
5.0			HPMB04_5.0				Silty Sand Medium to Coarse, Light Yellow Traces of fines	W			5.00 17.44
			HPMB04_5.5								5.50
6.0											
7.0											
8.0											
9.0											
10.0											

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency Abbreviations:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SB01
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391840.031
Northing: 6439658.657
Grid Ref: GDA94_MGA_zone_50
Elevation: 28.986
Logged by: J Stegena **Checked by:** JS

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
										28.99
0.0							D			0.00
			HPSB01_0.1			Sand Medium to Coarse, Black to Dark Grey	D			
										28.49
			HPSB01_0.5			Sand Medium to Coarse, Light Grey	D			0.50
						Sand Medium to Coarse, Yellow and Light Grey				
1.0			HPSB01_1.0							
			HPSB01_1.5							
										26.99
2.0			HPSB01_2.0			Silty Sand Fine to Medium, Black Charcoal Layer	D M			2.00
			HPSB01_2.5			Sand Medium to Coarse, Yellow				
3.0			HPSB01_3.0							
			HPSB01_3.5							
4.0			HPSB01_4.0							
			HPSB01_4.5							
										23.99
5.0			HPSB01_5.0							5.00
6.0										
7.0										
8.0										
9.0										
10.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency:**	
AH - Air Hammer, **AR -** Air Rotary, **BE -** Bucket Excavation, **DC -** Diamond Core, **FH -** Foam Hammer, **HA -** Hand Auger, **HE -** Hand Excavation (shovel), **HFA -** Hollow Flight Auger, **NDD -** Non Destructive Drilling, **PT -** Pushtube, **SD -** Sonic Drilling, **SFA -** Solid Flight Auger, **SS -** Split Spoon, **WB -** Wash Bore, **WS -** Window Sampler	**D -** Dry, **SM -** Slightly Moist, **M -** Moist, **VM -** Very Moist, **W -** Wet, **S -** Saturated	**Granular Soils** **VL -** Very Loose, **L -** Loose, **MD -** Medium Dense, **D -** Dense, **VD -** Very Dense	**Cohesive Soils** **VS -** Very Soft, **S -** Soft, **F -** Firm, **ST -** Stiff, **VST -** Very Stiff, **H -** Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SB02
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391727.92
Northing: 6439650.011
Grid Ref: GDA94_MGA_zone_50
Elevation: 26.296
Logged by: J Stegena **Checked by:** JS

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
										26.30
0.0							D			0.00
			HPSB02_0.1			Silty Sand Fine and Coarse, Grey	D			
			HPSB02_0.5			Sand Medium to Coarse, Light and Dark Grey				25.30
1.0			HPSB02_1.0			Sand Medium to Coarse, White	D			1.00
			HPSB02_1.5							24.30
2.0			HPSB02_2.0			Sand Medium to Coarse, Yellow	M			2.00
			HPSB02_2.5							
3.0			HPSB02_3.0							
			HPSB02_3.5							22.30
4.0			HPSB02_4.0			Sand Fine to Coarse, White	M			4.00
			HPSB02_4.5							21.30
5.0			HPSB02_5.0							5.00
6.0										
7.0										
8.0										
9.0										
10.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SB03
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391714.986
Northing: 6439766.057
Grid Ref: GDA94_MGA_zone_50
Elevation: 24.118
Logged by: J Stegena **Checked by:** JS

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
										24.12
0.0			HPSB03_0.1			Silty Sand Fine to Medium, Dark Grey	D			0.00 23.62
			QA07							
			HPSB03_0.5 HPSB03_0.1			Sand Fine to Medium, Grey	D			0.50 23.12
1.0			HPSB03_1.0			Sand Fine to Medium, White to Light Grey	D			1.00 22.62
			HPSB03_1.5			Sand Fine to Coarse, Yellow, fading to White with depth	D			1.50
2.0			HPSB03_2.0							
			QA03							21.62
			HPSB03_2.5			Sand Medium to Coarse, Light to Dark Grey	M			2.50 21.12
3.0			HPSB03_3.0			Sand Medium to Coarse, Light to Dark Grey	W		Strong odour	3.00
			HPSB03_3.5							
4.0			HPSB03_4.0							
			QA05							
			HPSB03_4.5							
5.0			HPSB03_5.0							19.12 5.00
			HPSB03_5.0							
6.0										
7.0										
8.0										
9.0										
10.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency:**	
AH - Air Hammer, **AR** - Air Rotary, **BE** - Bucket Excavation, **DC** - Diamond Core, **FH** - Foam Hammer, **HA** - Hand Auger, **HE** - Hand Excavation (shovel), **HFA** - Hollow Flight Auger, **NDD** - Non Destructive Drilling, **PT** - Pushtube, **SD** - Sonic Drilling, **SFA** - Solid Flight Auger, **SS** - Split Spoon, **WB** - Wash Bore, **WS** - Window Sampler	**D** - Dry, **SM** - Slightly Moist, **M** - Moist, **VM** - Very Moist, **W** - Wet, **S** - Saturated	**Granular Soils** **VL** - Very Loose, **L** - Loose, **MD** - Medium Dense, **D** - Dense, **VD** - Very Dense	**Cohesive Soils** **VS** - Very Soft, **S** - Soft, **F** - Firm, **ST** - Stiff, **VST** - Very Stiff, **H** - Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SB04
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391738.307
Northing: 6439814.284
Grid Ref: GDA94_MGA_zone_50
Elevation: 23.582
Logged by: J Stegena **Checked by:** JS

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
										23.58
0.0							D			0.00
			HPSB04_0.1			Silty Sand Fine to Medium, Black	D			
						Silty Sand Fine to Coarse, Light Grey				
			HPSB04_0.5							
1.0			HPSB04_1.0							
			HPSB04_1.5							
2.0			HPSB04_2.0							21.08
			HPSB04_2.5			trace Silt Sandy Gravel Fine to Coarse, Black Clay	W	MD		2.50 20.58
3.0			HPSB04_3.0			trace Clay Silty Sand Fine to Coarse, Dark Orange to Brown, lighter with depth	W		Strong odour	3.00
			HPSB04_3.5							19.58
4.0			HPSB04_4.0			Sand Medium to Coarse, Dark Yellow	W		Mild odour	4.00
			HPSB04_4.5							18.58
5.0			HPSB04_5.0							5.00
6.0										
7.0										
8.0										
9.0										
10.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency:**	
AH - Air Hammer, **AR -** Air Rotary, **BE -** Bucket Excavation, **DC -** Diamond Core, **FH -** Foam Hammer, **HA -** Hand Auger, **HE -** Hand Excavation (shovel), **HFA -** Hollow Flight Auger, **NDD -** Non Destructive Drilling, **PT -** Pushtube, **SD -** Sonic Drilling, **SFA -** Solid Flight Auger, **SS -** Split Spoon, **WB -** Wash Bore, **WS -** Window Sampler	**D -** Dry, **SM -** Slightly Moist, **M -** Moist, **VM -** Very Moist, **W -** Wet, **S -** Saturated	**Granular Soils** **VL -** Very Loose, **L -** Loose, **MD -** Medium Dense, **D -** Dense, **VD -** Very Dense	**Cohesive Soils** **VS -** Very Soft, **S -** Soft, **F -** Firm, **ST -** Stiff, **VST -** Very Stiff, **H -** Hard

BOREHOLE LOG

ENVIRONMENTAL - SOIL BORE

Bore No.: SB05
Page: 1 of 1

Client: Department of Treasury
Project: Schools PPP
Project No.: 6131027
Location: Hammond Park Senior High School
Date Drilled: 30 Sep 2014 **to:** 30 Sep 2014

Drill Co: Direct Push Probing
Driller: P Grimwood
Rig Type: Geoprobe
Total Depth (m): 5.000
Diameter (mm): 50

Easting: 391676.232
Northing: 6439690.217
Grid Ref: GDA94_MGA_zone_50
Elevation: 24.881
Logged by: J Stegena **Checked by:** JS

DRILLING										
Depth (m)	Drilling Method	PID (ppm)	Sample ID	Water	Graphic Log	LITHOLOGICAL DESCRIPTION Soil Type (Classification Group Symbol); Particle Size; Colour; Secondary / Minor Components.	Moisture	Consistency	COMMENTS/ CONTAMINANT INDICATORS Odours, staining, waste materials, separate phase liquids, imported fill, ash.	Elevation / Depth (m)
										24.88
0.0						Silty Sand Medium to Coarse, Black to Dark Grey Fines	D			0.00 24.68
			HPSB05_0.1				D			0.20
						Sand Medium to Coarse, White with Black streaks				
			HPSB05_0.5							
										23.88
1.0			HPSB05_1.0			Sand Fine to Medium, Yellow, lighter with depth	D			1.00
			HPSB05_1.5							
2.0			HPSB05_2.0							
			HPSB05_2.5							
3.0			HPSB05_3.0							21.68
						trace Clay Sand Fine to Coarse, White	D			3.20
			HPSB05_3.5							
										20.88
4.0			HPSB05_4.0			Sand Fine to Coarse, Black	M			4.00 20.58
						Sand Fine to Coarse, Black Indurated sands and weakly cemented coffee rock	M	MD		4.30 20.28
			HPSB05_4.6				M			4.60
						Gravelly Sand Fine to Coarse, Black	M			19.88
5.0			HPSB05_5.0			Gravelly Clayey Sand Fine to Coarse, Dark Brown				5.00
6.0										
7.0										
8.0										
9.0										
10.0										

NOTES:

GHD Soil Classifications: The GHD Soil Classification is based on Australian Standards AS 1726-1993. This log is not intended for geotechnical purposes.

Drilling Abbreviations:	**Moisture Abbreviations:**	**Consistency:**	
AH - Air Hammer, **AR -** Air Rotary, **BE -** Bucket Excavation, **DC -** Diamond Core, **FH -** Foam Hammer, **HA -** Hand Auger, **HE -** Hand Excavation (shovel), **HFA -** Hollow Flight Auger, **NDD -** Non Destructive Drilling, **PT -** Pushtube, **SD -** Sonic Drilling, **SFA -** Solid Flight Auger, **SS -** Split Spoon, **WB -** Wash Bore, **WS -** Window Sampler	**D -** Dry, **SM -** Slightly Moist, **M -** Moist, **VM -** Very Moist, **W -** Wet, **S -** Saturated	**Granular Soils** **VL -** Very Loose, **L -** Loose, **MD -** Medium Dense, **D -** Dense, **VD -** Very Dense	**Cohesive Soils** **VS -** Very Soft, **S -** Soft, **F -** Firm, **ST -** Stiff, **VST -** Very Stiff, **H -** Hard

Appendix H – Site Photographs

Plate 1 – Uncontrolled fill

Plate 2 – Uncontrolled fill

Plate 3 – MB01

Plate 4 – MB02

Plate 5 – MB03

Plate 6 – MB04

Plate 7 – SB01

Plate 8 – SB02

Plate 9 – SB03

Plate 10 – SB04

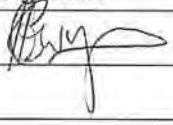
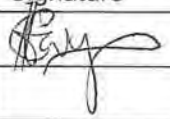
Plate 11 – SB05

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\31027\WP\142246.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	J Stegena	C Gwynne		C Gwynne		10/10/2014

www.ghd.com

Appendix H – Geotechnical Investigation (October 2014)

Department of Treasury - Strategic Projects

WA Schools PPP - Site Investigations

Report on Phase 2 Geotechnical Investigation

Hammond Park

October 2014

Table of contents

Table index

Figure index

Appendices

1. Introduction

1.1 General

GHD understands that Department of Treasury - Strategic Projects intends to develop a new secondary school in Hammond Park, Western Australia, located approximately 30 km south of the Perth CBD. The site extends across five lots (Lots 14, 31, 32, 33 and 47) along Barfield Road in Hammond Park and measures approximately 10.2 Ha in plan area.

The proposed development is understood to comprise the construction of new single to double storey buildings, parking facilities, hard courts, public open spaces and playing fields. The proposed finished ground level was not known at the time of writing, however, fill placement to raise the site level is considered likely, based on similar works undertaken across the surrounding residential subdivisions.

GHD has been engaged by the Department of Treasury - Strategic Projects to obtain additional geotechnical information to supplement the existing geotechnical data for the site. This report presents the results of a geotechnical investigation carried out in accordance with the proposed scope of work outlined in GHD's proposal to Strategic Projects dated 04 April 2014.

1.2 Previous work

GHD has previously undertaken a desktop investigation and literature review for the Hammond Park school site, known as the Phase One investigation. An outcome of the Phase One investigation was a gap analysis and recommendations for any further investigations that may be required. Further investigation (Phase Two) was recommended across the site.

1.3 Purpose of this report

The purpose of this report is to interpret the information collected during execution of the Phase Two site investigation and provide recommendations related to the following:

- The properties of the in-situ soil materials;
- Site preparation requirements and earthworks recommendations;
- Design parameters to assist in pavement design;
- Assessment of excavation conditions;
- Residential Site Classification in accordance with AS2870;
- Allowable bearing capacity and estimated settlements for shallow foundations;
- Assessment of the suitability of cut materials for re-use; and
- Review of drainage conditions.

This report is intended for the use of the school's Designer only. The conclusions and recommendations contained within do not supersede the Drawings or Specification issued by the Designer.

1.4 Scope of work

The scope of the geotechnical investigation recommended in the Phase One report and undertaken during Phase Two included the following:

- An initial desktop review of relevant available data;

- Dial-Before-You-Dig buried services check;
- Cone Penetrometer Testing (CPTs);
- Collection of soil samples for geotechnical testing;
- Laboratory testing of samples recovered from near surface; and
- Preparation of a geotechnical report to document the work performed, summarise the geotechnical findings, and to highlight any potential geotechnical issues identified by the investigation that may impact the development.

1.5 Limitations

This report has been prepared by GHD for Department of Treasury - Strategic Projects and may only be used and relied on by Department of Treasury - Strategic Projects for the purpose agreed between GHD and the Department of Treasury - Strategic Projects as set out in and as defined in the this report, letters of appointment and letters of aggregate liability dated 25 August 2014.

GHD otherwise disclaims responsibility to any person other than Department of Treasury - Strategic Projects arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible and as defined in the letters of appointment and letters of aggregate liability dated 25 August 2014.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Department of Treasury - Strategic Projects and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

GHD has not been involved in the preparation of the EOI, RFP, Development Application or other documents beyond this report and has had no contribution to, or review of these documents. GHD shall not be liable to any person for any error in, omission from, or false or misleading statement in, any other part of these other documents.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions (including the presence of hazardous substances and/or site contamination) may change after the date of this Report. GHD does not accept responsibility arising from, or in

connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

GHD excludes and disclaims all liability for all claims, expenses, losses, damages and costs, including indirect, incidental or consequential loss, legal costs, special or exemplary damages and loss of profits, savings or economic benefit, Department of Treasury - Strategic Projects may incur as a direct or indirect result of the PPP Schools Site Investigations Library, for any reason being inaccurate, incomplete or incapable of being processed on Department of Treasury - Strategic Projects' equipment or systems or failing to achieve any particular purpose. To the extent permitted by law, GHD excludes any warranty, condition, undertaking or term, whether express or implied, statutory or otherwise, as to the condition, quality, performance, merchantability or fitness for purpose of the PPP Schools Site Investigations Library.

GHD does not guarantee that the PPP Schools Site Investigations Library is free of computer viruses or other conditions that may damage or interfere with data, hardware or software with which it might be used. Department of Treasury - Strategic Projects absolves GHD from any consequence of Department of Treasury - Strategic Projects' or other person's use of or reliance on, PPP Schools Site Investigations Library.

2. Background information

2.1 General

A review of the existing information on the area has been based on the following data.

Client provided data

Taylor Robinson Architecture, *Interiors & Masterplanning. Hammond Park High School – DOE Business Case Development.* Report Ref.: MP02A, September 2011.

GHD

GHD Pty Ltd. *Stage 1 Report for School Site – Inspection and Feasibility Study – Hammond Park High School.* Report Ref No.: 113762, August 2011.

GHD Pty Ltd. *Phase 1 Geotechnical Data Desktop Review*. Report Ref No. 142239, June 2014.

Published literature

Gozzard, J.R., *Geological Survey of Western Australia 1:50,000 Environmental Geology Series, Part Sheets 2033 I & 2033 IV* ("Fremantle"), 1986.

Department of Water, *Perth Groundwater Atlas*, http://www.water.wa.gov.au accessed 5 June 2014.

2.2 GHD

GHD conducted a contaminated site inspection in March 2011. The inspection was based on a desktop and walkover assessment. It did not, therefore, obtain quantative site data of use to the Phase Two geotechnical investigation.

A desktop geotechnical investigation was undertaken in June 2014. This was our Phase One investigation, which determined that there was sufficient information gap to require a Phase Two investigation.

2.3 Published data

2.3.1 Regional geology

The 1:50,000 Environmental Series map (Fremantle Sheet) indicates the predominant near surface geology to comprise Bassendean Sand.

The Bassendean Sand is described by the Geological Survey of Western Australia (GSWA) as very light grey at surface to yellow at depth, fine to medium grained, moderately sorted, sub-rounded to rounded quartz sand of eolian origin. A layer of friable, iron-cemented sand, colloquially known as "coffee rock" commonly occurs near the groundwater table.

2.3.2 Regional groundwater

Reference to the Department of Water Perth Groundwater Atlas (PGA) indicates that the maximum historic groundwater elevation is approximately RL+22 m AHD (Australian Height Datum), with elevations increasing to the east. At RL+22 m AHD, groundwater would be expected approximately 2 to 3 m below the current ground surface across the site. Typical groundwater elevations would be expected to be below this level.

3. Site description

The high school site is located off Barfield Road in the suburb of Hammond Park as indicated on the inset of Figure 1. The site extends across five lots (Lots 14, 31, 32, 33 and 47) along Barfield Road and measures approximately 10.2 Ha in plan area.

The site surface appears generally flat, with a typical elevation of RL+24 m AHD. A small sand dune in the south-east corner of the site rises from the flat area to an elevation of about RL+29 m AHD.

The majority of the site consists of undeveloped native bushland. Sandy access tracks are typically aligned with property boundaries with smaller tracks present within the lots. Some access tracks on the southern side of the site have a bituminous gravel layer at the surface.

Rubbish and refuse materials including general waste, household waste, old 44-gallon drums, fibreglass, gas cylinders, construction materials and scrap metals have been disposed of in localised piles across the site. A waste disposal site with concrete paving, a bituminous gravel hardstand and sand stockpiles is located in the south-east corner of the proposed development area.

Photographs of selected waste areas have been included as Plates 1 – 3. Areas where concentrations of rubbish and waste were noted are outlined on Figure 1, though debris and waste are dispersed across the site.

4. Site investigation

4.1 General

The investigation undertaken for Phase Two has been informed by the site masterplan, prepared by Taylor Robinson Architecture (*Hammond Park High School*, 1151 MP02A, September 2011). Investigation points have been selected to provide the greatest concentration of data around proposed structures.

The fieldwork for the site investigations were carried out on 25 September 2014 under the technical direction of a Geotechnical Engineer from GHD. Investigation of the site has been based on a walkover inspection, Cone Penetrometer Testing (CPTs) and near-surface sample collection.

The geotechnical investigation was carried out in general accordance with Australian Standards AS1726 and standard GHD procedures.

Co-ordinates (in MGA Zone 50) and elevation in Australian Height Datum (AHD) of the CPT locations were determined using a geodetic grade differential GPS, which has a typical accuracy of ±50 mm. Test locations are indicated on Figure 1.

4.2 Cone penetrometer tests

Probedrill Pty Ltd (Probedrill) was engaged to perform Electric Friction Cone Penetrometer Test (CPT) probing at the site using a 19 tonne track mounted rig. A total of 14 CPT probes were performed to a nominal target depth of 5 m or refusal as indicated in Table 1. Each probe hole was dipped with a tape measure on completion in order to determine the apparent depth to the water table or the collapse level of the test.

The CPT testing was performed in accordance with AS 1289 using a standard cone with a projected area of 10 cm^2, an apex angle of 60° and a friction sleeve area of 150 cm^2. During testing, the test probe was advanced at a constant standard rate of 20 mm/s.

Details of the CPT probe locations are summarised in Table 1. The CPT probe results are presented in Appendix A and are shown graphically as plots of cone resistance, sleeve friction and friction ratio versus depth of penetration. Interpretation of CPT test data has been based on the relationships and methods recommended by Robertson et. al. (1986) and from field observations.

Table 1 CPT location summary

CPT ID	Coordinates (MGA zone 50)		Inferred Surface Elevation (m AHD)	Depth Achieved (m)	Termination Reason	Groundwater Depth (m)
	Easting	Northing				
CPT01	391763	6439633	+28.0	5.2	Target depth	Dry to 5.2m
CPT02*	391775	6439607	+28.5	0.08	Refusal	-
CPT02A	391761	6439600	+29.0	5.2	Target depth	Dry to 5.0m
CPT03	391684	6439556	+25.7	5.2	Target depth	Dry to 5.1m
CPT04	391617	6439599	+25.7	5.2	Target depth	Dry to 4.9m
CPT05	391720	6439648	+26.5	5.2	Target depth	Dry to 4.6m
CPT06	391626	6439691	+24.1	5.2	Target depth	Dry to 4.8m
CPT07	391697	6439715	+25.2	5.2	Target depth	Dry to 4.7m
CPT08	391550	6439703	+23.2	5.2	Target depth	Dry to 5.0m
CPT09	391574	6439727	+23.5	5.2	Target depth	Dry to 4.0m
CPT10	391615	6439775	+24.1	5.2	Target depth	Dry to 4.4m
CPT11	391772	6439777	+25.5	5.2	Target depth	Dry to 4.6m
CPT12	391760	6439727	+26.4	5.2	Target depth	Dry to 4.7m
CPT13	391738	6439815	+23.9	5.2	Target depth	Dry to 4.6m

* CPT02 was relocated to CPT02A due to shallow refusal on a concrete slab / concrete pavement.

4.3 Soil sampling

Geotechnical soil samples were recovered adjacent to selected CPT locations using a shovel. Disturbed and bulk samples collected were submitted for laboratory classification and index property testing.

5. Laboratory testing

Laboratory testing was carried out on representative soil samples to assist in the evaluation of the intersected materials. Geotechnical testing included the following:

- Particle Size Distribution – PSD (AS1289.3.1.2, 3.3.1 and 3.4.1);
- Maximum modified dry density – MMDD (AS1289.5.2.1);
- Minimum and maximum dry density – Min/Max (AS1289.5.5.1); and
- Four day soaked California Bearing Ratio – CBR (AS1289.6.1.1). CBR testing was specified for remoulded bulk samples at 96% MMDD, using a 4 kg surcharge.

All geotechnical laboratory testing was completed in accordance with the relevant Australian Standards by a NATA accredited soil testing laboratory. The results of the laboratory tests conducted on the soil samples are summarised in Table 2.

Laboratory test certificates are provided in Appendix B.

Table 2 Laboratory test results summary

Sample Location	Depth (m)	Soil Description	USC Symbol	Particle Size Distribution			Max/Min Density (t/m^3)	Mod, Compaction		Soaked California Bearing Ratio (%)
				% Fines (<0.075mm)	% Sand (0.075-2.36mm)	% Gravel (>2.36mm)		Modified Maximum Dry Density (t/m^3)	Optimum Moisture Content (%)	
Test 1: CPT04	0.3-0.5	Sand	SP	2	98	0	-	-	-	-
Test 2: CPT08	0.2-0.5	Sand	SP	2	97	1	1.42,1.73	1.688	12.1	12
Test 3: CPT12	0.4-0.6	Sand	SP	2	98	0	-	-	-	-
Test 4: CPT13	0.4-0.6	Sand	SP	2	98	0	1.51,1.79	1.692	14	11

6. Subsurface conditions

6.1 Ground conditions

6.1.1 General

The interpreted geotechnical investigation results indicate that the site is underlain by sandy soils of the Bassendean Sand unit. Soils are likely to be undisturbed (i.e. natural), however tests carried out on tracks and around developments could may have intersected a thin layer of reworked materials near surface.

Topsoil and gravelly sand fill were locally noted at sample locations. Various rubbish and waste is also present at discrete locations across the site.

6.1.2 Topsoil

A layer of topsoil up to 0.15 m thick was noted at sample locations which were conducted away from access tracks. The topsoil typically comprised dark brown-grey silty sand that is fine to medium grained with non-plastic fines. Topsoil is inferred to be loose to very loose from the CPT traces.

6.1.3 Fill

Gravelly sand fill was noted near the surface in the vicinity of CPT01 and CPT02A. The gravelly sand fill was described as fine to medium grained, sub-angular to sub-rounded, predominantly quartz sand with fine to coarse limestone and bituminous gravel. Traces of non-plastic fines and rootlets were also noted. The CPT trace for CPT2A suggests that fill, reworked natural sand, or disturbed ground, may persist to a depth of approximately 1.1 m in the vicinity of this test site.

Sampling carried out adjacent to CPT01 intersected gravel to cobble sized pieces of asphalt and limestone from surface to a depth of 0.3 m.

6.1.4 Bassendean sand

The CPT probe traces indicate that the site is predominantly underlain by sand interpreted as belonging to the Bassendean Sand unit. The sand is typically loose to medium dense, with a gradually increasing density with depth. CPT tip resistance plots indicate the sand is typically medium dense with localised dense zones below 2.5 m depth. Notable exceptions to the general trend are:

- CPT2A, remaining loose to a depth of 5 m.
- CPT04, which became very loose to loose at about 5 m depth.
- CPT08, which identified a very loose zone from 3.5 to 5 m depth, overlain by a very dense zone from 2 to 2.5 m depth.
- CPT09, which identified a very loose zone from 4 to 4.7 m depth.

Owing to the aeolian origins of the Bassendean Sand, it is likely that other, similar loose zones exist across the site.

Representative soil testing on samples collected at CPT04, CPT08, CPT12 and CPT13 indicated that soils contain 0-1% gravels, 97-98% sands, and 2% fines. Compaction testing at CPT08 and CPT13 recorded modified maximum dry densities between 1.688 t/m^3 and 1.692 t/m^3.

Minimum/maximum density testing recorded a minimum density range of 1.42 to 1.51 t/m^3 , and a maximum density range of 1.79 to 1.873 t/m^3. Max/min ratios of 1.18 and 1.22 have been derived, which suggests that potential compaction difficulties could be experiences during construction.

6.2 Groundwater

Groundwater was not encountered to the full depth of investigation at 5.2 m. However, this may not be representative of onsite conditions during the wet season or following periods of heavy rainfall.

7. Geotechnical evaluation and recommendations

7.1 General

The site extends across five lots (Lots 14, 31, 32, 33 and 47) along Barfield Road in Hammond Park and measures approximately 10.2 Ha in plan area. Subsurface conditions encountered comprise very loose to dense sand, with relative density generally and gradually increasing with depth.

Local areas of fill and waste including drums and gas canisters and assorted rubbish were observed across the site. The approximate locations of clusters of waste observed are indicated on Figure 1. Other areas of debris and waste may exist in other parts of the site.

The development is understood to comprise the construction of new single to double storey buildings, parking facilities, hard courts, public open spaces and playing fields. The proposed design grade is not known at the time of preparing this report. However, fill placement to raise the site level is considered likely, based on similar works undertaken across surrounding residential subdivisions.

Outlines of the structures proposed for the development are included on Figure 1.

7.2 Site preparation and earthworks

7.2.1 Site preparation

Site construction works should be preceded by appropriate preparation of the ground surface in areas of proposed development. Preparation should include the following as applicable:

- Identification of and diversion / protection of any buried services within the work areas;
- Initial clearing (including building debris, old structures, footings, slabs and refuse);
- Grubbing of any tree roots;
- Removal of topsoil, typically around 0.2 m thick, containing significant quantities of organic material (e.g. plant roots);
- Excavation and removal to spoil of any refuse, or localised softened zones identified by visual examination of the stripped ground surface; and
- Contouring and shaping of ground surface to ensure any surface runoff drains from the site.

7.2.2 Ground improvement

Ground improvement may be required within the building envelope(s) to increase bearing capacity of the subgrade/ reduce total settlement potential as loose sands locally persist up to depths of 5 m.

Various ground improvement methods and techniques are considered potentially applicable to this site. The following ground improvement techniques are considered suitable:

- Excavation followed by scarification and compaction of the base, then replacement in layers 300 mm thick (loose thickness) to achieve a minimum of 95% of modified maximum dry density (MMDD) or a density index of 75% (for sandy or granular soils);

- Impact rolling, with a variety of deep vibratory methods suitable the Contractor should aim to achieve a minimum of 95% of MMDD or a density index of 75% (for sandy or granular soils) throughout the improved soil profile; and
- Stone columns, installed using vibratory techniques, to improve the subsurface stiffness directly beneath each footing.

7.2.3 Earthworks

Earthworks should include the placement and compaction of additional fill (if required to achieve design site levels) in layers 300 mm thick or less (loose thickness) to achieve a minimum of 95% of modified maximum dry density (MMDD) or a density index of 75% (for sandy or granular soils).

Compliance with compaction requirements of fill or replaced loose sand should be made by field density testing in accordance with AS 3798. For each 0.75 m lift of fill (or less) the level of compaction should be verified by Perth Sand Penetrometer (PSP) probing, calibrated according to the requirements of AS 1289. A minimum blow-count of 8 blows per 300 mm, to 0.75 m depth, would be expected. All earthworks should be undertaken in accordance with current standards and to the specifications set by the designer.

7.3 Excavation

7.3.1 Excavation conditions

Excavation across the site is expected to be within loose to medium dense quartz sand. Excavation is therefore expected to be within the operating capacity of typical mechanical excavators. Bulk excavation could also be achieved using scrapers or bulldozers.

Shallow excavations (e.g. for utility trenches) across the school site are expected to be within loose to medium dense quartz sand, or fill. Excavation is therefore expected to be within the operating capacity of typical mechanical excavators.

7.3.2 Excavation stability

Based on the ground conditions intersected (i.e. predominantly loose to medium dense sand), it is expected that unretained temporary excavations above the groundwater level and less than 3 m in depth could be battered to a maximum slope of 1(V):2(H). Engineered support, such as shoring or trench-boxes, may be preferable for excavations in close proximity to existing features such as roads or buried services.

The maximum batter slope recommended is conditional upon dewatering being implemented when required, and the method chosen being verified as effective. Excavation during rainfall periods should be avoided, and appropriate procedures implemented to prevent possibly accumulation of rainfall runoff in the base of excavations. It is unlikely that the batters of any unsupported excavations opened during rainfall periods (or beneath the groundwater tablet) will require flattening or support of the slopes to maintain stability of the excavation.

No significant loads (dead or live loads) should be placed within a distance of the slope crest equivalent to the excavation depth. Steeper batter slopes may be adopted if it can be demonstrated to be appropriate by the Contractor. The Contractor should be required to verify the adequacy of each slope design on a case by case basis, and compliance to State OH&S regulations and Worksafe Australia's Excavation Code of Practice.

7.3.3 Suitability of excavated materials for re-use as fill

Sand excavated from across the site is considered generally suitable for re-use elsewhere on the site as general and structural fill. Material containing significant quantities of organic matter (i.e. topsoil) or other deleterious inclusions are not be considered appropriate for re-use as structural fill and should be removed off-site or stockpiled for future landscaping purposes.

7.4 Groundwater and dewatering

Groundwater was not encountered within 5 m of the current site levels, corresponding to an elevation of RL+19.3 mAHD. However, the historical maximum groundwater levels across the site are typically 2 to 3 m below ground level, at elevation RL+ 22mAHD. Therefore, dewatering may be required if construction work below these levels coincides with the wet season, or after prolonged periods of heavy rainfall.

7.5 Pavement subgrade conditions

Laboratory testing of bulk samples recovered near surface at CPT08 and CPT13 recorded soaked CBR values of 12% and 11% respectively.

Based on interpretation of laboratory testing, and the extensive library of published test results for Perth sands, a soaked CBR value of 12% is recommended for subgrades on this site, provided the subgrade is compacted to a minimum relative density of 96% MMDD.

7.6 Soil permeability / drainage

The site subsurface materials comprise free-draining granular soils. Accordingly, disposal of stormwater runoff by infiltration (e.g. soakwells or sumps) is considered feasible, provided the base of the infiltration infrastructure is above the design flood level.

A design permeability of $1x10^{-5}$ m/s is recommended for the near surface sands, taking clogging effects into account. Where stormwater runoff will infiltrate into fill, the design permeability may be different, dependent upon the material properties of the fill

7.7 Site classification and foundations

7.7.1 Site classification

A residential Site Class “A” would be considered appropriate provided that the buildings are designed with footing widths ranging between 0.7 m and 2.5 m to maintain an allowable maximum bearing pressure of at least 100kPa (refer Figure 2). Foundations dimensions larger than this range may settle more than the acceptable building tolerances, which would classify the site as Class “P” (i.e. where excessive foundation settlement may occur under foundation loading) and therefore warrant ground improvement works.

7.7.2 Bearing capacity and settlement

Analysis of bearing capacity and settlement has been undertaken for the site. The results of the analysis are presented on Figure 2 as a plot of recommended maximum bearing pressure versus foundation width. Key assumptions underpinning the analysis are:

- Site preparation as described in Section 7.2 has been carried out;
- Settlement of 25 mm is acceptable;
- Horizontal loading and/or load eccentricity is not considered; and,
- The base of footings is at 0.5 m depth.

Where adjacent columns carry significantly different loads, foundation sizes should be selected to limit differential movement of the beams supported by the columns to less than 1:1000.

In all instances the base of footing excavations should be proof compacted using a plate compactor before footing construction takes place.

7.8 Fill and settlement

As the subgrade materials are granular, settlement due to fill placement is expected to be predominantly immediate, i.e. it will occur during construction. It will therefore pose a negligible risk to structures founded on the fill, provided that site preparation is completed in accordance with the recommendations made in Section 7.2. Ongoing (time dependent) creep settlement is expected to be negligible.

8. References

Australian Standard AS 1289 – 2000, *Methods of Testing Soils for Engineering Purposes*, Standards Australia

Australian Standard. AS1726-1993: *Geotechnical Site Investigations,* Standards Australia

Australian Standards AS 2870. *Residential slabs and footings – Construction*, Standards Australia

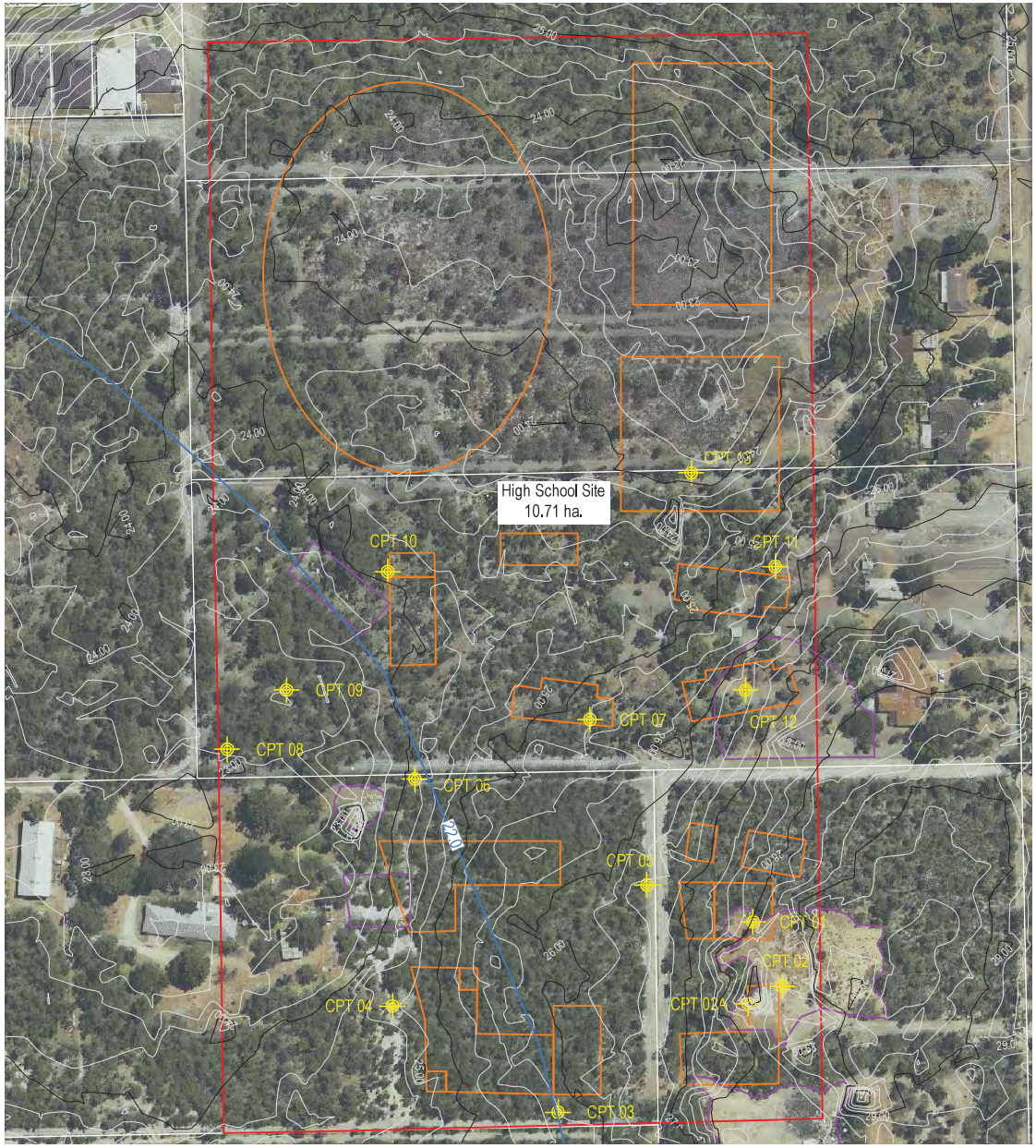
Australian Standards. AS3798-2007, *Guidelines on earthworks for commercial and residential developments.*

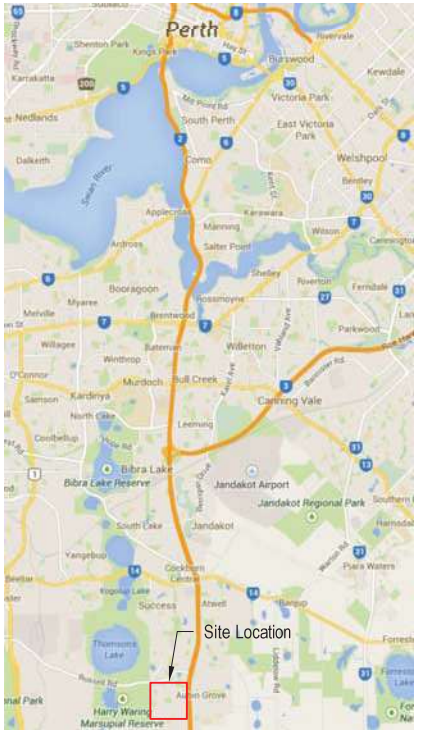
Department of Water of Western Australia. *Perth Groundwater Atlas*, http://www.water.wa.gov.au retrieved online in August 2014

Robertson et al. (1986). "Use of penetrometer cone data", ASCE Speciality Conference In situ '86: Use of In situ tests in Geotechnical Engineering, American Society of Engineers (ASCE) Blacksburg

Gozzard, J.R., *Geological Survey of Western Australia 1:50,000 Environmental Geology Series Sheet 2033I and2033* ("Fremantle"), 1986.

Figures





Locality Map
N.T.S

THIS FIGURE SHOULD BE READ IN CONJUNCTION WITH DOCUMENT NUMBER 61-30127-145107

0 20 40 60m
SCALE 1:2000 AT ORIGINAL SIZE

N

Legend

CPT 07 CPT Locations
School Site
Structures
Contours
PGA Contours
Cadastre

Areas where rubbish & waste found

VERTICAL DATUM
GDA
COORDINATE SYSTEM
MGA94 50

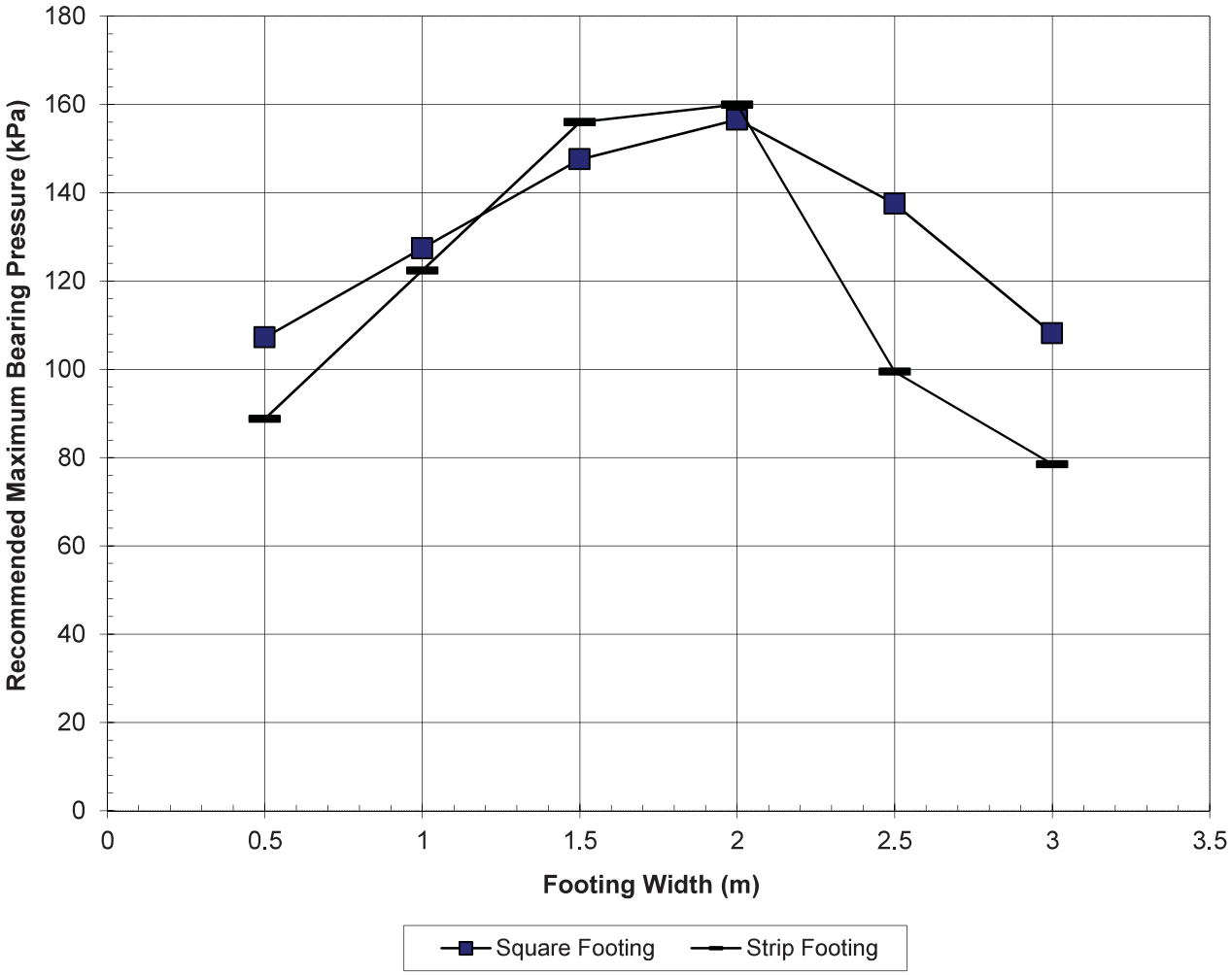
Department of Treasury (Strategic Projects)
PPP Schools Investigation - Phase 2 Report
Hammond Park
Geotechnical Investigation
Site Plan and Locality Map

Job Number 61-31027
Revision A
Date Oct 2014

Figure 01

GHD House, 239 Adelaide Tce Perth WA 6004 T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com

Plot Date: 2 October 2014 - 3:46 PM Plotted by: Josh Vale
Cad File No: G:\61\31027\CADD\Drawings\Figures\Report 145107\61-31027-Fig-Q01.dwg



Notes : (1) Recommended maximum bearing pressures are based on a Factor of Safety of 3 against bearing failure

(2) Allowable settlement of 25 mm

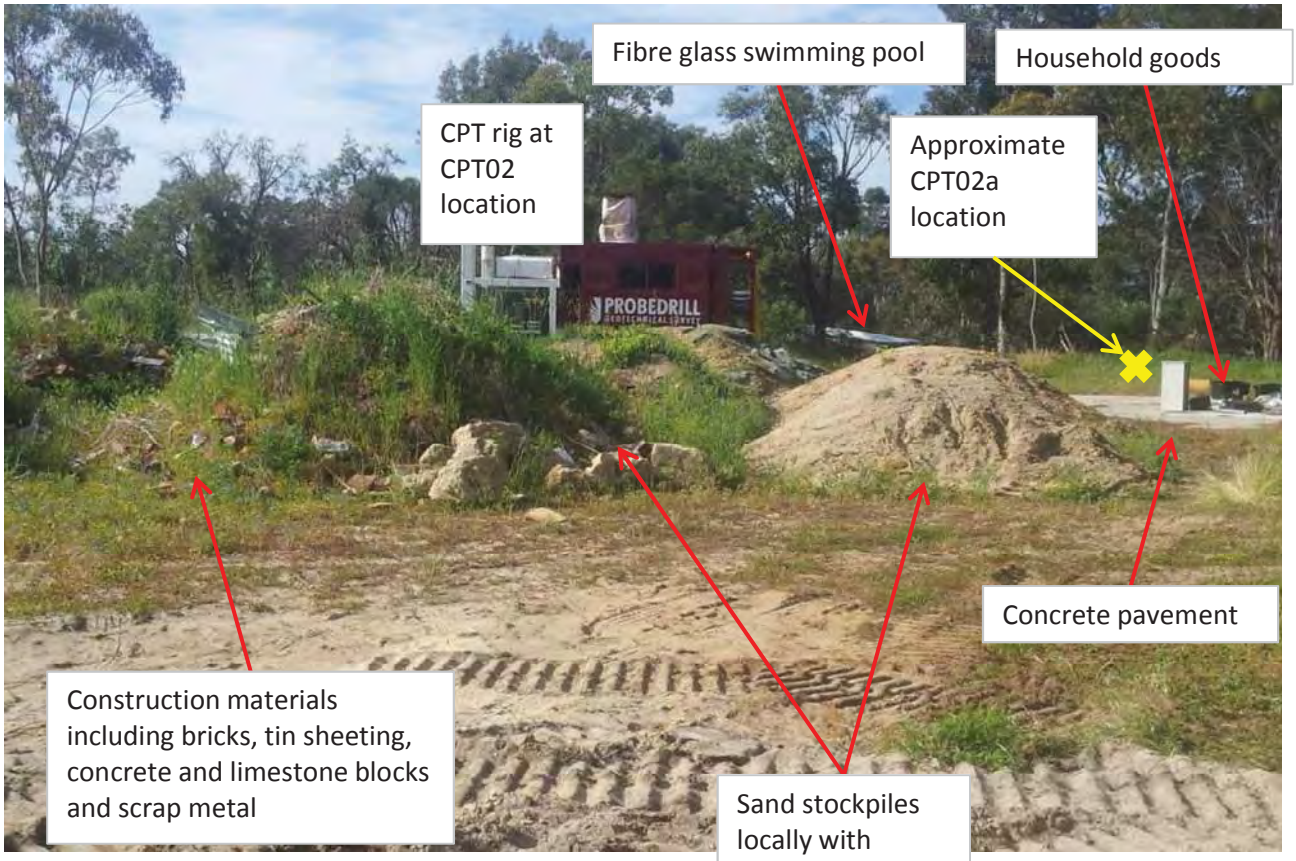
(3) Effects of horizontal loading or load eccentricity have not been considered.

(4) Founding depths are assumed to be 0.5 m.

(5) Site preparation as described in report 6131027/145107 has been carried out.

Job number	61/31027		**RECOMMENDED MAXIMUM FOUNDATION BEARING PRESSURES**	GHD MANAGEMENT ENGINEERING ENVIRONMENT	Department of Treasury
Ref	FOOTING				PPP Schools Project Hammond Park
By	AW	02-Oct-14			
Revision	0	10-Oct-14			**Figure 2**

Plates



GHD Pty Ltd
GHD Pty Ltd
239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 61 8 6222 8222 F61 8 6222 8555
E permail@ghd.com.au www.ghd.com.au

Drawn: TL	Date: 30/09/2014	Job Number: 61/31308	A4
Checked	Date		
Revision: 0	Date: 30/09/2014	Cad Reference	

This drawing should be read in conjunction with report number 61/31027/145107

Title: Plate 1
Waste Disposal Area
Located near CPT01/CPT02

Client: Department of Treasury - Strategic Projects

Project: PPP Schools - Phase 2 Hammond Park Geotechnical Investigation

Figure No: A.1

GHD Pty Ltd

GHD Pty Ltd
239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 61 8 6222 8222 F61 8 6222 8555
E permail@ghd.com.au www.ghd.com.au

Drawn: TL	Date: 30/09/2014	Job Number: 61/31308	A4	Title: Plate 2 Waste Disposal Area Located near CPT10	Client: Department of Treasury - Strategic Projects
Checked	Date				Project: PPP Schools - Phase 2 Hammond Park Geotechnical Investigation
Revision: 0	Date: 30/09/2014	Cad Reference			Figure No: A.2
This drawing should be read in conjunction with report number 61/31027/145107					

GHD Pty Ltd
GHD Pty Ltd
239 Adelaide Terrace Perth WA 6004
PO Box Y3106 Perth WA 6832
T 61 8 6222 8222 F61 8 6222 8555
E permail@ghd.com.au www.ghd.com.au

Drawn: TL	Date: 30/09/2014	Job Number: 61/31308	A4	Title: Plate 3 Waste Disposal Area Located near CPT12	Client: Department of Treasury - Strategic Projects
Checked	Date				Project: PPP Schools - Phase 2 Hammond Park Geotechnical Investigation
Revision: 0	Date: 30/09/2014	Cad Reference			Figure No: A.3
This drawing should be read in conjunction with report number 61/31027/145107					

Appendices

Appendix A – Cone penetrometer test results

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

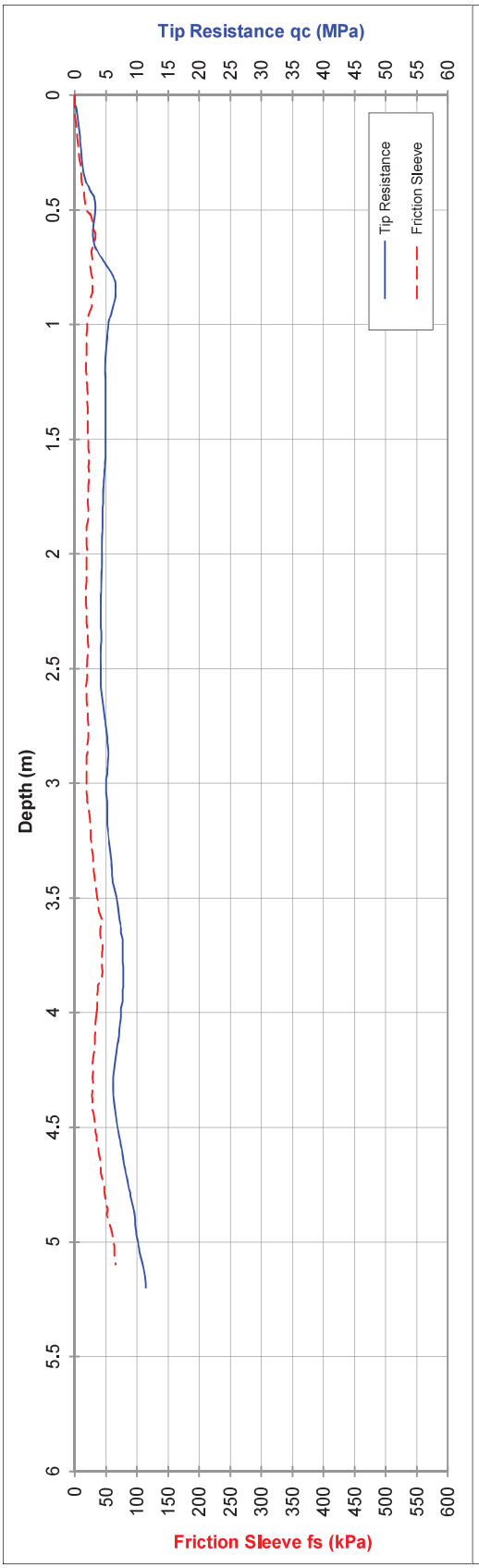
Probe No.: CPT 1

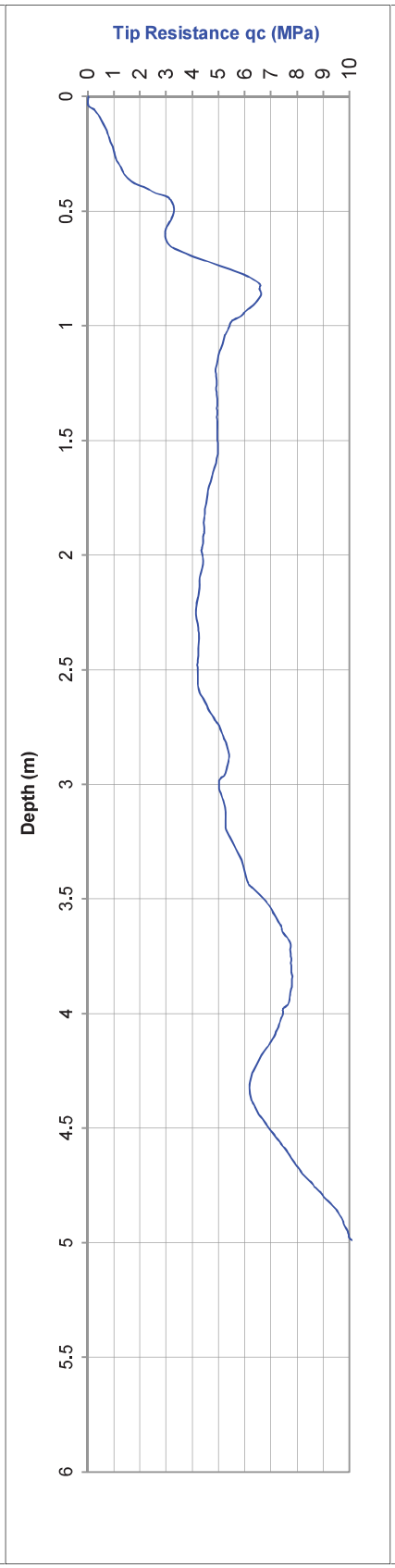
LOCATION: Hammond Park

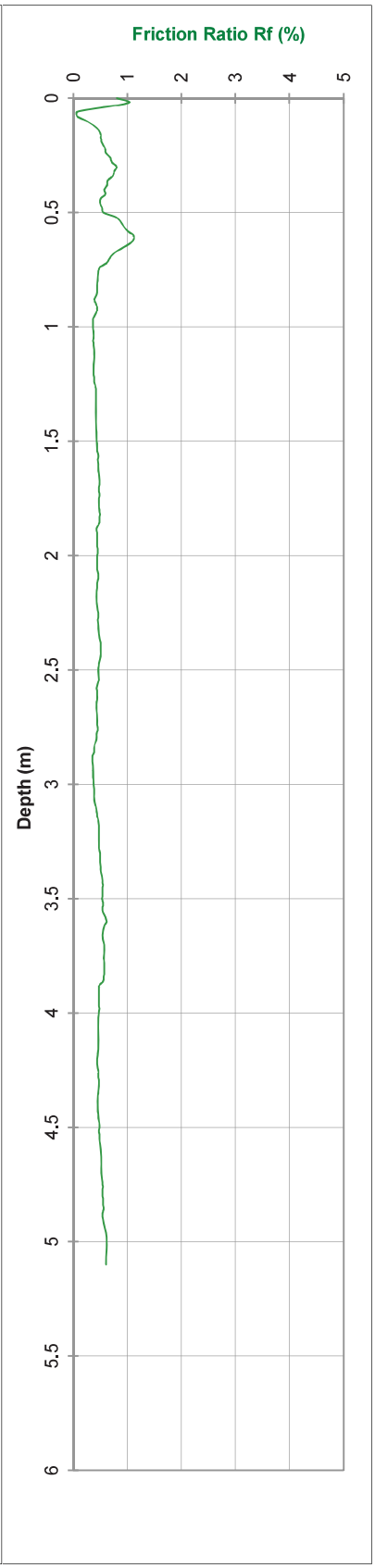
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 5.2

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2842M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

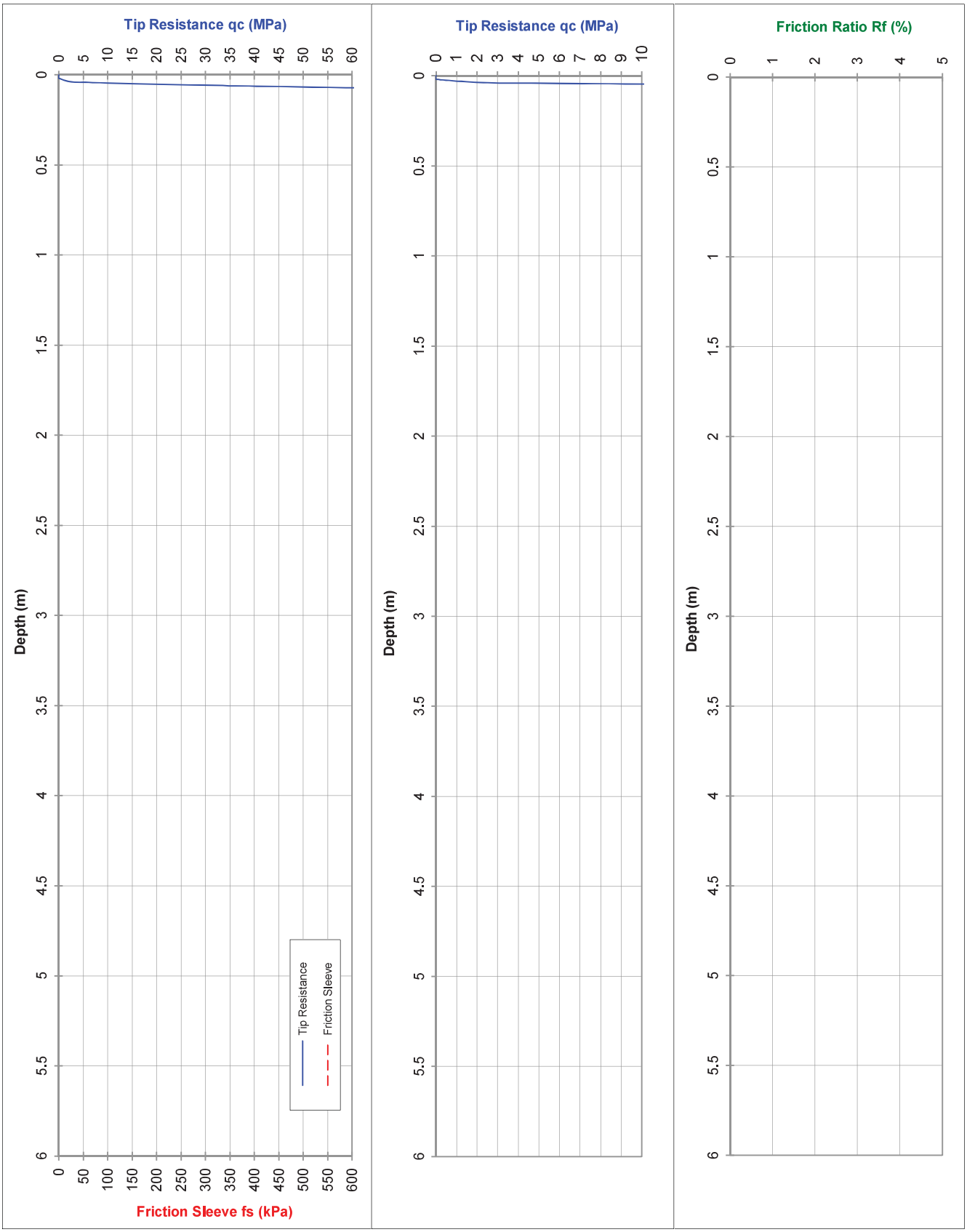
Probe No.: CPT 2

LOCATION: Hammond Park

Job Number: 61/31027/08

RL (m):

Co-ordinates:



PROBEDRILL GEOTECHNICAL SURVEY

Water (m): -

Refusal: 80MPa

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2843M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

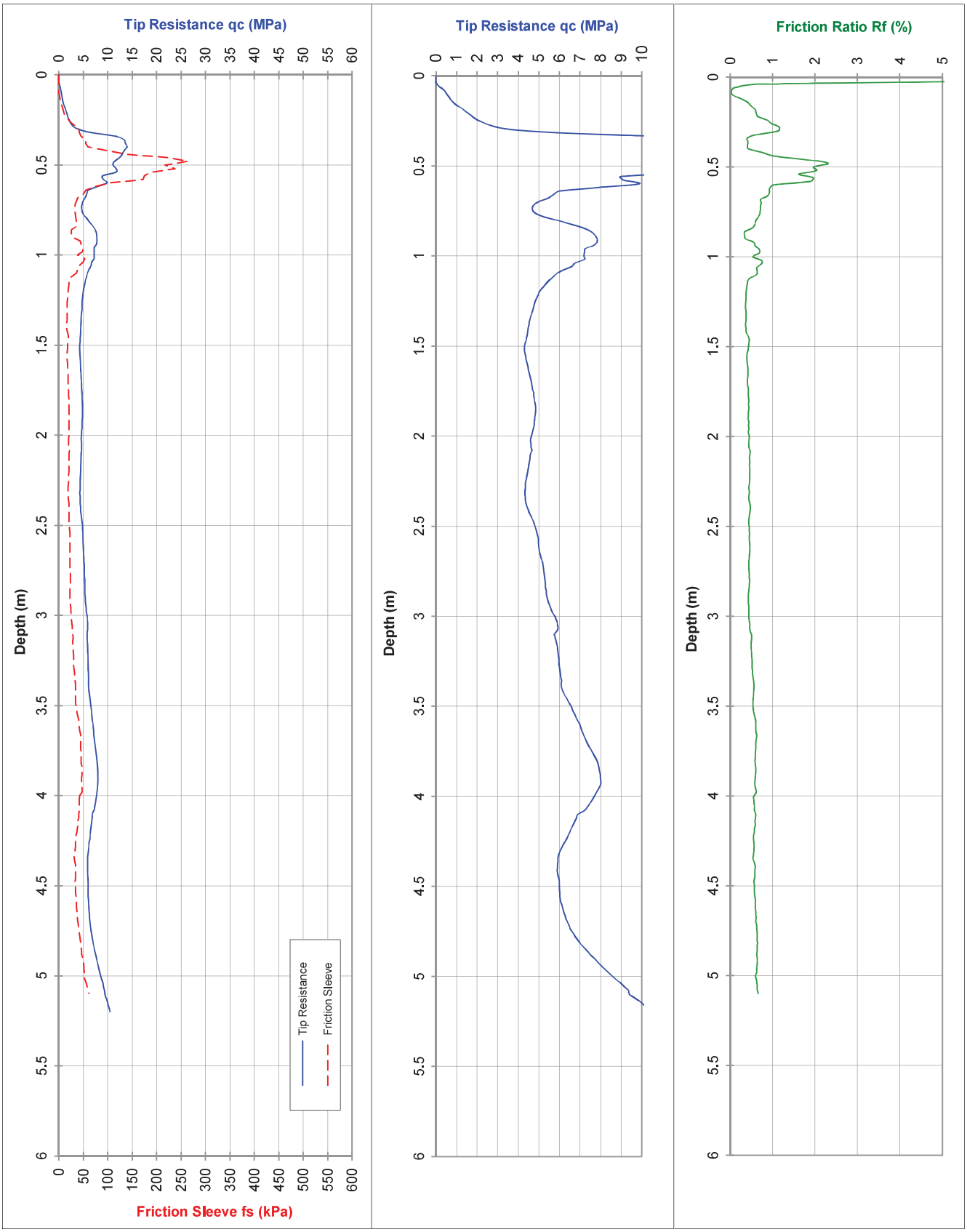
Probe No.: CPT 2A

LOCATION: Hammond Park

Job Number: 61/31027/08

RL (m):

Co-ordinates:



PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 5.0

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2844M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

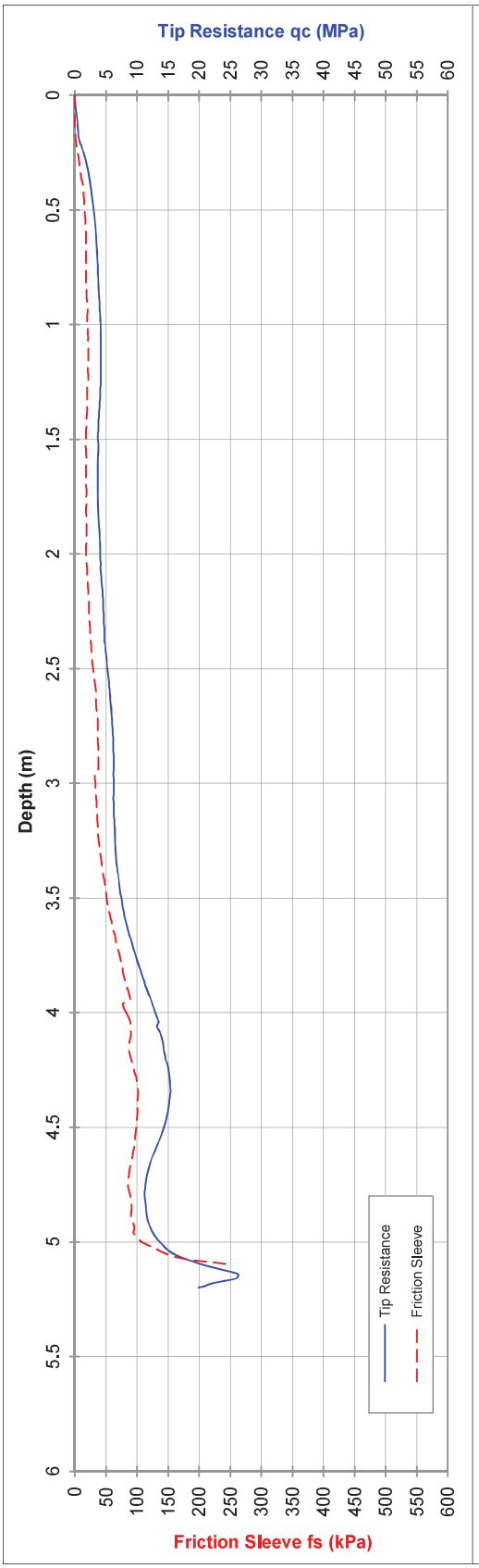
Probe No.: CPT 3

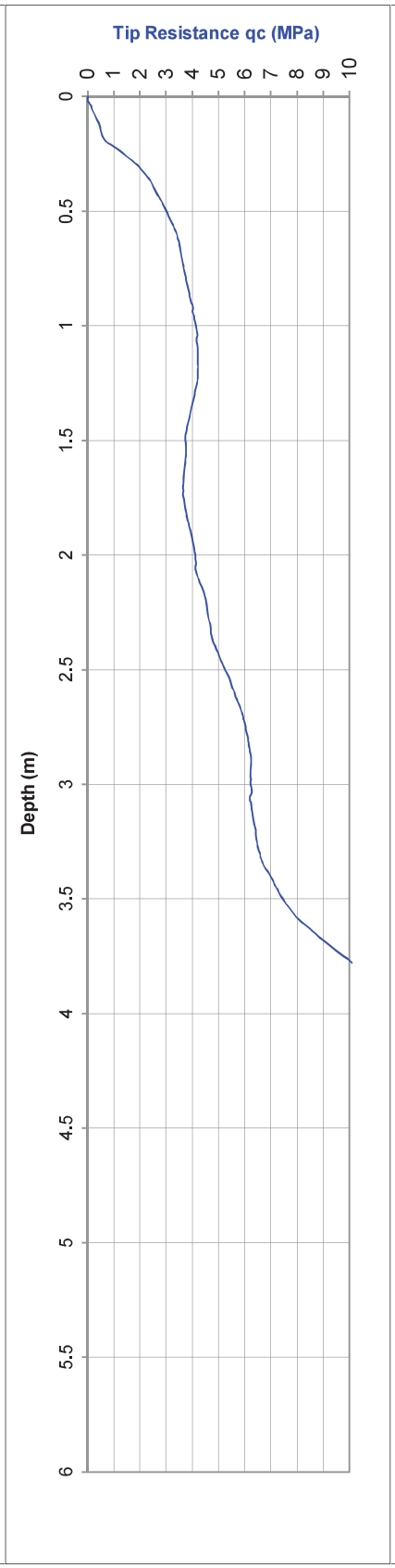
LOCATION: Hammond Park

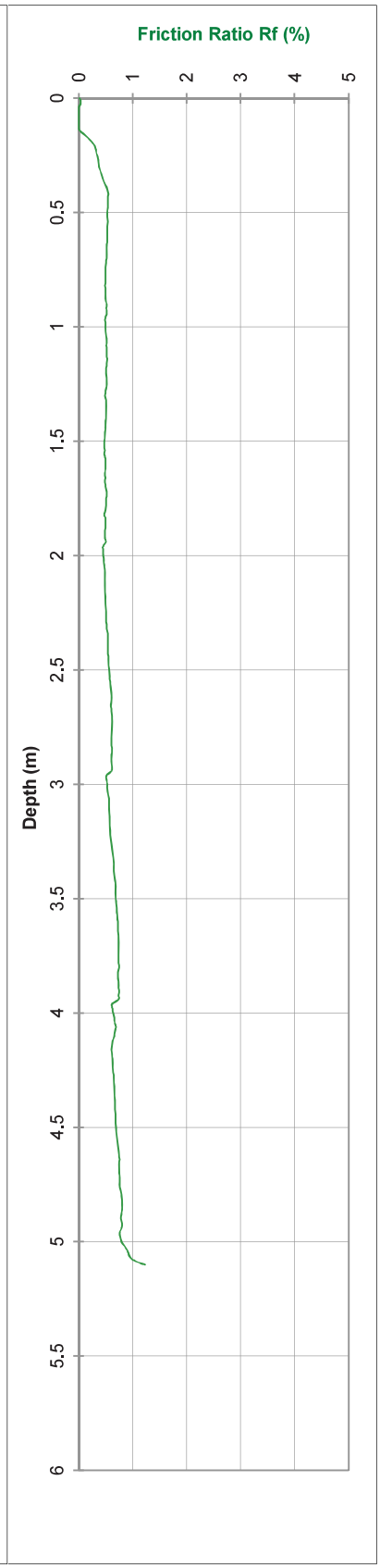
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 5.1

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2845M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

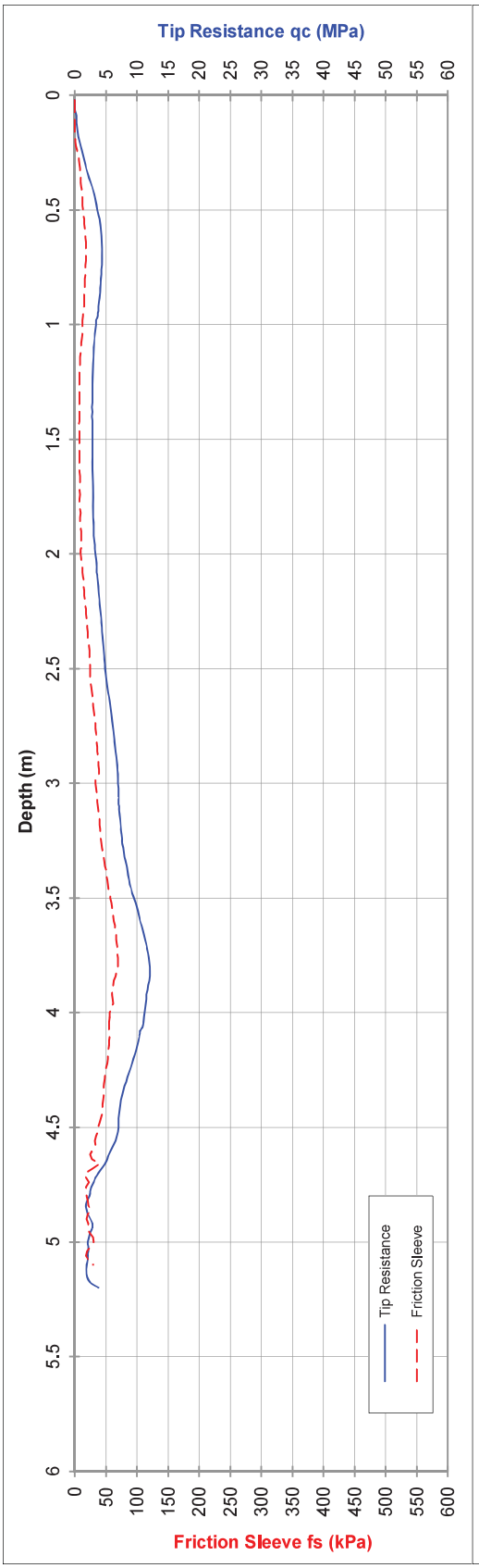
Probe No.: CPT 4

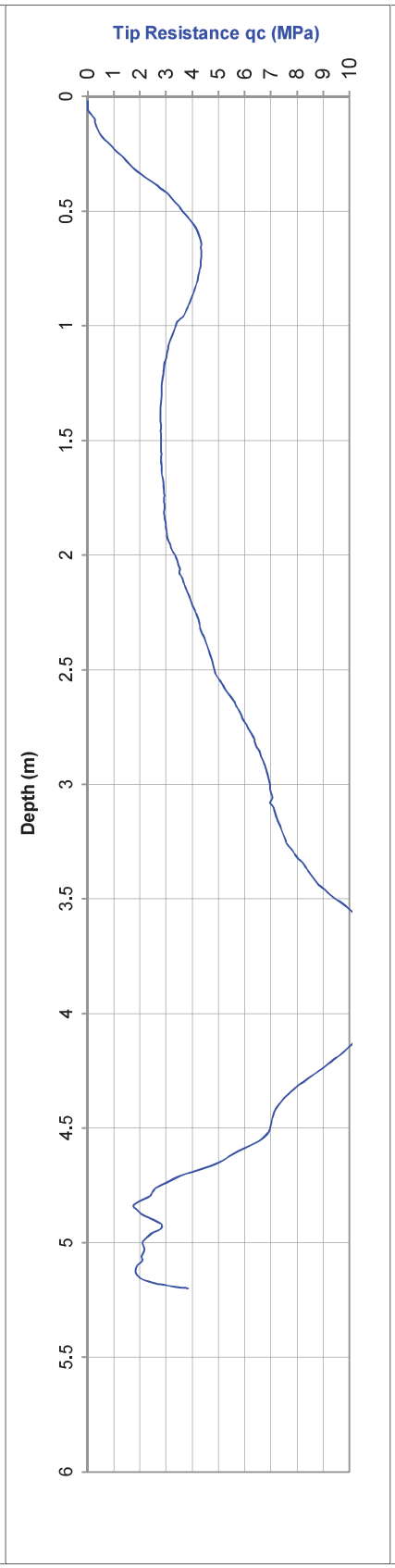
LOCATION: Hammond Park

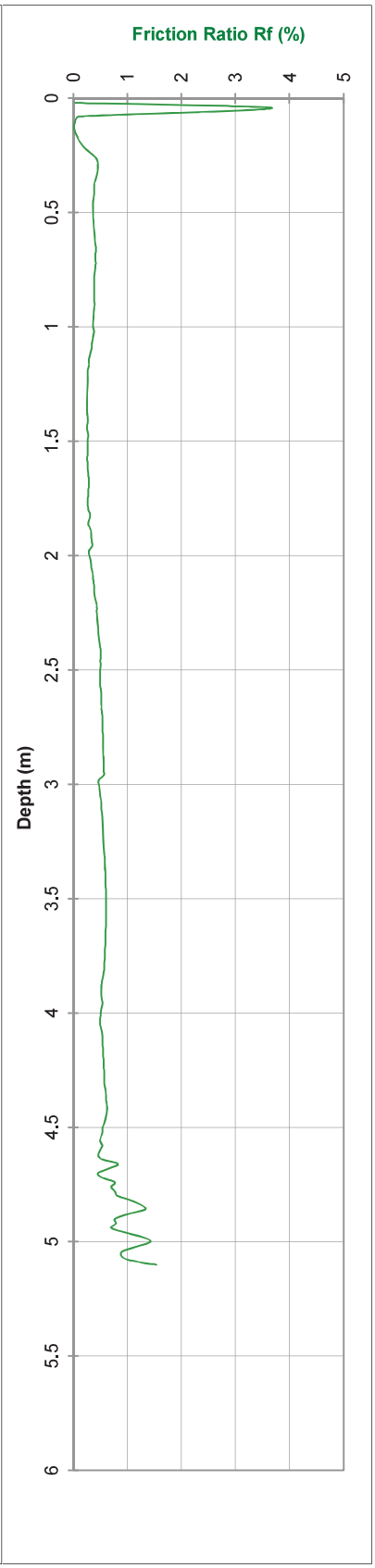
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.9

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2846M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

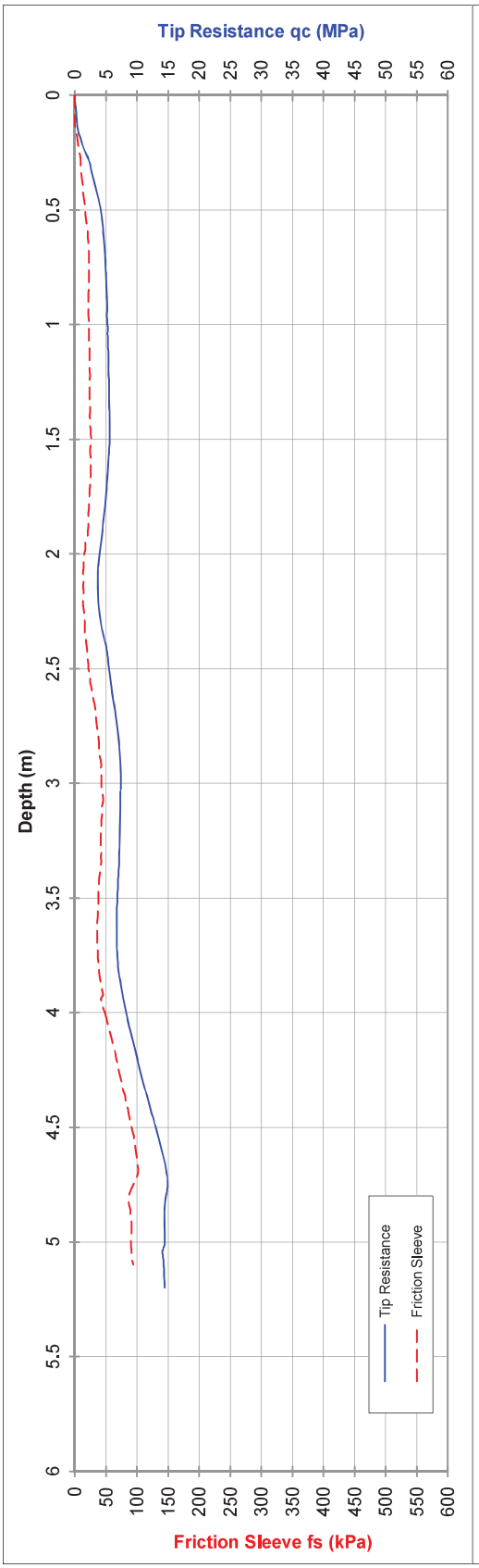
Probe No.: CPT 5

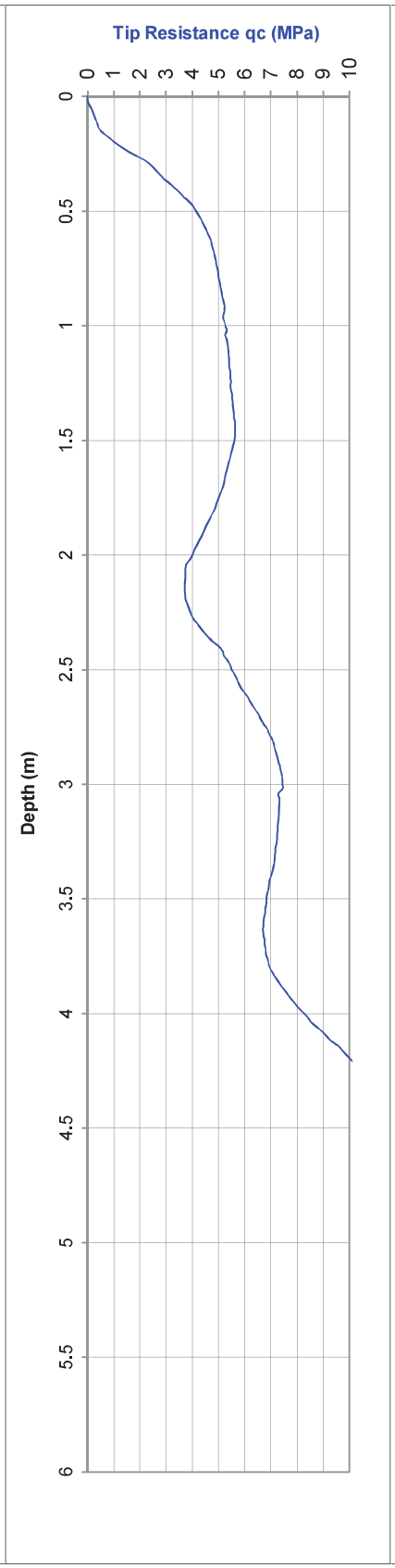
LOCATION: Hammond Park

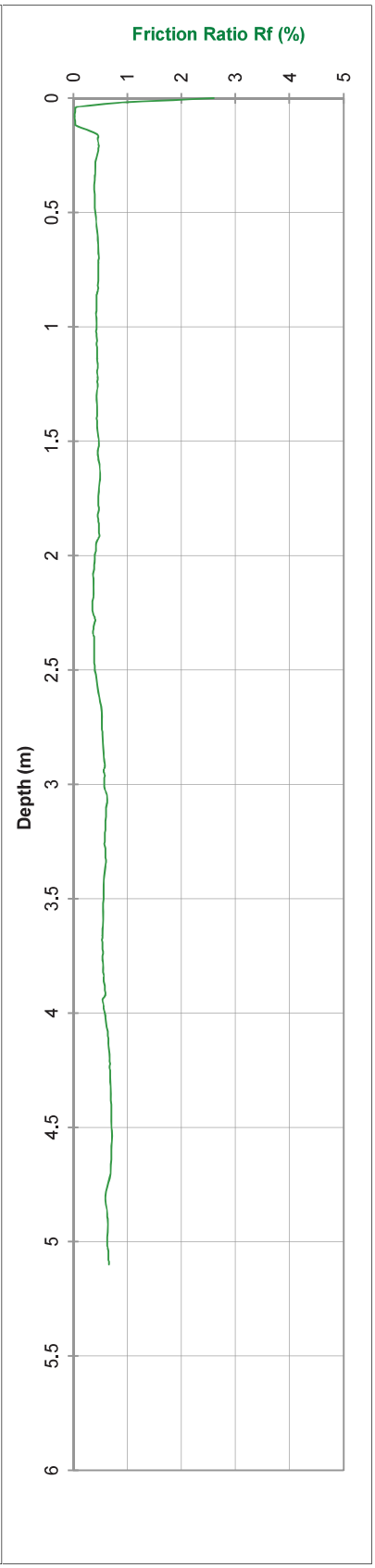
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.6

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2847M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

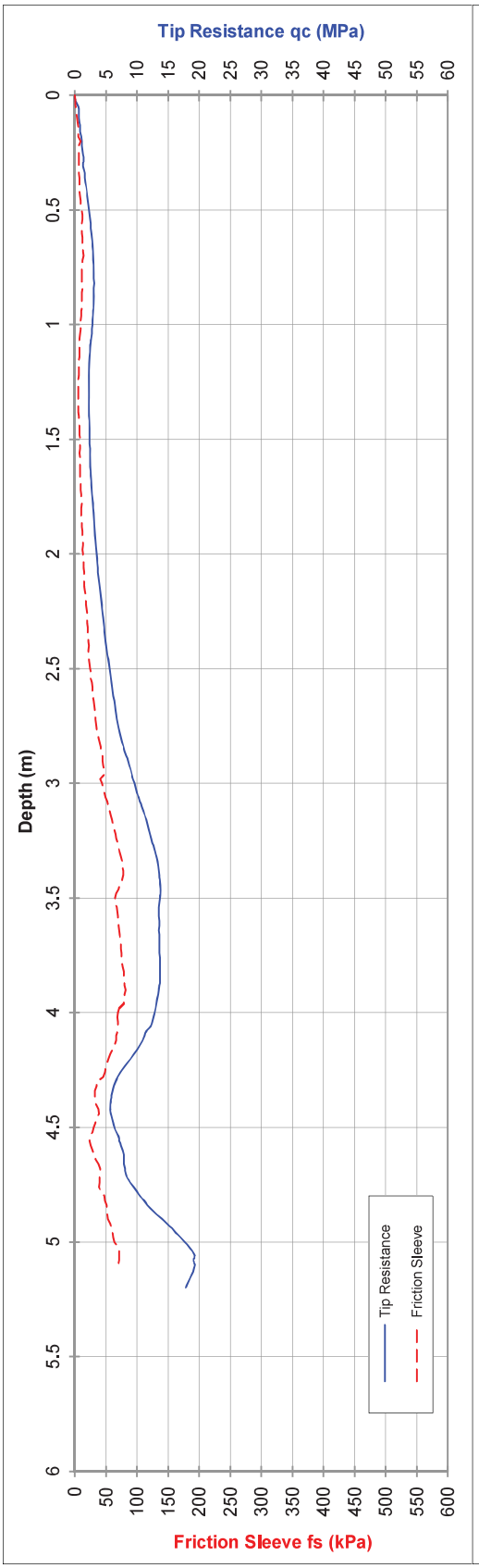
Probe No.: CPT 6

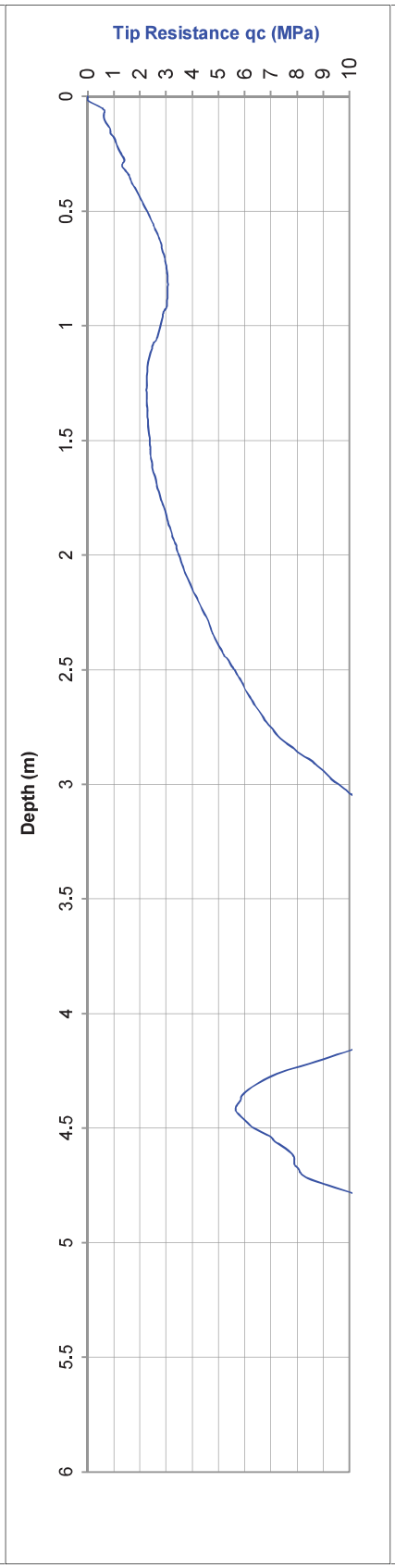
LOCATION: Hammond Park

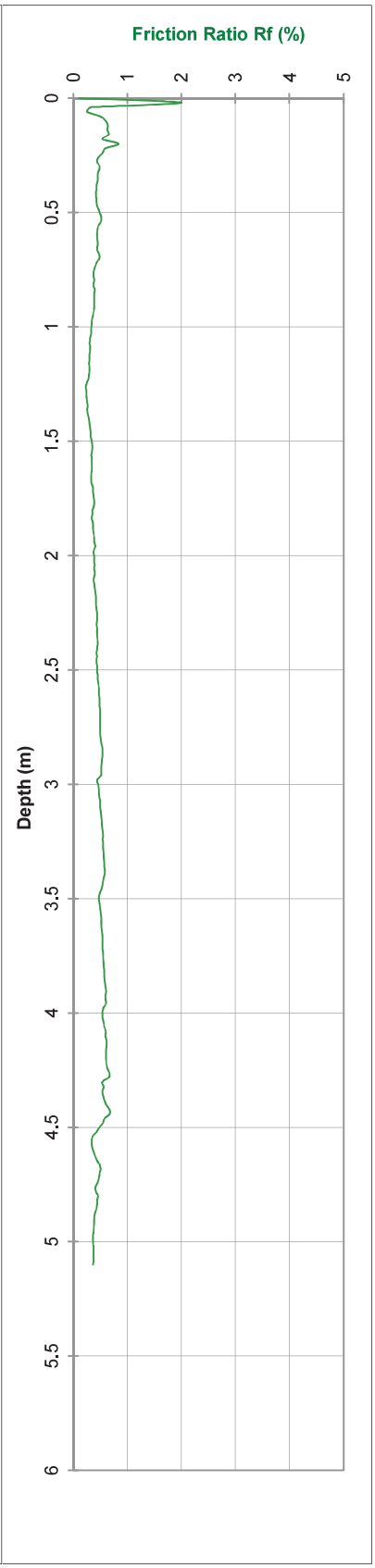
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.8

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2848M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

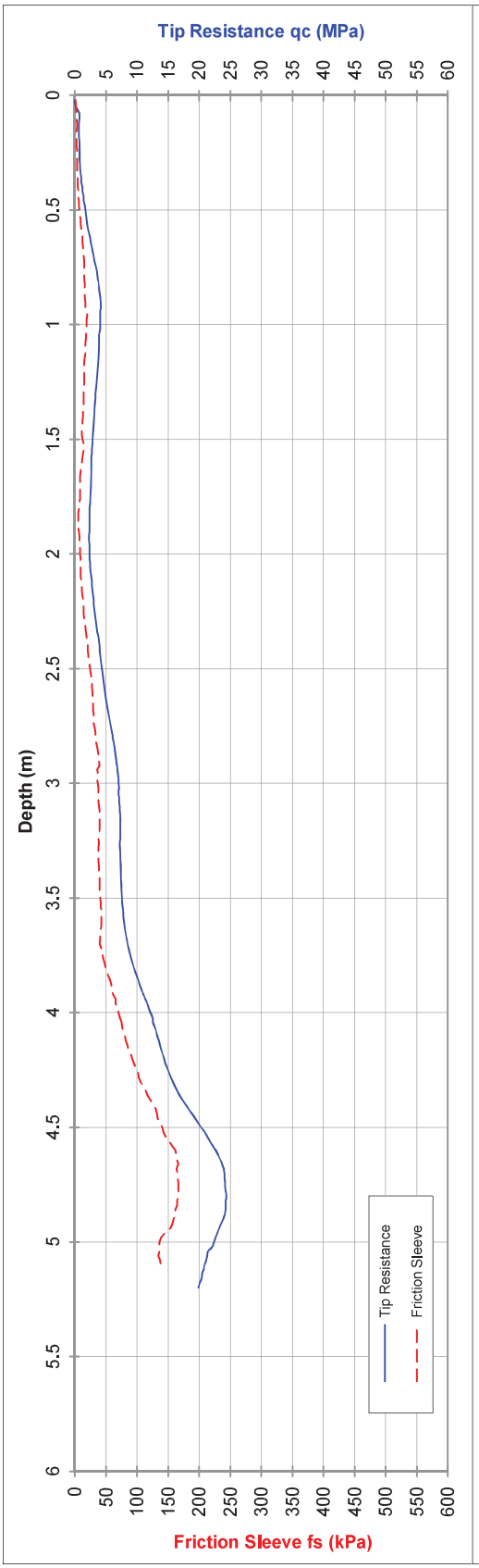
Probe No.: CPT 7

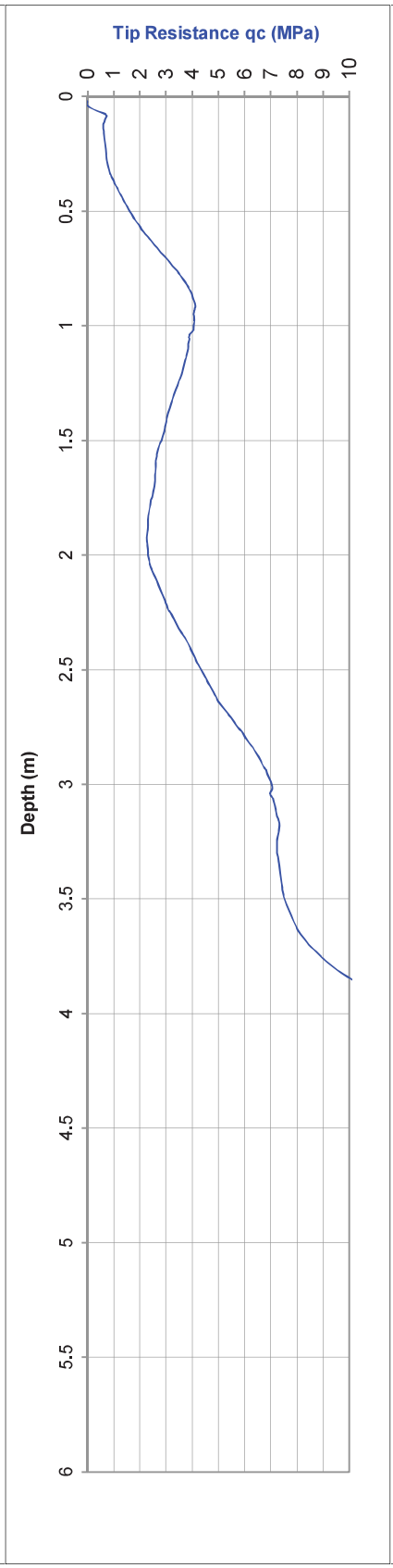
LOCATION: Hammond Park

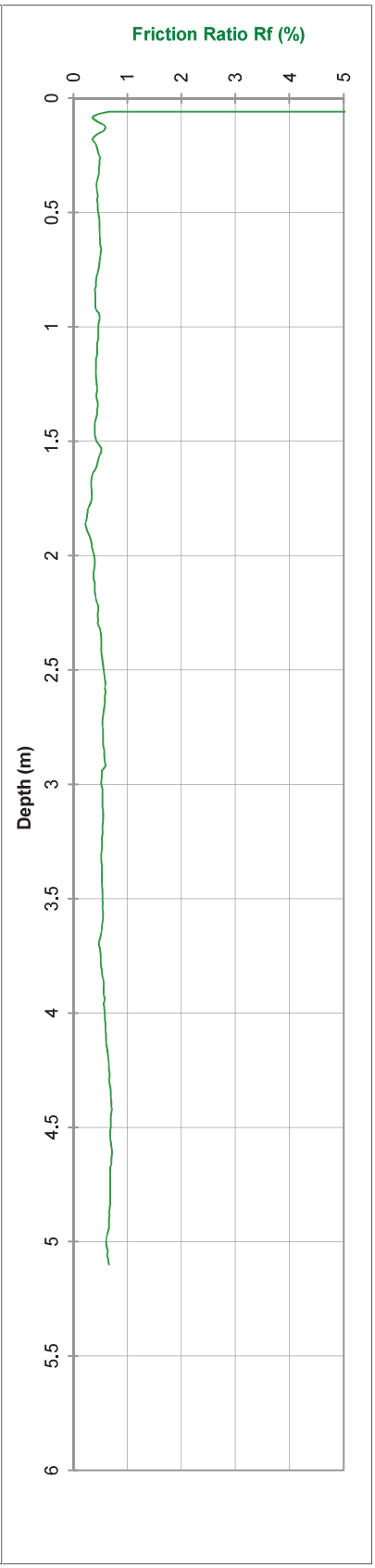
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.7

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2849M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

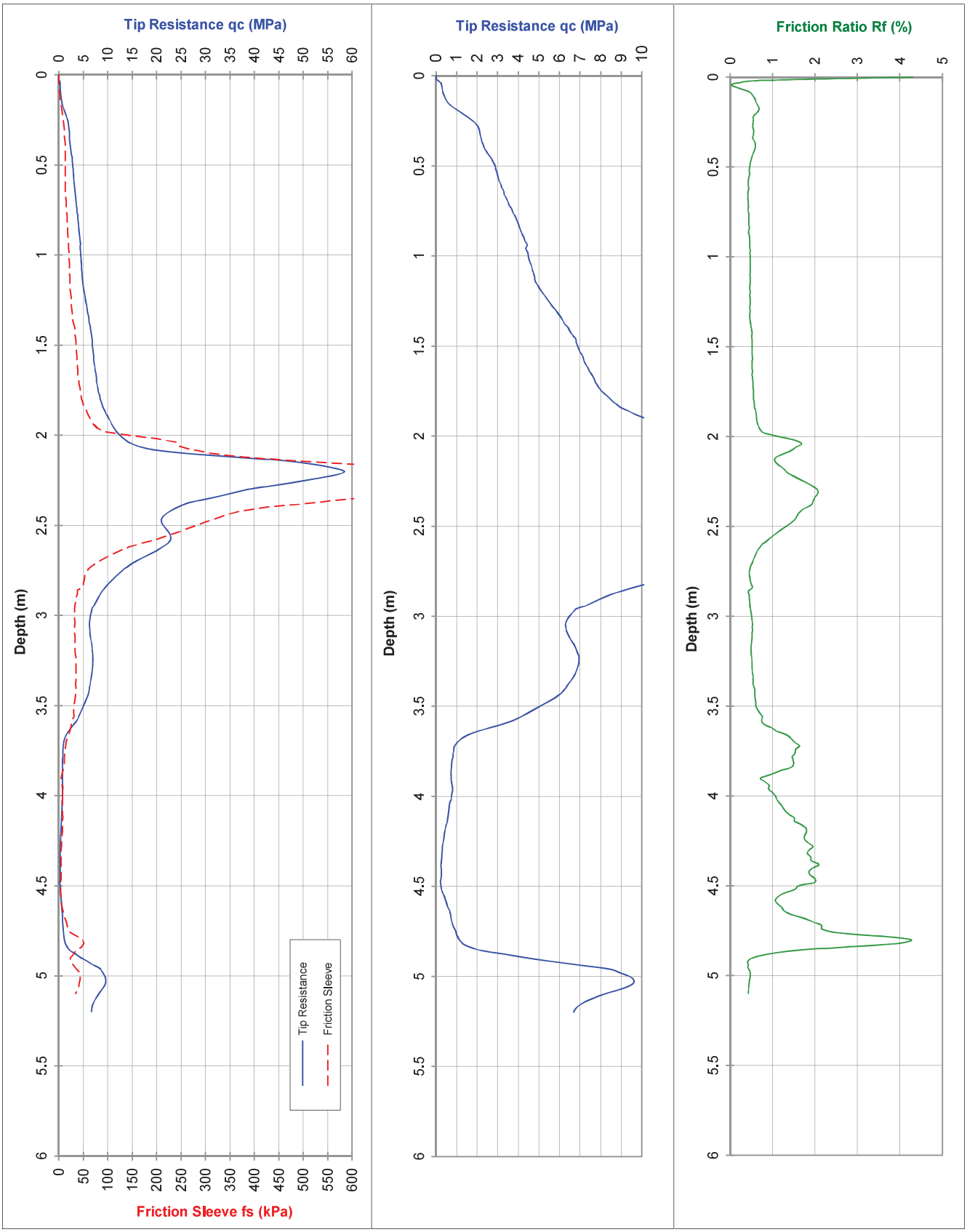
Probe No.: CPT 8

LOCATION: Hammond Park

Job Number: 61/31027/08

RL (m):

Co-ordinates:



PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 5.0

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2850M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

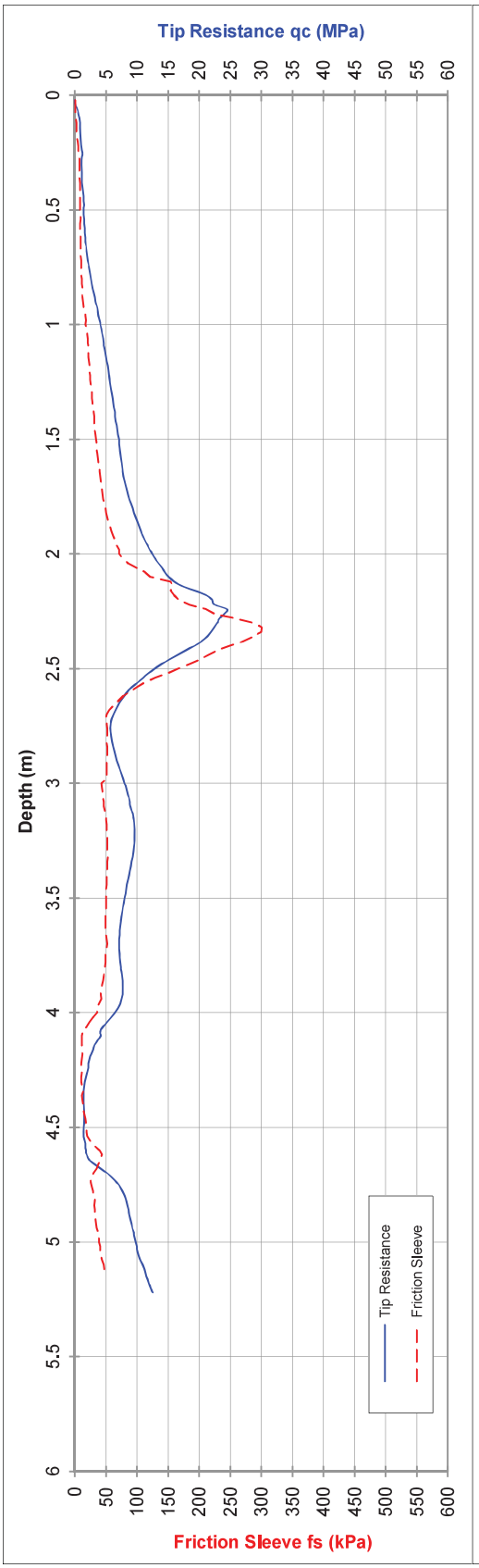
Probe No.: CPT 9

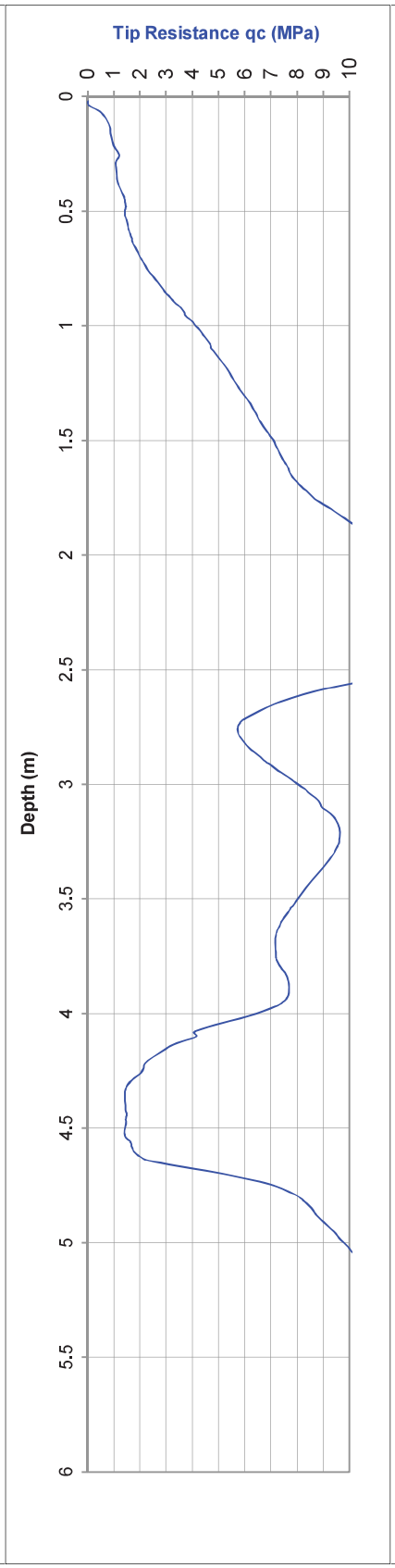
LOCATION: Hammond Park

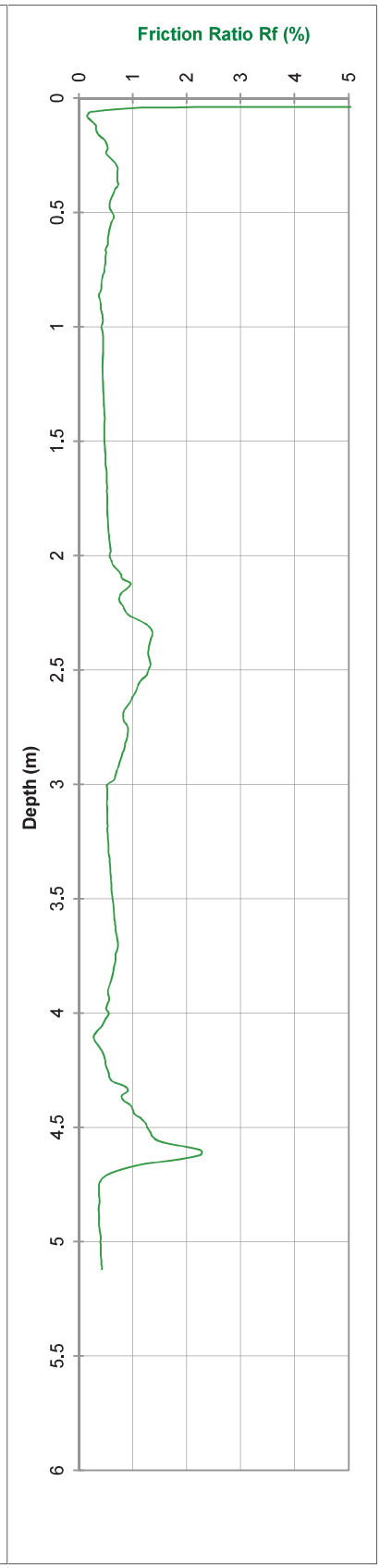
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.0

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2851M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

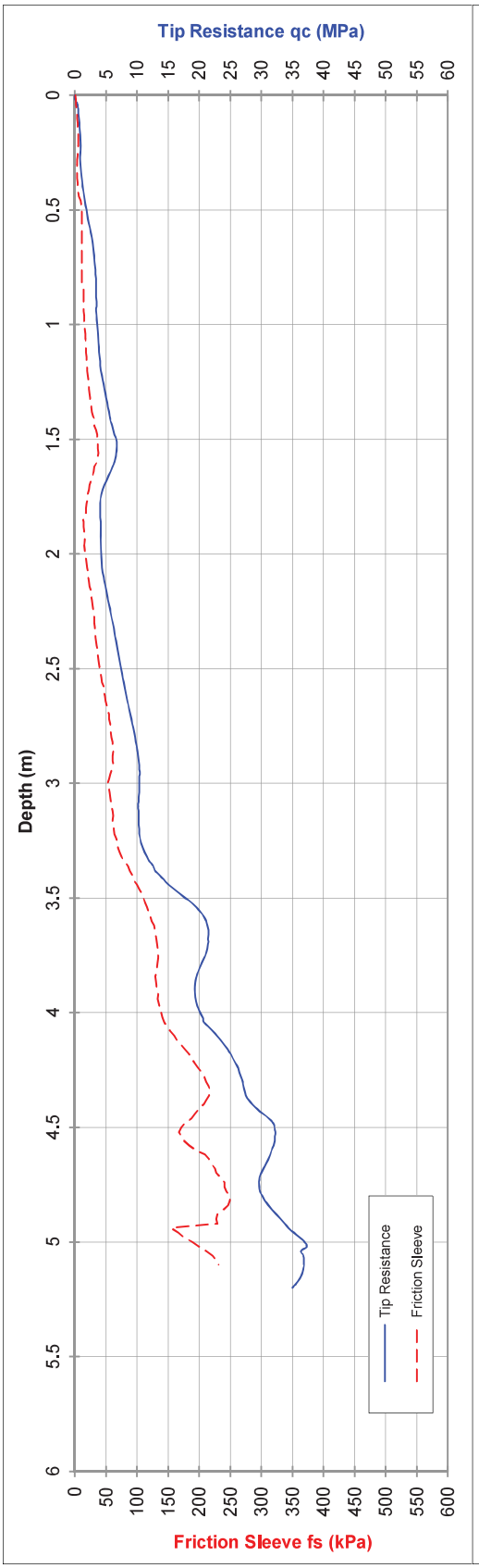
Probe No.: CPT 10

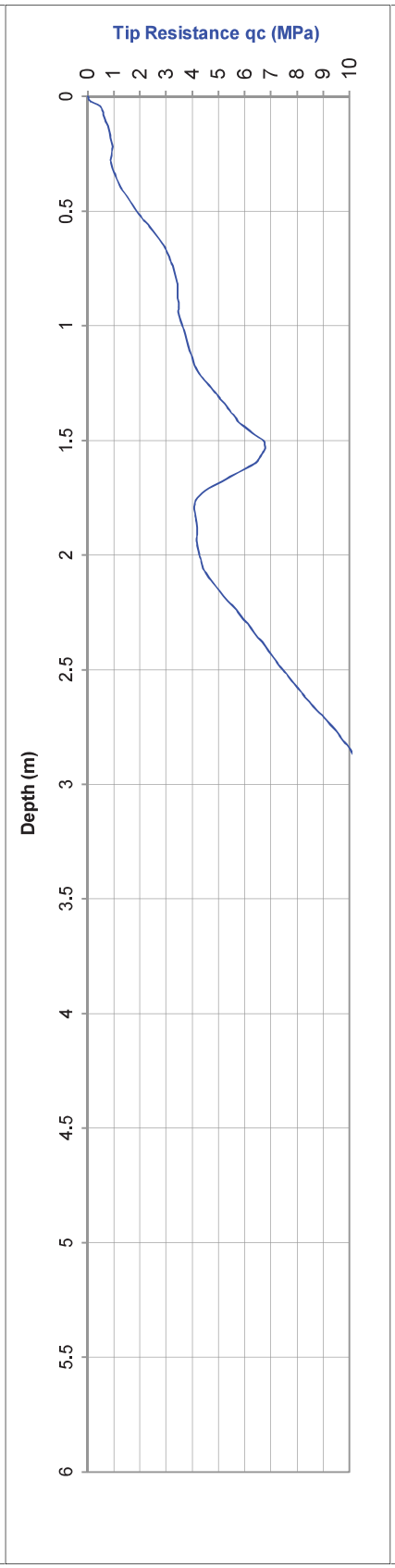
LOCATION: Hammond Park

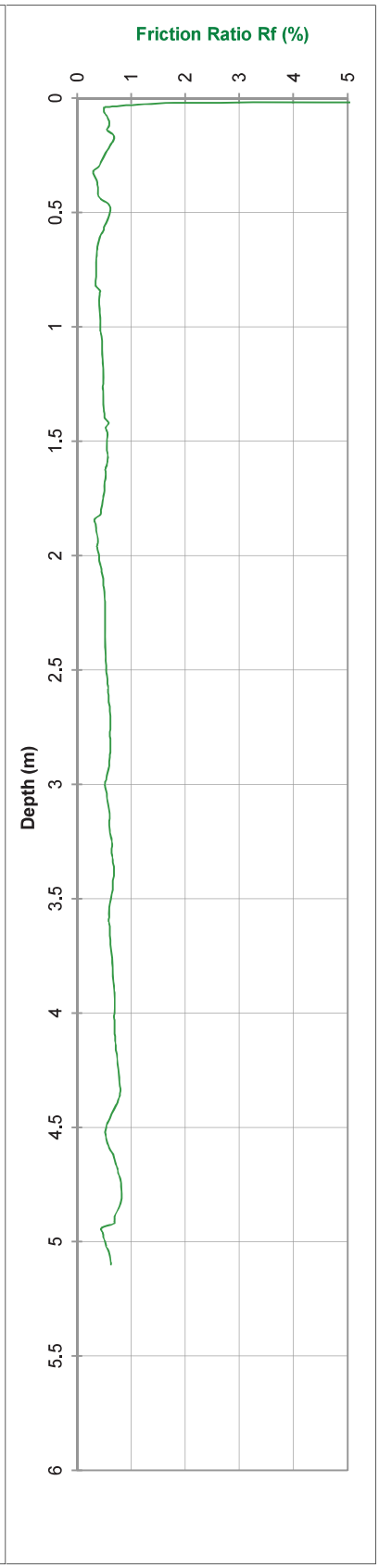
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.4

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2852M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

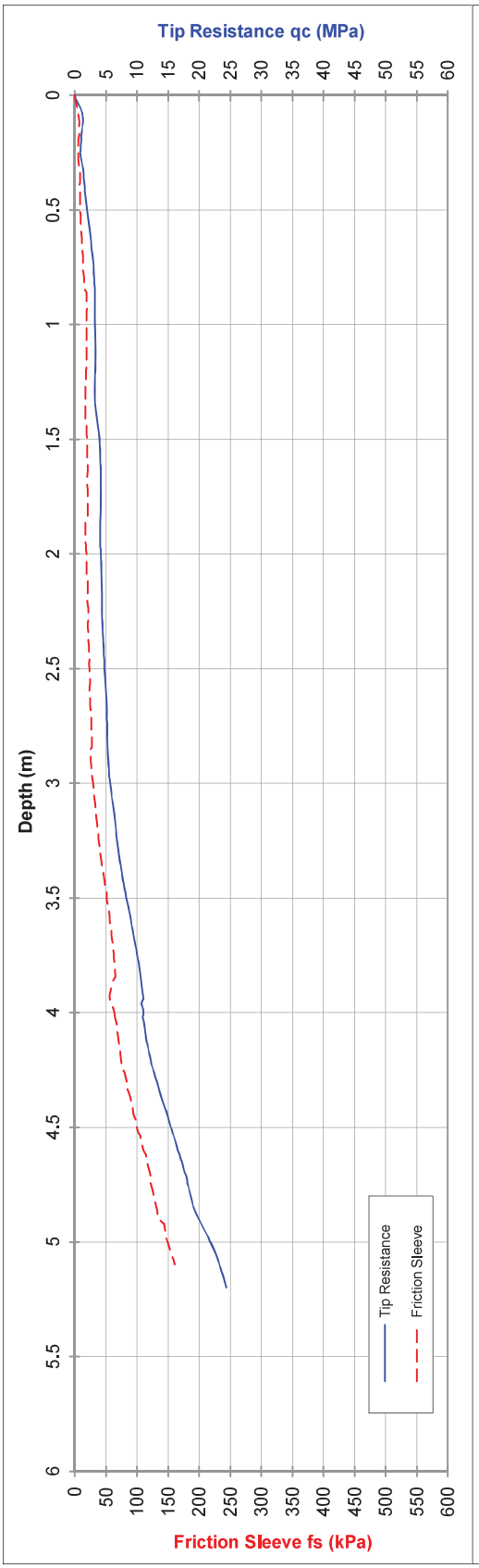
Probe No.: CPT 11

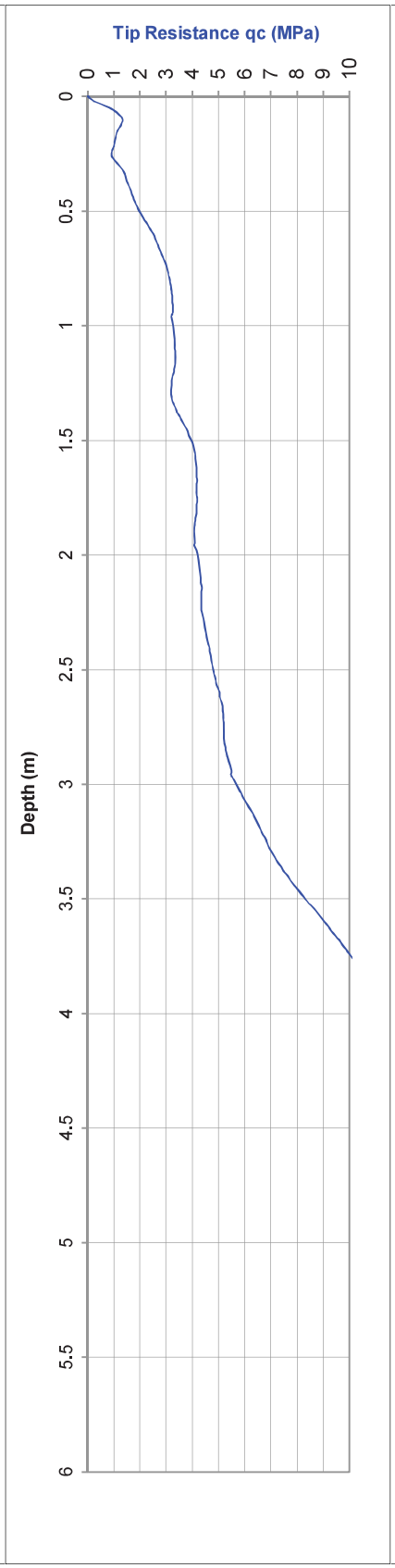
LOCATION: Hammond Park

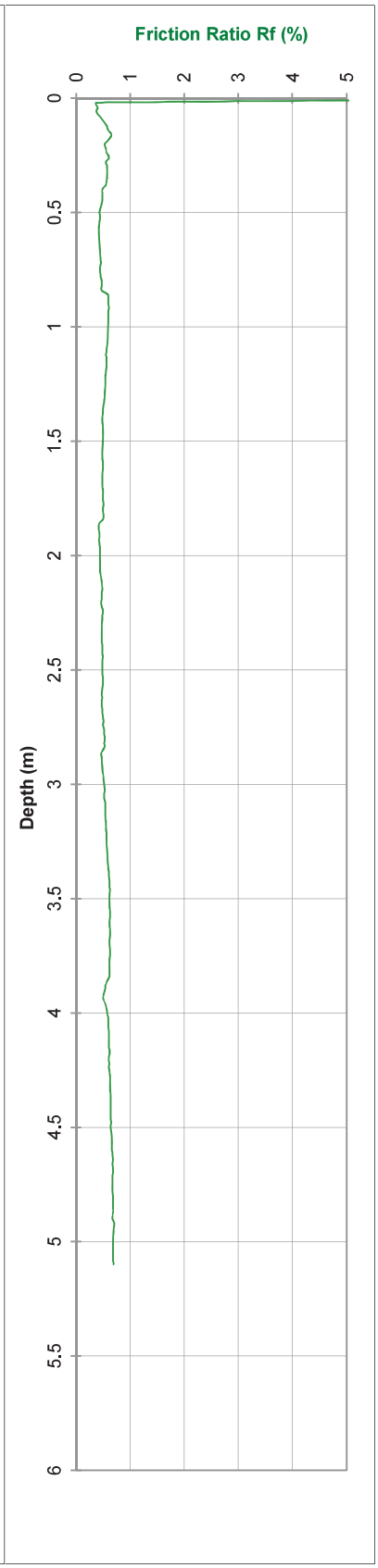
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.6

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2853M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

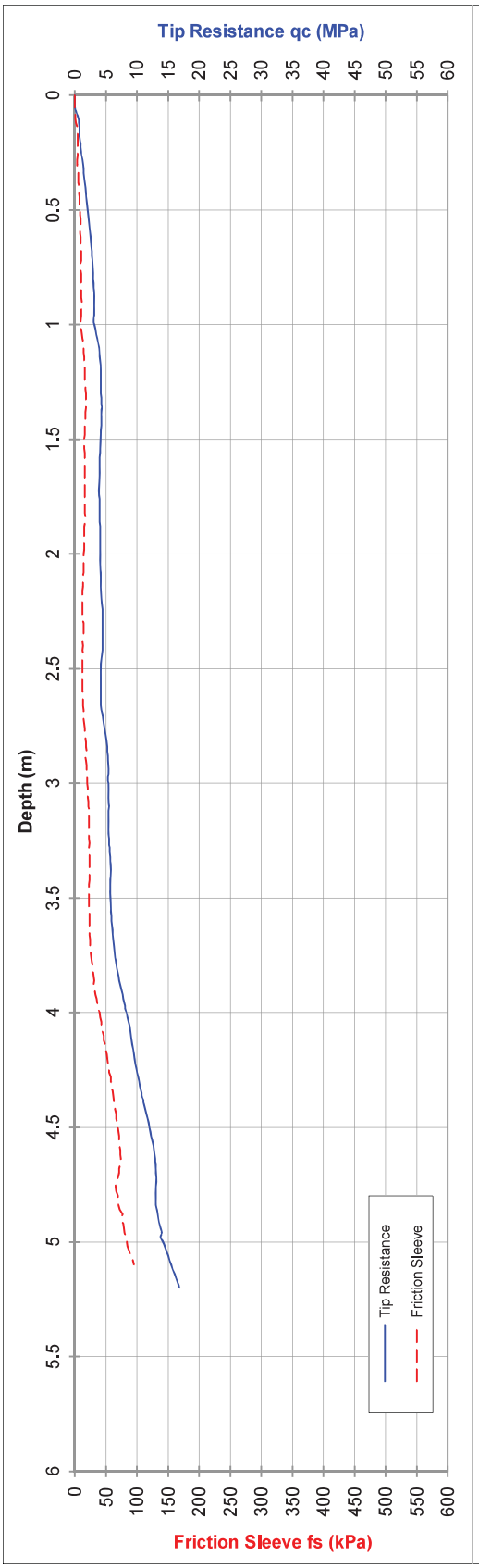
Probe No.: CPT 12

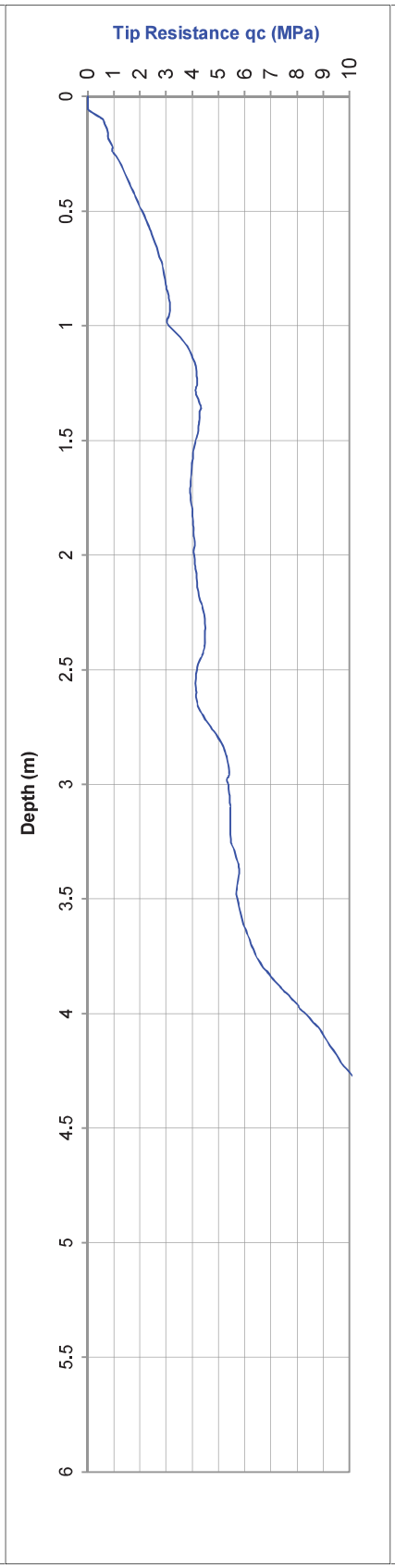
LOCATION: Hammond Park

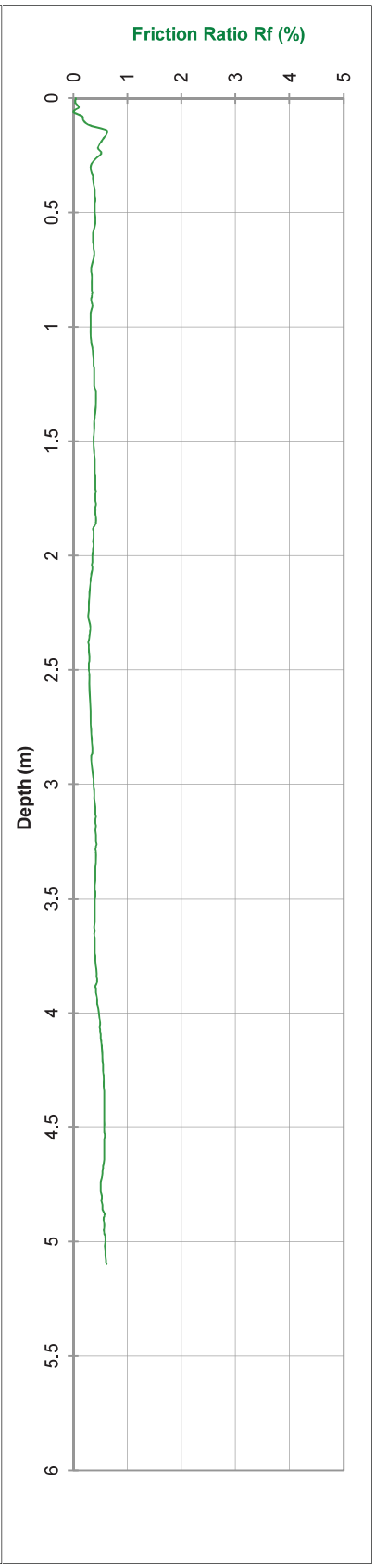
Job Number: 61/31027/08

RL (m):

Co-ordinates:







PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.7

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2854M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: BMW

Date: Thursday, 25 September 2014

PROJECT: Phase 2 - Hammond Park Geotechnical Investigation

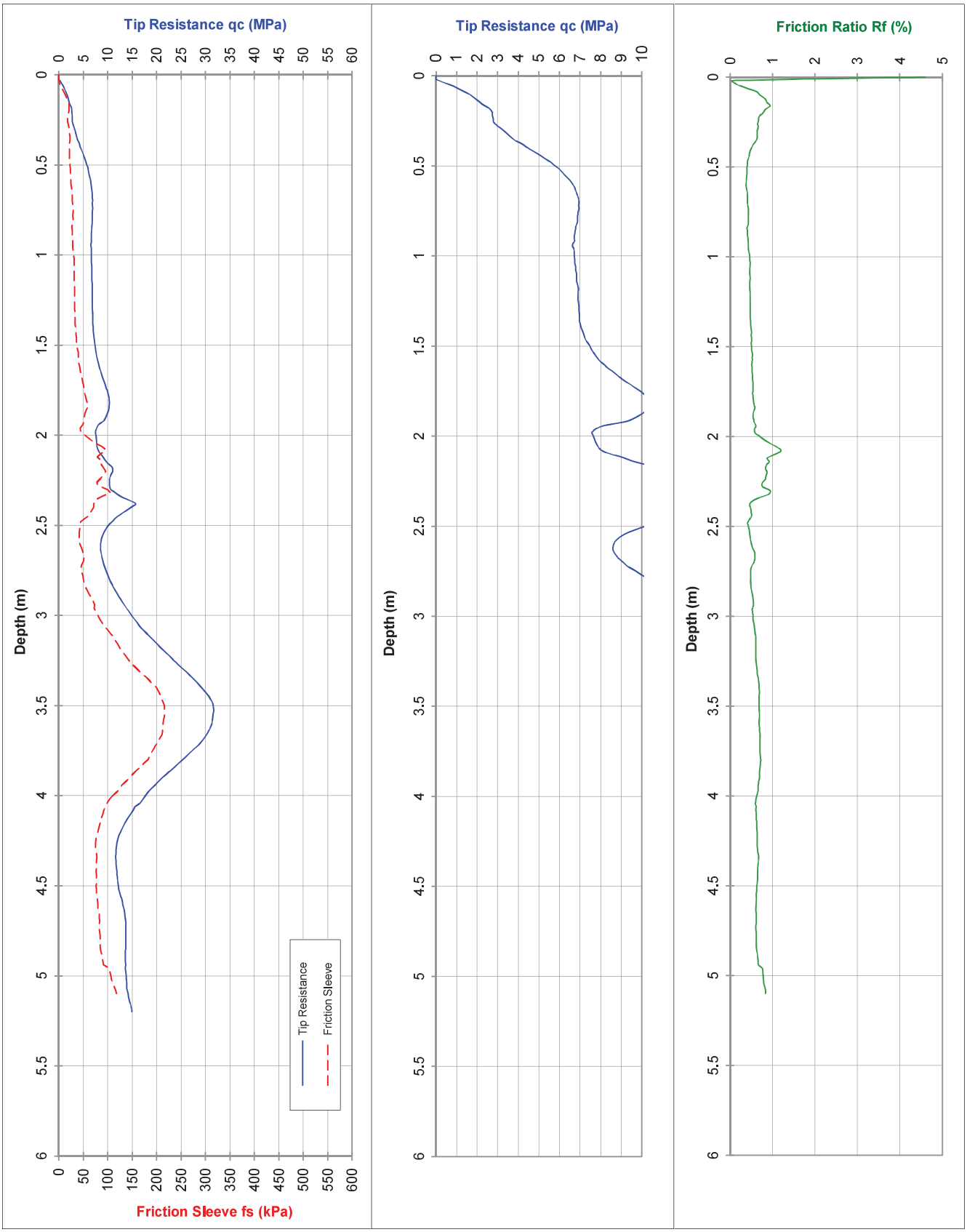
Probe No.: CPT 13

LOCATION: Hammond Park

Job Number: 61/31027/08

RL (m):

Co-ordinates:



PROBEDRILL GEOTECHNICAL SURVEY

Water (m): Dry to 4.6

Refusal:

Tested in accordance with AS 1289.6.5.1 - 1999 and IRTP 2001 for friction reducer

File: GH2855M

Cone I.D. : EC36

Dummy probe to (m):

12 tonne track mounted CPT Rig (M1)

Appendix B – Laboratory test certificates

Particle Size Distribution & Plasticity Index tests

Mining & Civil

Geotest Pty Ltd

unit1/1 Pusey Road, Jandakot, WA 6164

Ph (08) 9414 8022 Fax (08) 9414 8011

Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P14/3667
Sample No:	P14/3667
Issue Date:	8 October 2014

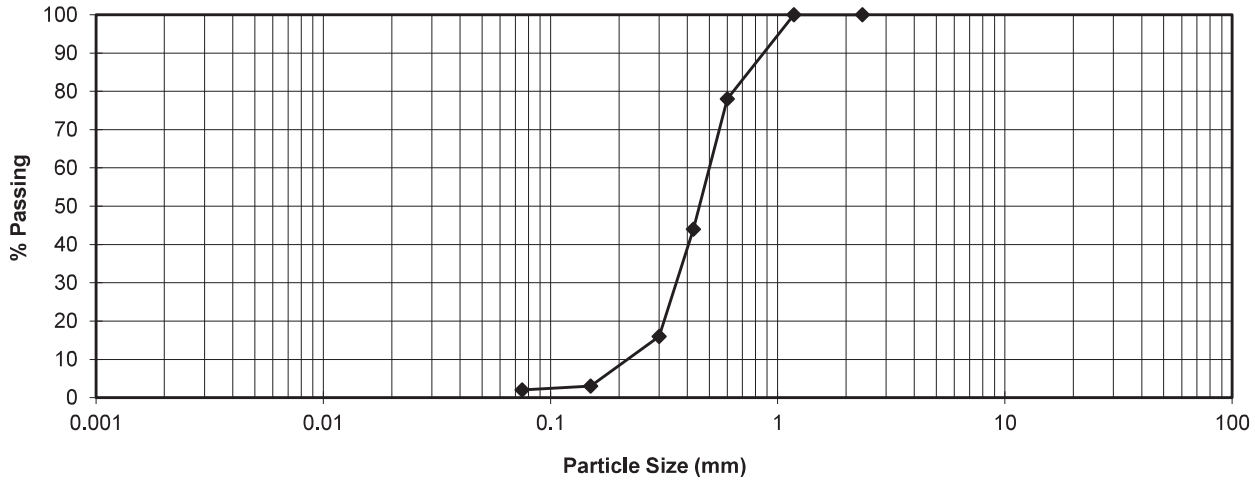
Client: GHD Pty Ltd 61/31027/08

Project: Phase Two - Hammond Park Geotechnical Investigation

Location: Hammond Park

Sample location: CPT04

Sample Depth (m): 0.3-0.5



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	78
0.425	44
0.300	16
0.150	3
0.075	2

Plasticity index tests

AS 1289

Liquid limit 3.1.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

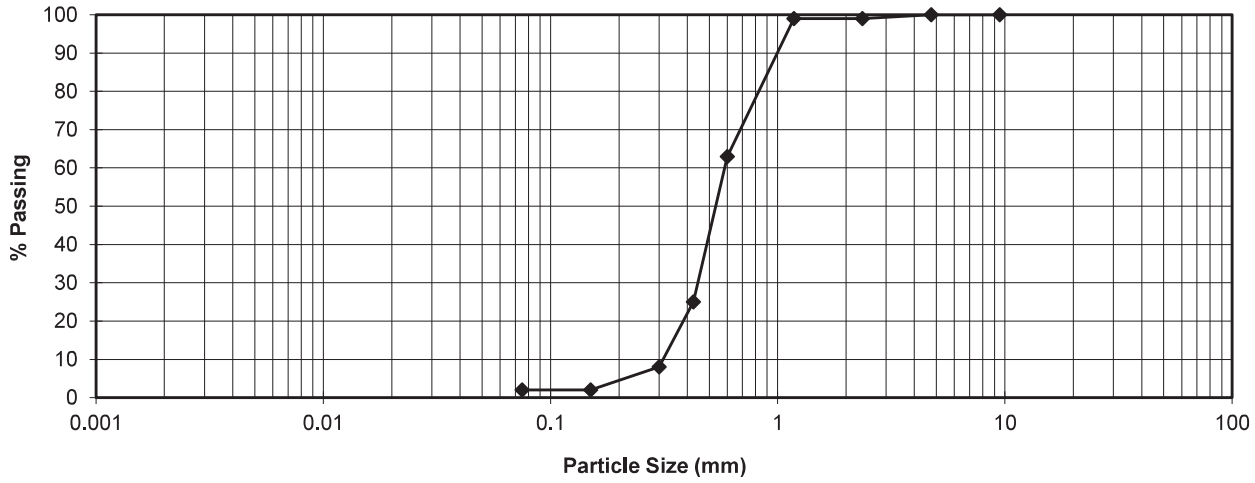
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P14/3665
Sample No:	P14/3665
Issue Date:	8 October 2014

Client: GHD Pty Ltd 61/31027/08
Project: Phase Two - Hammond Park Geotechnical Investigation
Location: Hammond Park

Sample location: CPT08
Sample Depth (m): 0.2-0.5



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	100
4.75	100
2.36	99
1.18	99
0.600	63
0.425	25
0.300	8
0.150	2
0.075	2

Plasticity index tests
AS 1289

Liquid limit 3.1.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

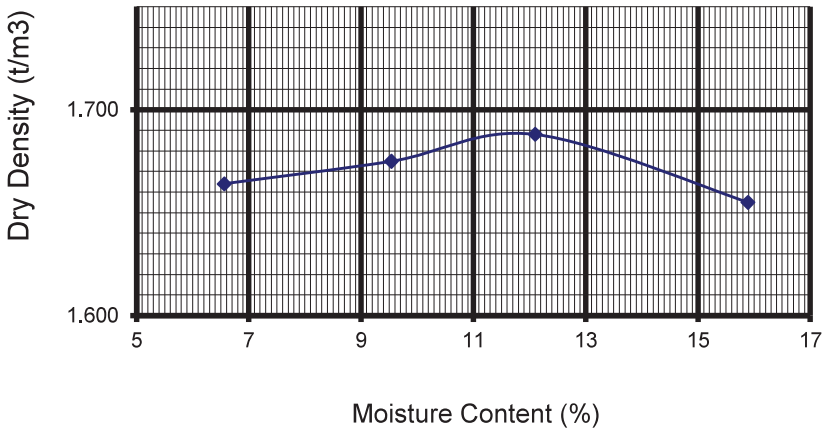
Mining &
Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Modified Maximum Dry Density (AS 1289.5.1.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P14/3665	**Client:**	GHD Pty Ltd (61/31027/08)
Sample No:	P14/3665	**Location:**	Hammond Park
Project:	Phase Two - Hammond Park	**Date of issue:**	8 October 2014
	CPT08 0.2-0.5m	**Job No:**	60054

Maximum Dry Density t/m^3:	1.688	**Conditions at Test**	
Optimum Moisture Content %:	12.1	Soaking Period (Days)	4
Desired Conditions: %MDD / %OMC	96/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	19.4
Mass of hammer kg	4.9	Entire Moisture Ratio %	160.0
Number of layers	5	Top 30mm Moisture Content %	15.1
Number of blows/layer	15	Top 30mm Moisture Ratio %	124.5
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.602	C.B.R. at 5.0 mm Penetration %	12
Moisture Content %	12.1	**Conditions after Soaking**	
Density Ratio %	96.0	Dry Density t/m^3	1.602
Moisture Ratio %	99.5	Moisture Content %	18.6
Soaked / Unsoaked	Soaked	Dry Density Ratio %	96.0
		Moisture Ratio %	153.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

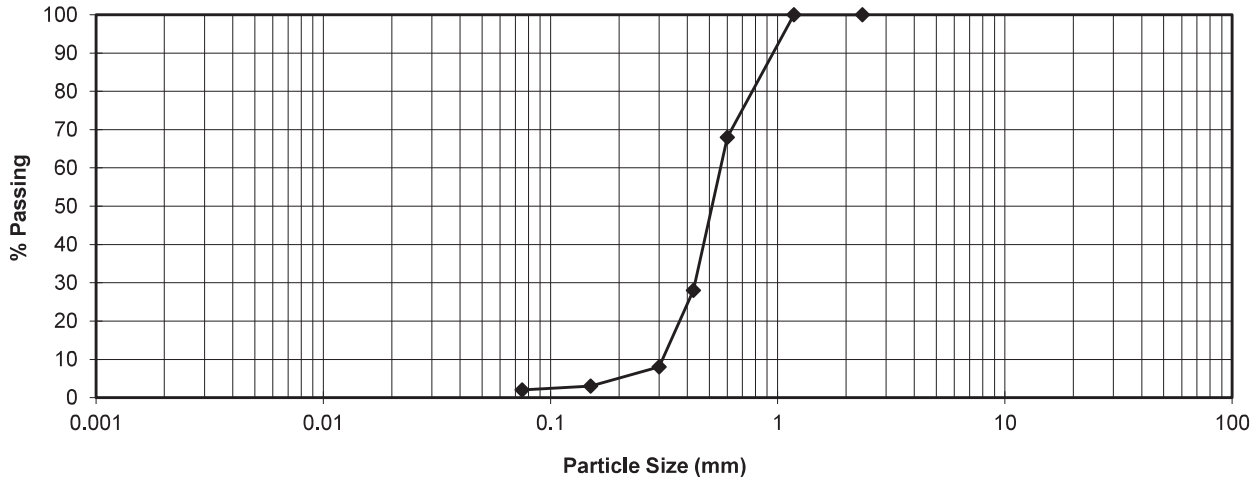
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P14/3668
Sample No:	P14/3668
Issue Date:	8 October 2014

Client: GHD Pty Ltd 61/31027/08
Project: Phase Two - Hammond Park Geotechnical Investigation
Location: Hammond Park

Sample location: CPT12
Sample Depth (m): 0.4-0.6



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	68
0.425	28
0.300	8
0.150	3
0.075	2

Plasticity index tests
AS 1289

Liquid limit 3.1.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

AS PSDPI May 2009

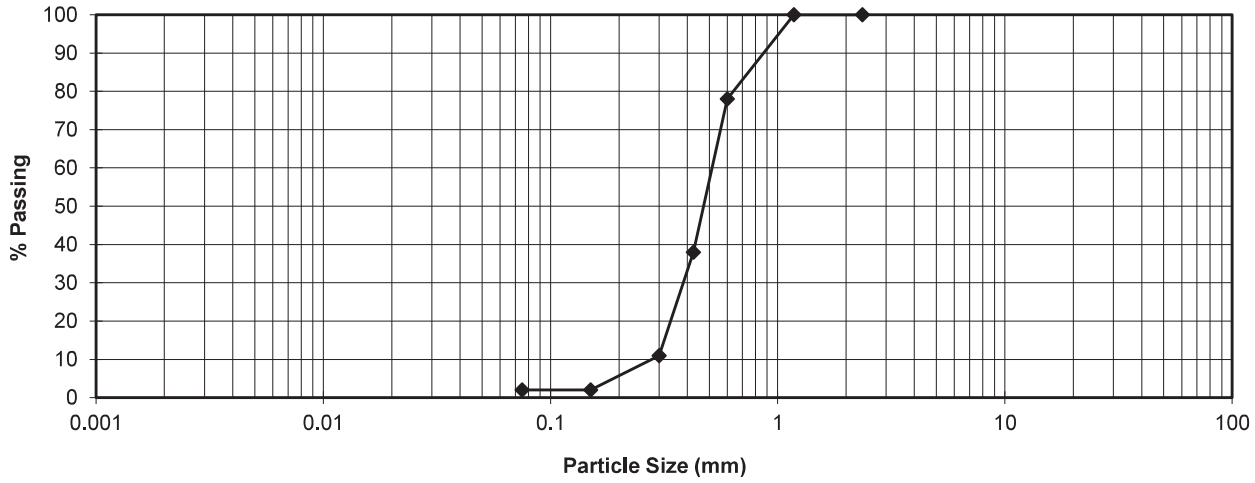
Particle Size Distribution & Plasticity Index tests

Mining & Civil
Geotest Pty Ltd
unit1/1 Pusey Road, Jandakot, WA 6164
Ph (08) 9414 8022 Fax (08) 9414 8011
Email: matt@mcgeotest.com.au

Job No:	60054
Report No:	60054-P14/3666
Sample No:	P14/3666
Issue Date:	8 October 2014

Client: GHD Pty Ltd 61/31027/08
Project: Phase Two - Hammond Park Geotechnical Investigation
Location: Hammond Park

Sample location: CPT13
Sample Depth (m): 0.4-0.6



SIEVE ANALYSIS AS 1289.3.6.1

Sieve Size (mm)	% Passing
75.0	
37.5	
19.0	
9.5	
4.75	
2.36	100
1.18	100
0.600	78
0.425	38
0.300	11
0.150	2
0.075	2

Plasticity index tests
AS 1289

Liquid limit 3.1.1	NA	%
Plastic limit 3.2.1		%
Plasticity index 3.3.1		%
Linear shrinkage 3.4.1		%

Cracked ☐

Curled ☐

Client Address: GHD House, Adelaide Terrace, Perth

Sampling Procedure: Tested as received

NATA WORLD RECOGNISED ACCREDITATION

Approved signature

Matthew van Herk

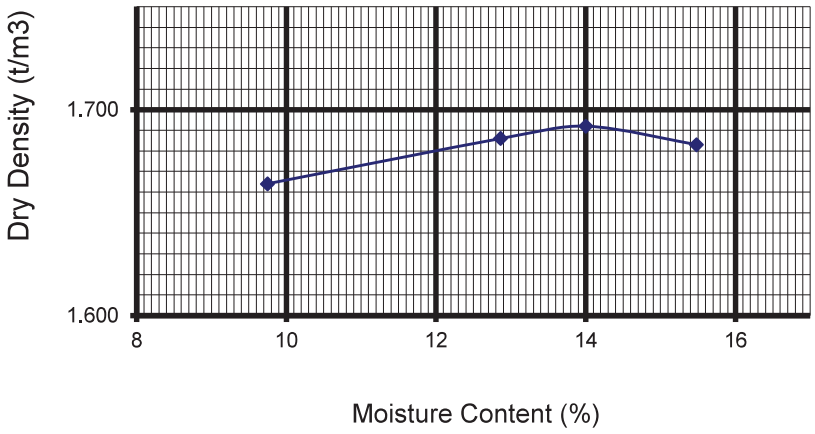
Mining &
Civil
Geotest Pty Ltd
Unit 1/1 Pusey Road, JANDAKOT WA 6164
Ph (08) 9414 8022
Fax (08)9414 8011
Email matt@mcgeotest.com.au

Modified Maximum Dry Density (AS 1289.5.1.1) & California Bearing Ratio (AS 1289.6.1.1) Test Report

Certificate No:	60054-P14/3666	**Client:**	GHD Pty Ltd (61/31027/08)
Sample No:	P14/3666	**Location:**	Hammond Park
Project:	Phase Two - Hammond Park	**Date of issue:**	8 October 2014
	CPT13 0.4-0.6m	**Job No:**	60054

Maximum Dry Density t/m^3:	1.692	**Conditions at Test**	
Optimum Moisture Content %:	14.0	Soaking Period (Days)	4
Desired Conditions: %MDD / %OMC	96/100	Surcharge (kg)	4.5
Compactive Effort		Entire Moisture Content %	16.1
Mass of hammer kg	4.9	Entire Moisture Ratio %	115.0
Number of layers	5	Top 30mm Moisture Content %	15.7
Number of blows/layer	17	Top 30mm Moisture Ratio %	112.0
Conditions after Compaction		Swell %	0.0
Dry Density t/m^3	1.610	C.B.R. at 5.0 mm Penetration %	11
Moisture Content %	13.9	**Conditions after Soaking**	
Density Ratio %	96.0	Dry Density t/m^3	1.610
Moisture Ratio %	99.5	Moisture Content %	16.7
Soaked / Unsoaked	Soaked	Dry Density Ratio %	96.0
		Moisture Ratio %	119.5

Comments: Tested as received



Client Address: GHD House, Adelaide Tce Perth

ASMDD-CBR May 2009

Approved Signature Matthew van Herk

Qualcon Laboratories Pty. Ltd.

N.A.T.A. Accreditation Number: 10731

as trustee for Qualcon Unit Trust
ABN: 34 736 601 547 ACN: 068 691 369

Unit 2/2 Lorries Court,
MALAGA. W.A. 6090.
Phone: (08) 9249 9895
Fax: (08) 9248 1822
Email: qualcon@iinet.net.au

MAXIMUM AND MINIMUM DENSITY REPORT

AS1289.5.5.1

Report Number	QL6287-14	**Date of Report**	09-Oct-14
Client	Mining & Civil Geotest Pty Ltd (GHD 61/31027/08)	Job No.	60054
Location	Phase 2 - Hammond Park Geotech Investigation (CPT08 - 0.2m to 0.5m)		
Sampled By	As Received 2-Oct-2014	**Date Sampled**	NA
Material Description	Sand	**Size of Mould**	1000
Test Number	5833 (P14/3665)		

Maximum Density (t/m3) $Q_{dmax.}$	**1.73**
Minimum Density (t/m3) $Q_{dmin.}$	**1.42**

Authorised Signatory
G J Donatti

MAMDREP.REV03.AUG2013
Approved by : G Donatti

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025

Qualcon Laboratories Pty. Ltd.

N.A.T.A. Accreditation Number: 10731

as trustee for Qualcon Unit Trust
ABN: 34 736 601 547 ACN: 068 691 369

Unit 2/2 Lorries Court,
MALAGA. W.A. 6090.
Phone: (08) 9249 9895
Fax: (08) 9248 1822
Email: qualcon@iinet.net.au

MAXIMUM AND MINIMUM DENSITY REPORT

AS1289.5.5.1

Report Number	QL6287-14	**Date of Report**	09-Oct-14
Client	Mining & Civil Geotest Pty Ltd (GHD 61/31027/08)	Job No.	60054
Location	Phase 2 - Hammond Park Geotech Investigation (CPT13 - 0.4m to 0.6m)		
Sampled By	As Received 2-Oct-2014	**Date Sampled**	NA
Material Description	Sand	**Size of Mould**	1000
Test Number	5834 (P14/3666)		

Maximum Density (t/m3)	$Q_{dmax.}$	**1.79**
Minimum Density (t/m3)	$Q_{dmin.}$	**1.51**

Authorised Signatory : G J Donatti

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Accredited for compliance with ISO/IEC 17025

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\31027\WP\Geotech\Stage 2 Reports\4. Hammond Park\145107.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
A	T. Lillo	A. Jennings	*A. Jennings*	P. Tilley	*P. Tilley*	*06/10/14*
0	W. Houghton	K. Wu		P. Tilley		10/10/14

www.ghd.com

GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au

G:\61\31027\Phase 2 & 3 - Client Package\School Summary Reports\Hammond Park - Summary.docx

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B. Meyer	P. Tilley		P. Tilley		10/10/14

www.ghd.com

Aurecon Australasia Pty Ltd
ABN 54 005 139 873
Level 5
863 Hay Street
Perth WA 6000
Australia

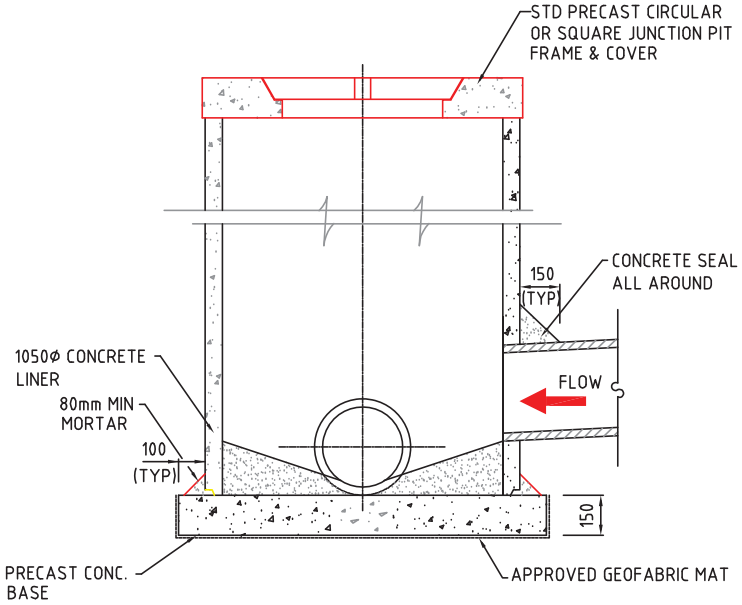
T +61 8 6145 9300
F +61 8 6145 5020
E perth@aurecongroup.com
W aurecongroup.com

Aurecon offices are located in:
Angola, Australia, Botswana, Chile, China, Ethiopia, Ghana, Hong Kong, Indonesia, Lesotho, Libya, Malawi, Mozambique, Namibia, New Zealand, Nigeria, Philippines, Qatar, Singapore, South Africa, Swaziland, Tanzania, Thailand, Uganda, United Arab Emirates, Vietnam.

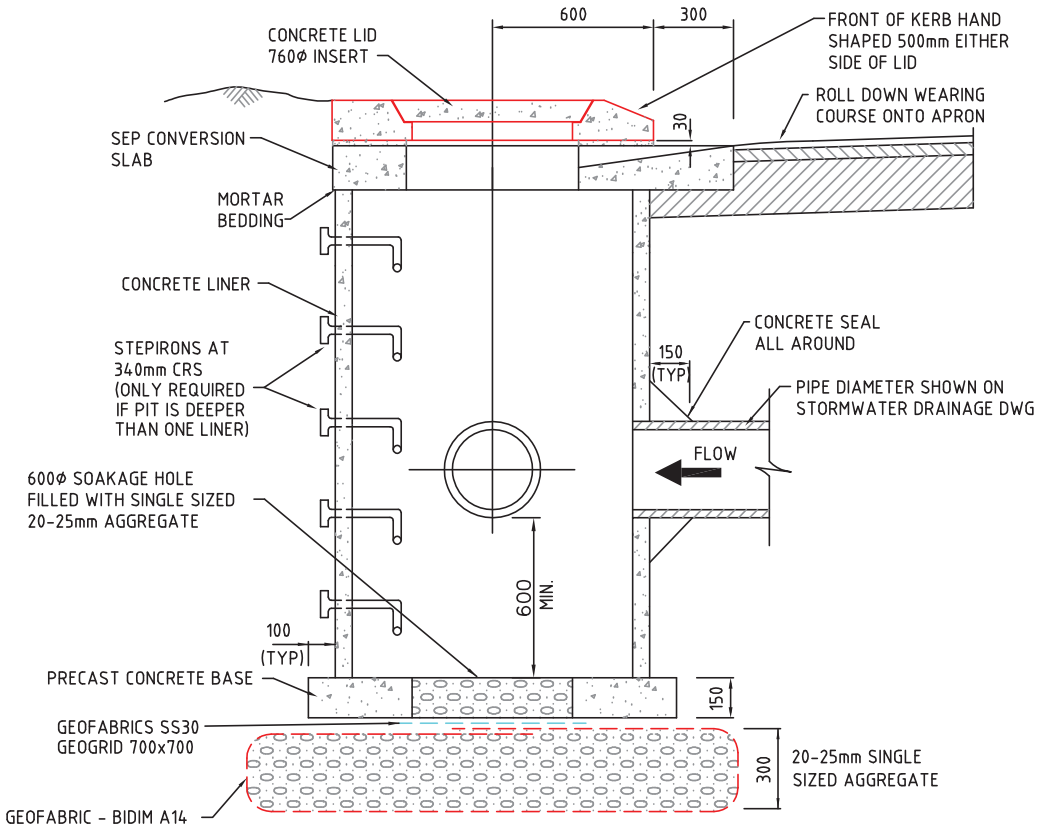
Appendix C
Drainage – SEP Soakwell & Standard Linear Junction Pit

NOTES
1. GEOFABRIC BIDIM A14 AND AGGREGATE SOAKAGE UDERPLAY IS REQUIRED FOR PITS WHEN BASE IS MORE THAN 500mm ABOVE AAMGL FOR THE SITE

2. LESS THAN 500mm ABOVE AAMGL PITS TO BE BENCHED



STD LINER JUNCTION PIT
BASE SHOWN FOR WET CONDITIONS



SINGLE SIDE ENTRY PIT WITH SOAKAGE
BASE SHOWN FOR WET CONDITIONS

400 200 0 400 800mm
1:20

No.	Revision-	Chk'd	App'd	Date

CITY OF COCKBURN WOULD LIKE TO ACKNOWLEDGE AND THANK GUTTERIDGEHASKINS & DAVEY PTY. LTD. FOR THEIR ASSISTANCE IN THE PRODUCTION OF THESE STANDARD DETAIL DRAWINGS

CITY OF COCKBURN
9 COLEVILLE CRESCENT, SPEARWOOD WA 6163
PHONE: (08) 9411 3444 FAX: (08) 9411 3416

STANDARD DETAILS

Title
DRAINAGE
SEP SOAKWELL & STD LINEAR JUNCTION PIT

DESIGNED GHD	APPROVED	SCALE AS SHOWN	JOB No
DRAWN KMF/SYC		DWG No 2423B03	SHEET No 08
CHECKED KR	DATE		REV

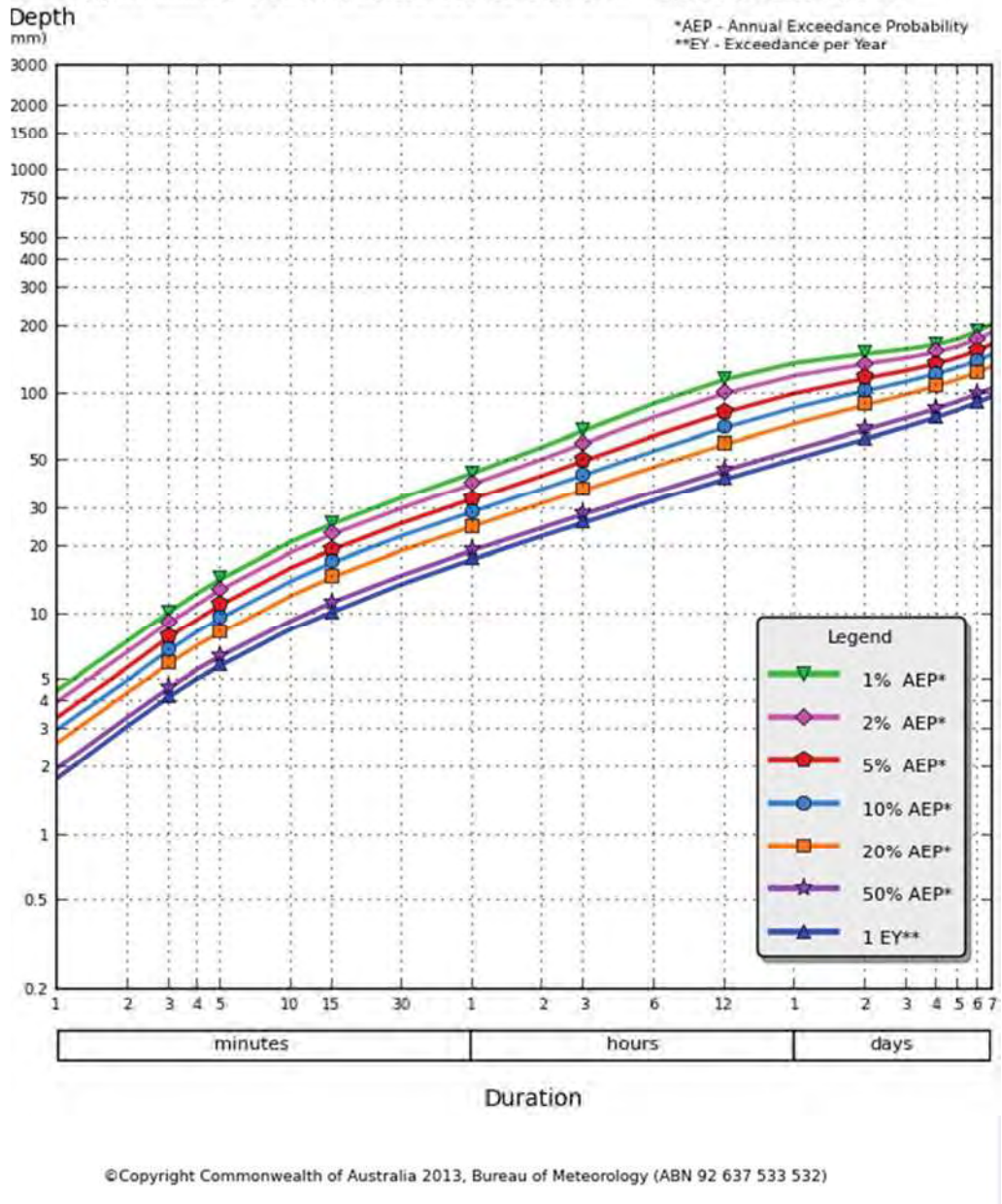
Appendix D
IFD Design Rainfall Depth

Requested coordinate Latitude: -32.0550 Longitude: 115.7500
Nearest grid cell Latitude: 32.0625 (S) Longitude: 115.7625 (E)

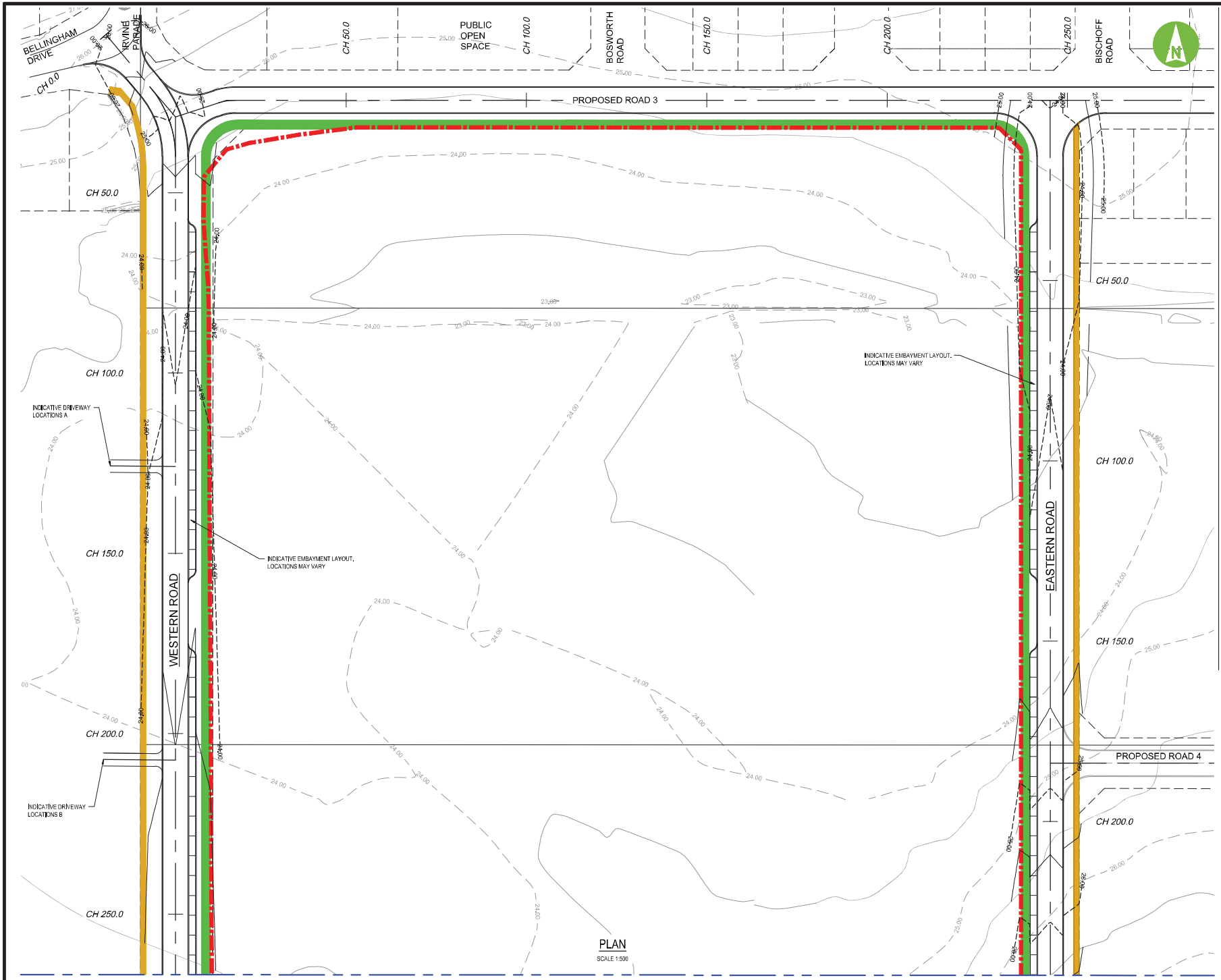
IFD Design Rainfall Depth (mm)

Issued: 17 March 2015

Rainfall depth in millimetres for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP)



Appendix E
Drainage Calculations



PLAN
SCALE 1:500

MATCHLINE JOINS - WASP-AUR-CIV-DWG-0621

LEGEND

- PROPOSED PEDESTRIAN PATH
- PROPOSED SHARED PATH
- INDICATIVE CADASTRAL BOUNDARY
- FUTURE LOT BOUNDARY (BY OTHERS)
- PROPOSED SEMI-MOUNTABLE KERB
- PROPOSED ROAD CENTRELINE
- EXISTING SURFACE CONTOURS (MINOR) (0.5m INTERVAL)
- EXISTING SURFACE CONTOURS (MAJOR) (0.5m INTERVAL)
- APPROXIMATE PRELIMINARY DESIGN (MINOR) CONTOURS (0.5m INTERVAL)
- APPROXIMATE PRELIMINARY DESIGN (MAJOR) CONTOURS (0.5m INTERVAL)
- × 49.786 APPROXIMATE PRELIMINARY DESIGN LEVELS

NOTES

1. ALL DIMENSIONS ARE IN METRES UNO.
2. ALL LEVELS AND DIMENSIONS ARE TO BE CHECKED ON SITE.
3. THIS DRAWING IS PRELIMINARY ONLY AND INTENDED FOR INFORMATION FOR DESIGN DEVELOPMENT CO-ORDINATION NOT FOR CONSTRUCTION PURPOSES.
4. THE LEVELS INDICATED ON THIS DRAWING ARE BASED INFORMATION RECEIVED FROM THIRD PARTIES AND SHALL BE READ IN CONJUNCTION WITH GHD DRAWING "HAMMOND PARK HIGH SCHOOL SURVEY" 18.08.14.
5. PROJECT CO SHALL COMPLY WITH THE REQUIREMENTS CONTAINED IN THE AUSTRALIAN STANDARDS FOR ENVIRONMENTAL PROTECTION.
6. AT THE TIME OF ISSUE, THIS DRAWING IS BASED UPON SURVEY AND PRELIMINARY DESIGN INFORMATION FOR THE SURROUNDING LOTS PRESENTED BY OTHER CONSULTANT DRAWINGS WHICH ARE KNOWN TO BE PARTIALLY COMPLETE.
7. THIS PLAN IS INTENDED TO BE USED FOR PRELIMINARY DESIGN ONLY AND HAS BEEN PREPARED IN THE ABSENCE OF FULL AND PROPER DUE DILIGENCE. ALL AREAS AND DIMENSIONS ARE INDICATIVE ONLY AND SUBJECT TO CHANGE, DETAILED DESIGN, FINAL SURVEY AND APPROVED BY VARIOUS EXTERNAL AUTHORITIES.

PRELIMINARY
(FOR INFORMATION ONLY)

REV	DESCRIPTION	DATE	APP
A	ISSUED FOR INFORMATION	14.04.15	

aurecon
www.aurecongroup.com

AURECON PROJECT ID - 242591

Department of Education
Department of Treasury
GOVERNMENT OF WESTERN AUSTRALIA

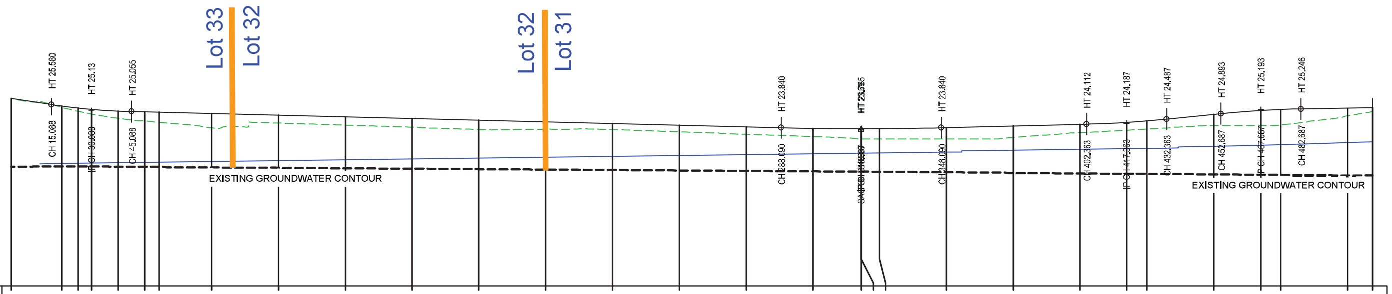
WASP SURROUNDING WORKS
HAMMOND PARK HIGH SCHOOL
PRELIMINARY CIVIL WORKS PLAN - SHEET 1 OF 2

DRAWN	JJL	DESIGNED	RR
CHECKED	BOS	PRINCIPAL	
APPROVED	PH		
SCALE 1 : 500		DATE APRIL 2015	DRAWING No. DWG-0620 A
PROJ No. -		FILE No. WASP-AUR-CV-DWG-0620	

REDUCTION

THIS IS A CADD DRAWING DO NOT AMEND MANUALLY

P:\242591 - WA SCHOOLS PPP TECHNICAL ADVISOR\3.0 PROJECT DELIVERY\CADD\DRGS\CIV\WASP-AUR-CIV-DWG-0620



DATUM PCGZ50 12.00

CHAINAGE MC01	SETOUT COORDINATES EASTING (X)	SETOUT COORDINATES NORTHING (Y)	DESIGN SURFACE REDUCED LEVEL	CUT / FILL DEPTH TO EXISTING SURFACE	EXISTING SURFACE REDUCED LEVEL	DEPTH TO EXISTING GROUND CONTOURS
0.00	53090.327	239167.301	26.033	0.00	26.030	5.122
18.94	53102.677	239152.936	25.471	0.10	25.372	4.551
25.00	53106.137	239147.978	25.324	0.24	25.086	4.403
30.09	53108.225	239143.345	25.224	0.36	24.863	4.304
39.98	53109.927	239133.644	25.092	0.53	24.558	4.180
50.00	53110.016	239123.626	25.031	0.70	24.333	4.132
55.30	53110.063	239118.323	25.004	0.75	24.252	4.112
75.00	53110.237	239098.627	24.906	1.07	23.841	4.037
100.00	53110.458	239073.628	24.781	0.58	24.199	3.943
125.00	53110.68	239048.629	24.656	0.62	24.037	3.851
150.00	53110.901	239023.63	24.531	0.66	23.874	3.759
175.00	53111.122	238998.631	24.406	0.69	23.711	3.668
200.00	53111.343	238973.632	24.281	0.55	23.735	3.577
225.00	53111.564	238948.633	24.156	0.45	23.708	3.487
250.00	53111.786	238923.634	24.031	0.50	23.532	3.398
275.00	53112.007	238898.635	23.906	0.55	23.357	3.308
300.00	53112.228	238873.636	23.793	0.62	23.178	3.229
318.09	53112.388	238855.55	23.765	0.76	23.004	3.227
318.09	53112.388	238855.547	23.765	0.76	23.004	3.227
325.00	53112.449	238848.637	23.769	0.77	23.000	3.241
350.00	53112.67	238823.638	23.850	0.85	23.000	3.358
375.00	53112.892	238798.639	23.975	0.87	23.106	3.520
400.00	53113.113	238773.64	24.100	0.64	23.465	3.682
417.36	53113.266	238756.278	24.243	0.59	23.657	3.850
425.00	53113.334	238748.641	24.353	0.61	23.747	3.971
450.00	53113.555	238723.642	24.840	0.84	24.000	4.494
467.69	53113.712	238705.956	25.131	1.13	24.000	4.812
475.00	53113.776	238698.643	25.203	1.15	24.049	4.895
500.00	53113.998	238673.644	25.306	0.59	24.717	5.035
509.49	53114.082	238664.151	25.340	0.27	25.065	5.080

VOLUMES

CUT	FILL
33	14
0	251
0	510
0	434
0	336
0	321
0	244
0	171
0	148
0	196
0	248
0	304
0	399
0	461
0	519
0	417
0	320
0	399
25	499
27	30
7	5

VERTICAL DATA: L=15.09 G=-3.00% | K=12 L=30.00m | L=243.00 G=-0.50% | K=59.99 L=60.00m | L=54.27 G=0.50% | K=20 L=30.00m | L=20.32 G=2.00% | K=18.18 L=30.00m | L=26.81 G=0.35%

HORIZONTAL DATA: L=18.94 | L=21.04 R=30.00 | L=15.32 | L=454.19

LONGITUDINAL SECTION - WESTERN ROAD

H. 1:1000
V. 1:100

PRELIMINARY
(FOR INFORMATION ONLY)

REV	DESCRIPTION	DATE	APP
A	ISSUED FOR INFORMATION	-	

aurecon
www.aurecongroup.com

AURECON PROJECT ID : 242591

GOVERNMENT OF WESTERN AUSTRALIA
Department of Education
Department of Treasury

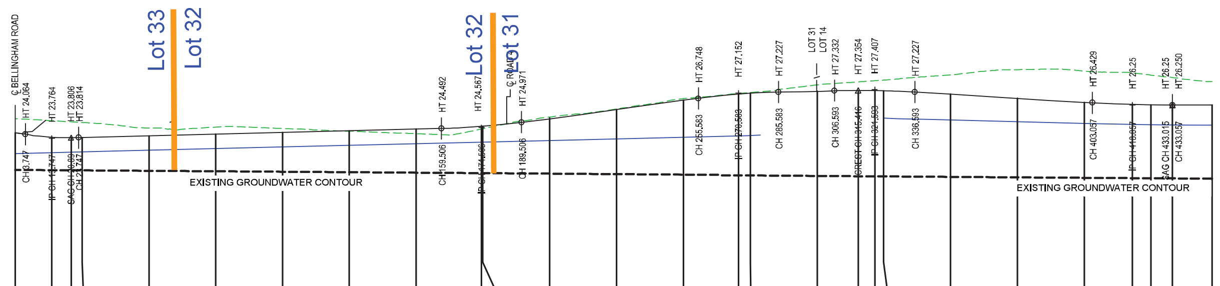
WASP SURROUNDING WORKS
HAMMOND PARK HIGH SCHOOL
LONG SECTIONS - ROAD 1

DRAWN	JJL	DESIGNED	RR	REDUCTION
CHECKED	-	PRINCIPAL		
APPROVED	-			
SCALE 1 : 1000		DATE MAR 2015		DRAWING No.
PROJ No. -		FILE No. WASP-AUR-CV-DWG-0634		DWG-0634 A

THIS IS A CADD DRAWING
DO NOT AMEND MANUALLY

1:1000

P:\242591 - WA SCHOOLS PPP TECHNICAL ADVISOR\3.0 PROJECT DELIVERY\CADD\DRGS\CIV\WASP-AUR-CIV-DWG-0634



DATUM PCGZ50 12.50

CHAINAGE MC02	SETOUT COORDINATES EASTING (X)	SETOUT COORDINATES NORTHING (Y)	DESIGN SURFACE REDUCED LEVEL	CUT / FILL DEPTH TO EXISTING SURFACE	EXISTING SURFACE REDUCED LEVEL	DEPTH TO EXISTING GROUND CONTOURS
0.00	53352.24	239151.411	24.176	1.06	25.240	2.770
13.75	53352.361	239137.664	23.851	1.24	25.087	2.464
20.89	53352.424	239130.522	23.806	1.19	24.993	2.429
25.00	53352.461	239126.412	23.820	1.12	24.939	2.448
50.00	53352.682	239101.413	23.945	0.59	24.537	2.609
75.00	53352.903	239076.414	24.070	0.63	24.698	2.769
100.00	53353.124	239051.415	24.195	0.30	24.494	2.930
125.00	53353.346	239026.416	24.320	0.02	24.299	3.093
150.00	53353.567	239001.417	24.445	0.34	24.104	3.255
174.51	53353.784	238976.912	24.649	0.18	24.465	3.497
175.00	53353.788	238976.418	24.657	0.17	24.485	3.506
200.00	53354.009	238951.419	25.253	0.10	25.350	4.140
225.00	53354.23	238926.42	25.926	0.04	25.965	4.852
250.00	53354.452	238901.421	26.598	0.13	26.729	5.564
270.58	53354.634	238880.838	27.070	0.03	27.104	6.069
275.00	53354.673	238876.422	27.133	0.05	27.181	6.139
300.00	53354.894	238851.423	27.299	0.47	27.766	6.344
315.42	53355.03	238836.007	27.354	0.63	27.985	6.422
321.59	53355.085	238829.83	27.343	0.73	28.076	6.421
325.00	53355.115	238826.424	27.328	0.80	28.128	6.410
350.00	53355.337	238801.425	27.066	1.46	28.523	6.185
375.00	53355.558	238776.426	26.766	2.14	28.904	5.923
400.00	53355.779	238751.427	26.466	2.32	28.791	5.659
418.06	53355.939	238733.37	26.295	2.37	28.662	5.513
425.00	53356	238726.428	26.263	2.23	28.495	5.491
433.01	53356.071	238718.413	26.250	2.05	28.304	5.491
447.85	53356.202	238703.579	26.250	1.75	28.000	5.512

VOLUMES																
CUT	752	510	316	280	116	14	0	26	35	48	46	114	154	363	1007	1603	1877	1223
FILL	0	0	0	0	2	50	127	28	30	17	26	5	1	9	3	0	0	6

VERTICAL DATA: L=3.75, G=-3.00% · K=5.71, L=20.00m · L=135.76, G=0.50% · K=13.7, L=30.00m · L=66.08, G=2.69% · K=13.7, L=30.00m · L=21.01, G=0.50% · K=17.65, L=30.00m · L=66.46, G=-1.20% · K=24.97, L=30.00m · L=14.79, G=0.00%

HORIZONTAL DATA: L=447.85

LONGITUDINAL SECTION - EASTERN ROAD

H. 1:1000
V. 1:100

PRELIMINARY
(FOR INFORMATION ONLY)

REV	DESCRIPTION	DATE	APP
A	ISSUED FOR INFORMATION	-	

aurecon
www.aurecongroup.com

AURECON PROJECT ID : 242591

Department of Education
Department of Treasury
GOVERNMENT OF WESTERN AUSTRALIA

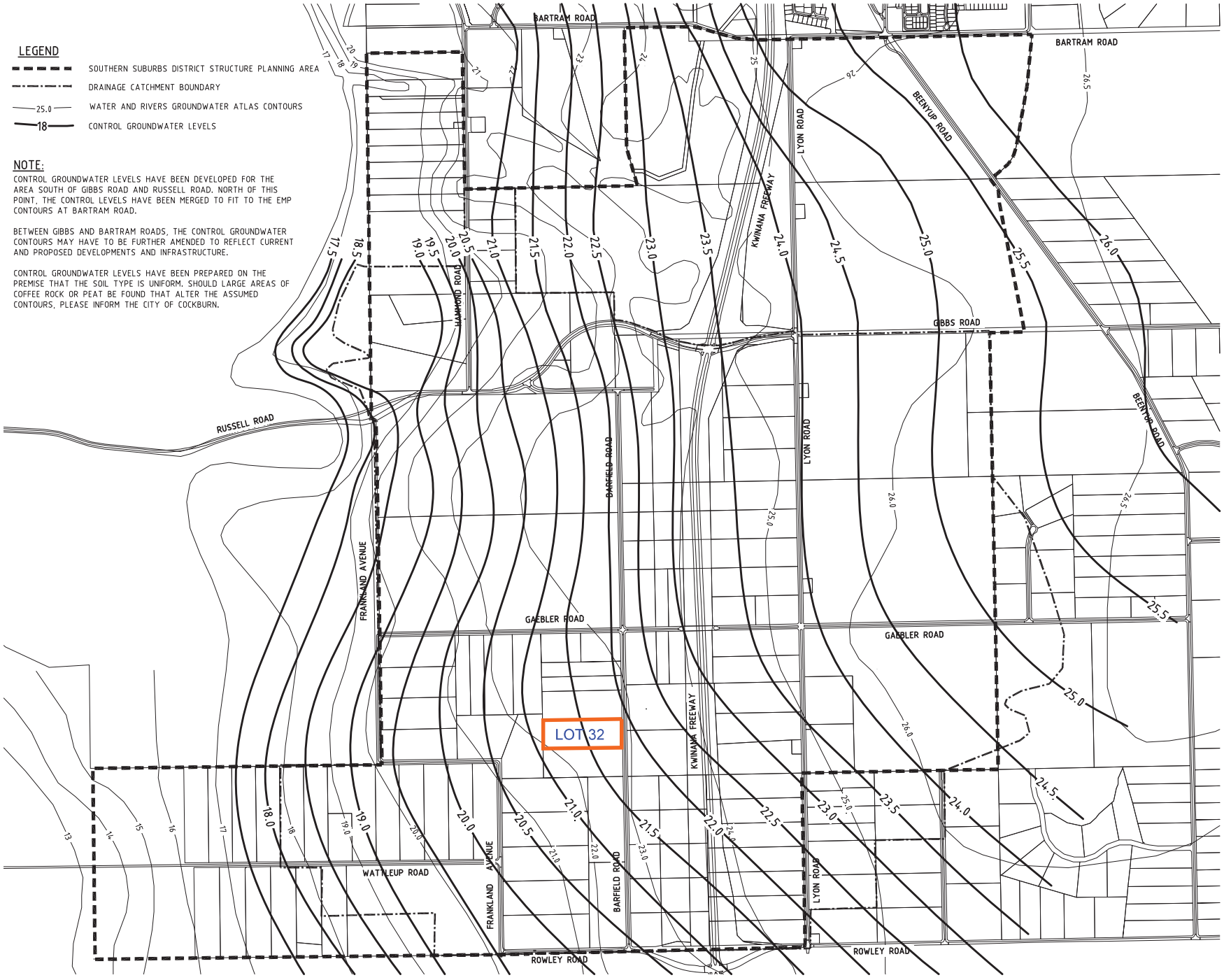
WASP SURROUNDING WORKS
HAMMOND PARK HIGH SCHOOL
LONG SECTIONS - ROAD 2

DRAWN	JJL	DESIGNED	RR	REDUCTION
CHECKED	-	PRINCIPAL		
APPROVED	-			
SCALE 1 : 1000		DATE MAR 2015		DRAWING No. DWG-735 A
PROJ No. -		FILE No. WASP-AUR-CV-DWG-735		

THIS IS A CADD DRAWING
DO NOT AMEND MANUALLY

1:1000 0 10m 20 30 40 50 60 70 80 90 100 110 120 130 140 150

Appendix F
Ground Water Contours



metres
150 0 150 300 450 m
1:7500
scales quoted apply to original drawing scale A1

REV	DATE	DESCRIPTION
A	19/12/02	Issued for Approval

GRID: LOCAL DATUM: AHD

David Wills and Associates
Consulting Engineers
OFFICE
Unit 7/14 Rooby Lane
MILLETTON WA 6155
POST
14 Hatherley Parade
WINTHROP WA 6150
phone - (08) 9259 4261
fax - (08) 9457 7932
mobile - 0417 778 575
e-mail - dwills@iinet.net.au
ABN - 84 442 721 344

CLIENT: City of Cockburn

PROJECT: Russell Road Arterial Drainage Scheme

DRAWING TITLE: Control Groundwater Levels

SCALE: AS SHOWN ORIGINAL DRAWING SIZE A1

DESIGNED	DATE	AUTHORISED	DATE
DJW	10/12/02	.....	../../..
DRAWN	DATE	David Wills AIT(Civil) GradDipB MEAust CPEng	
RMH	10/12/02		

JOB NUMBER	DWG No.	REV No.
02006	C3	A

Appendix G
PC Sump Temporal Model Outputs

Project Details	
Project	Hammond Park
Job Number	242591
Task	Eastern Road
Designer	RLR

Location	Cockburn

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Eastern Rd & Barfield	2788	0.9	2509	
Residential Lot32	8962	0.65	5825	
			0	
Total	11750		8335	

Sump Details		
GWL	22.000	m AHD
Depth to GWL from base	0.400	m
Max Allowable TWL	23.900	m AHD
Sump Base Level	22.400	m AHD
Sump Width at base	5	m
Sump Length at base	171.1	m
Side Slope	0.1	1 in --

Permeability			
Soil Permeability, K	1.0	m/d	
Permeability Clogged Layer	0.15	m/d	0.15
Thickness of Clogged Layer	50	mm	200
Porosity	0.25		0.25
Initial Degree of Saturation	14.5%		30.0%
Effective Porosity, n	21.4%		
Reduction Factor - Shallow	0.800		0.800
Reduction Factor - GreenAmpt	0.333		0.600
Reduction Factor - Clogged	1.000		1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details			
Weir Coefficient, Cd			1.7
Weir Length		m	
Weir Level		m AHD	

SUMMARY OUTPUT										
ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	**72**	**4320**	**72h 00m**	**4320**	**967**	**1.105**	**23.900**	**23.505**	**0.395**	**Green & Amp plus Shallow WT models**
20	48	2880	48h 00m	2880	930	1.063	23.900	23.463	0.437	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	884	1.012	23.900	23.412	0.488	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	851	0.975	23.900	23.375	0.525	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	805	0.923	23.900	23.323	0.577	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	745	0.856	23.900	23.256	0.644	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	666	0.767	23.900	23.167	0.733	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	592	0.682	23.900	23.082	0.818	Green & Amp plus Shallow WT models
20	6	360	6h 00m	360	499	0.577	23.900	22.977	0.923	Green & Amp plus Shallow WT models
20	4.5	270	4h 30m	270	443	0.512	23.900	22.912	0.988	Green & Amp plus Shallow WT models
20	12	720	4h 00m	240	379	0.439	23.900	22.839	1.061	Clogged base model
20	3	180	3h 00m	180	373	0.432	23.900	22.832	1.068	Green & Amp plus Shallow WT models

ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	36	2160	6h 00m	360	372	0.431	23.900	22.831	1.069	Clogged base model
20	9	540	4h 00m	240	372	0.431	23.900	22.831	1.069	Clogged base model
20	6	360	3h 00m	180	371	0.429	23.900	22.829	1.071	Clogged base model
20	30	1800	6h 00m	360	364	0.421	23.900	22.821	1.079	Clogged base model
20	24	1440	4h 00m	240	352	0.408	23.900	22.808	1.092	Clogged base model
20	18	1080	5h 00m	300	350	0.406	23.900	22.806	1.094	Clogged base model
20	4.5	270	2h 45m	165	344	0.399	23.900	22.799	1.101	Clogged base model
20	48	2880	4h 00m	240	342	0.396	23.900	22.796	1.104	Clogged base model
20	3	180	2h 00m	120	338	0.392	23.900	22.792	1.108	Clogged base model
20	2	120	1h 55m	115	322	0.374	23.900	22.774	1.126	Green & Amp plus Shallow WT models
20	2	120	1h 40m	100	317	0.368	23.900	22.768	1.132	Clogged base model
20	1.5	90	1h 25m	85	294	0.341	23.900	22.741	1.159	Clogged base model
20	1.5	90	1h 30m	90	294	0.341	23.900	22.741	1.159	Green & Amp plus Shallow WT models
20	72	4320	8h 00m	480	278	0.323	23.900	22.723	1.177	Clogged base model
20	1	60	1h 00m	60	267	0.310	23.900	22.710	1.190	Clogged base model
20	1	60	1h 00m	60	259	0.301	23.900	22.701	1.199	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	251	0.292	23.900	22.692	1.208	Clogged base model
20	0.75	45	0h 45m	45	242	0.281	23.900	22.681	1.219	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	226	0.262	23.900	22.662	1.238	Clogged base model
20	0.5	30	0h 30m	30	216	0.251	23.900	22.651	1.249	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	213	0.248	23.900	22.648	1.252	Clogged base model
20	0.4167	25	0h 25m	25	204	0.237	23.900	22.637	1.263	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	196	0.228	23.900	22.628	1.272	Clogged base model
20	0.3333	20	0h 20m	20	187	0.218	23.900	22.618	1.282	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	175	0.203	23.900	22.603	1.297	Clogged base model
20	0.25	15	0h 15m	15	167	0.194	23.900	22.594	1.306	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	147	0.172	23.900	22.572	1.328	Clogged base model
20	0.1667	10	0h 10m	10	141	0.164	23.900	22.564	1.336	Green & Amp plus Shallow WT models
100	**72**	**4320**	**72h 00m**	**4320**	**1429**	**1.617**	**23.900**	**24.017**	**-0.117**	**Green & Amp plus Shallow WT models**
100	48	2880	48h 00m	2880	1397	1.581	23.900	23.981	-0.081	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	1352	1.532	23.900	23.932	-0.032	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	1308	1.484	23.900	23.884	0.016	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	1255	1.425	23.900	23.825	0.075	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	1181	1.344	23.900	23.744	0.156	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	1077	1.227	23.900	23.627	0.273	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	963	1.100	23.900	23.500	0.400	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	808	0.927	23.900	23.327	0.573	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	715	0.822	23.900	23.222	0.678	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	603	0.695	23.900	23.095	0.805	Green & Amp plus Shallow WT models
100	6	360	4h 00m	240	546	0.630	23.900	23.030	0.870	Clogged base model
100	9	540	4h 30m	270	538	0.621	23.900	23.021	0.879	Clogged base model
100	12	720	4h 30m	270	532	0.614	23.900	23.014	0.886	Clogged base model
100	4.5	270	4h 00m	240	525	0.606	23.900	23.006	0.894	Clogged base model
100	3	180	2h 45m	165	508	0.586	23.900	22.986	0.914	Clogged base model
100	2	120	1h 55m	115	506	0.584	23.900	22.984	0.916	Green & Amp plus Shallow WT models
100	2	120	1h 50m	110	482	0.557	23.900	22.957	0.943	Clogged base model
100	18	1080	5h 00m	300	476	0.550	23.900	22.950	0.950	Clogged base model
100	24	1440	6h 00m	360	464	0.536	23.900	22.936	0.964	Clogged base model
100	30	1800	6h 00m	360	464	0.536	23.900	22.936	0.964	Clogged base model
100	36	2160	6h 00m	360	462	0.535	23.900	22.935	0.965	Clogged base model
100	1.5	90	1h 30m	90	457	0.529	23.900	22.929	0.971	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	445	0.515	23.900	22.915	0.985	Clogged base model
100	48	2880	4h 00m	240	406	0.470	23.900	22.870	1.030	Clogged base model
100	1	60	1h 00m	60	395	0.457	23.900	22.857	1.043	Clogged base model
100	1	60	1h 00m	60	392	0.454	23.900	22.854	1.046	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	374	0.433	23.900	22.833	1.067	Clogged base model
100	0.75	45	0h 45m	45	367	0.425	23.900	22.825	1.075	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	338	0.392	23.900	22.792	1.108	Clogged base model
100	72	4320	8h 00m	480	338	0.392	23.900	22.792	1.108	Clogged base model
100	0.5	30	0h 30m	30	329	0.381	23.900	22.781	1.119	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	321	0.372	23.900	22.772	1.128	Clogged base model
100	0.4167	25	0h 25m	25	311	0.361	23.900	22.761	1.139	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	299	0.347	23.900	22.747	1.153	Clogged base model
100	0.3333	20	0h 20m	20	290	0.336	23.900	22.736	1.164	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	269	0.312	23.900	22.712	1.188	Clogged base model
100	0.25	15	0h 15m	15	260	0.302	23.900	22.702	1.198	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	227	0.264	23.900	22.664	1.236	Clogged base model
100	0.1667	10	0h 10m	10	219	0.255	23.900	22.655	1.245	Green & Amp plus Shallow WT models

Project Details	
Project	Hammond Park
Job Number	242591
Task	Western Road
Designer	RLR

Location	Cockburn

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Western Road	3320	0.9	2988	
			0	
			0	
Total	3320		2988	

Sump Details		
GWL	22.000	m AHD
Depth to GWL from base	0.400	m
Max Allowable TWL	23.900	m AHD
Sump Base Level	22.400	m AHD
Sump Width at base	4.2	m
Sump Length at base	121.1	m
Side Slope	0.1	1 in --

Permeability			
Soil Permeability, K	1.0	m/d	
Permeability Clogged Layer	0.15	m/d	0.15
Thickness of Clogged Layer	50	mm	200
Porosity	0.25		0.25
Initial Degree of Saturation	14.5%		30.0%
Effective Porosity, n	21.4%		
Reduction Factor - Shallow	0.800		0.800
Reduction Factor - GreenAmpt	0.333		0.600
Reduction Factor - Clogged	1.000		1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details			
Weir Coefficient, Cd			1.7
Weir Length		m	
Weir Level		m AHD	

SUMMARY OUTPUT										
ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
2	**72**	**4320**	**72h 00m**	**4320**	**158**	**0.309**	**23.900**	**22.709**	**1.191**	**Green & Amp plus Shallow WT models**
2	48	2880	48h 00m	2880	145	0.284	23.900	22.684	1.216	Green & Amp plus Shallow WT models
2	36	2160	36h 00m	2160	134	0.261	23.900	22.661	1.239	Green & Amp plus Shallow WT models
2	30	1800	30h 00m	1800	126	0.246	23.900	22.646	1.254	Green & Amp plus Shallow WT models
2	24	1440	24h 00m	1440	114	0.222	23.900	22.622	1.278	Green & Amp plus Shallow WT models
2	18	1080	18h 00m	1080	101	0.198	23.900	22.598	1.302	Green & Amp plus Shallow WT models
2	12	720	12h 00m	720	82	0.161	23.900	22.561	1.339	Green & Amp plus Shallow WT models
2	9	540	9h 00m	540	72	0.141	23.900	22.541	1.359	Green & Amp plus Shallow WT models
2	36	2160	6h 00m	360	62	0.121	23.900	22.521	1.379	Clogged base model

ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
2	6	360	3h 00m	180	60	0.118	23.900	22.518	1.382	Clogged base model
2	48	2880	4h 00m	240	60	0.117	23.900	22.517	1.383	Clogged base model
2	30	1800	6h 00m	360	59	0.116	23.900	22.516	1.384	Clogged base model
2	12	720	4h 00m	240	59	0.115	23.900	22.515	1.385	Clogged base model
2	9	540	3h 30m	210	59	0.115	23.900	22.515	1.385	Clogged base model
2	24	1440	4h 00m	240	58	0.113	23.900	22.513	1.387	Clogged base model
2	6	360	6h 00m	360	58	0.113	23.900	22.513	1.387	Green & Amp plus Shallow WT models
2	3	180	2h 00m	120	58	0.113	23.900	22.513	1.387	Clogged base model
2	4.5	270	2h 30m	150	57	0.112	23.900	22.512	1.388	Clogged base model
2	18	1080	3h 00m	180	57	0.112	23.900	22.512	1.388	Clogged base model
2	2	120	1h 40m	100	55	0.108	23.900	22.508	1.392	Clogged base model
2	1.5	90	1h 25m	85	52	0.102	23.900	22.502	1.398	Clogged base model
2	3	180	2h 00m	120	51	0.100	23.900	22.500	1.400	Green & Amp plus Shallow WT models
2	4.5	270	2h 45m	165	50	0.099	23.900	22.499	1.401	Green & Amp plus Shallow WT models
2	1	60	1h 00m	60	48	0.095	23.900	22.495	1.405	Clogged base model
2	2	120	1h 40m	100	48	0.094	23.900	22.494	1.406	Green & Amp plus Shallow WT models
2	72	4320	4h 00m	240	47	0.093	23.900	22.493	1.407	Clogged base model
2	1.5	90	1h 25m	85	45	0.089	23.900	22.489	1.411	Green & Amp plus Shallow WT models
2	0.75	45	0h 45m	45	45	0.089	23.900	22.489	1.411	Clogged base model
2	1	60	1h 00m	60	42	0.083	23.900	22.483	1.417	Green & Amp plus Shallow WT models
2	0.5	30	0h 30m	30	40	0.078	23.900	22.478	1.422	Clogged base model
2	0.75	45	0h 45m	45	40	0.078	23.900	22.478	1.422	Green & Amp plus Shallow WT models
2	0.4167	25	0h 25m	25	38	0.074	23.900	22.474	1.426	Clogged base model
2	0.5	30	0h 30m	30	35	0.069	23.900	22.469	1.431	Green & Amp plus Shallow WT models
2	0.3333	20	0h 20m	20	35	0.068	23.900	22.468	1.432	Clogged base model
2	0.4167	25	0h 25m	25	34	0.066	23.900	22.466	1.434	Green & Amp plus Shallow WT models
2	0.3333	20	0h 20m	20	31	0.061	23.900	22.461	1.439	Green & Amp plus Shallow WT models
2	0.25	15	0h 15m	15	31	0.061	23.900	22.461	1.439	Clogged base model
2	0.25	15	0h 15m	15	28	0.054	23.900	22.454	1.446	Green & Amp plus Shallow WT models
2	0.1667	10	0h 10m	10	26	0.050	23.900	22.450	1.450	Clogged base model
2	0.1667	10	0h 10m	10	23	0.045	23.900	22.445	1.455	Green & Amp plus Shallow WT models
10	**72**	**4320**	**72h 00m**	**4320**	**261**	**0.507**	**23.900**	**22.907**	**0.993**	**Green & Amp plus Shallow WT models**
10	48	2880	48h 00m	2880	250	0.485	23.900	22.885	1.015	Green & Amp plus Shallow WT models
10	36	2160	36h 00m	2160	236	0.458	23.900	22.858	1.042	Green & Amp plus Shallow WT models
10	30	1800	30h 00m	1800	226	0.440	23.900	22.840	1.060	Green & Amp plus Shallow WT models
10	24	1440	24h 00m	1440	212	0.412	23.900	22.812	1.088	Green & Amp plus Shallow WT models
10	18	1080	18h 00m	1080	194	0.377	23.900	22.777	1.123	Green & Amp plus Shallow WT models
10	12	720	12h 00m	720	169	0.330	23.900	22.730	1.170	Green & Amp plus Shallow WT models
10	9	540	9h 00m	540	149	0.291	23.900	22.691	1.209	Green & Amp plus Shallow WT models
10	6	360	6h 00m	360	124	0.242	23.900	22.642	1.258	Green & Amp plus Shallow WT models
10	4.5	270	4h 30m	270	108	0.211	23.900	22.611	1.289	Green & Amp plus Shallow WT models
10	12	720	4h 00m	240	105	0.206	23.900	22.606	1.294	Clogged base model
10	6	360	3h 00m	180	105	0.205	23.900	22.605	1.295	Clogged base model
10	36	2160	6h 00m	360	104	0.204	23.900	22.604	1.296	Clogged base model
10	9	540	4h 00m	240	104	0.203	23.900	22.603	1.297	Clogged base model
10	30	1800	6h 00m	360	101	0.198	23.900	22.598	1.302	Clogged base model
10	24	1440	4h 00m	240	99	0.194	23.900	22.594	1.306	Clogged base model
10	18	1080	3h 00m	180	98	0.192	23.900	22.592	1.308	Clogged base model
10	4.5	270	2h 45m	165	98	0.191	23.900	22.591	1.309	Clogged base model
10	48	2880	4h 00m	240	97	0.190	23.900	22.590	1.310	Clogged base model
10	3	180	2h 00m	120	96	0.188	23.900	22.588	1.312	Clogged base model
10	3	180	2h 30m	150	93	0.183	23.900	22.583	1.317	Green & Amp plus Shallow WT models
10	2	120	1h 40m	100	91	0.178	23.900	22.578	1.322	Clogged base model
10	2	120	1h 45m	105	85	0.167	23.900	22.567	1.333	Green & Amp plus Shallow WT models
10	1.5	90	1h 25m	85	85	0.166	23.900	22.566	1.334	Clogged base model
10	1.5	90	1h 25m	85	79	0.155	23.900	22.555	1.345	Green & Amp plus Shallow WT models
10	1	60	1h 00m	60	78	0.152	23.900	22.552	1.348	Clogged base model
10	72	4320	8h 00m	480	77	0.151	23.900	22.551	1.349	Clogged base model
10	0.75	45	0h 45m	45	73	0.143	23.900	22.543	1.357	Clogged base model
10	1	60	1h 00m	60	72	0.140	23.900	22.540	1.360	Green & Amp plus Shallow WT models
10	0.75	45	0h 45m	45	67	0.132	23.900	22.532	1.368	Green & Amp plus Shallow WT models
10	0.5	30	0h 30m	30	65	0.128	23.900	22.528	1.372	Clogged base model
10	0.4167	25	0h 25m	25	61	0.120	23.900	22.520	1.380	Clogged base model
10	0.5	30	0h 30m	30	60	0.117	23.900	22.517	1.383	Green & Amp plus Shallow WT models
10	0.3333	20	0h 20m	20	57	0.112	23.900	22.512	1.388	Clogged base model
10	0.4167	25	0h 25m	25	57	0.111	23.900	22.511	1.389	Green & Amp plus Shallow WT models
10	0.3333	20	0h 20m	20	53	0.104	23.900	22.504	1.396	Green & Amp plus Shallow WT models
10	0.25	15	0h 15m	15	51	0.099	23.900	22.499	1.401	Clogged base model
10	0.25	15	0h 15m	15	47	0.092	23.900	22.492	1.408	Green & Amp plus Shallow WT models
10	0.1667	10	0h 10m	10	43	0.084	23.900	22.484	1.416	Clogged base model
10	0.1667	10	0h 10m	10	40	0.078	23.900	22.478	1.422	Green & Amp plus Shallow WT models
20	**72**	**4320**	**72h 00m**	**4320**	**320**	**0.620**	**23.900**	**23.020**	**0.880**	**Green & Amp plus Shallow WT models**
20	48	2880	48h 00m	2880	311	0.603	23.900	23.003	0.897	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	296	0.574	23.900	22.974	0.926	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	284	0.551	23.900	22.951	0.949	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	269	0.521	23.900	22.921	0.979	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	249	0.484	23.900	22.884	1.016	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	221	0.429	23.900	22.829	1.071	Green & Amp plus Shallow WT models

ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	9	540	9h 00m	540	194	0.379	23.900	22.779	1.121	Green & Amp plus Shallow WT models
20	6	360	6h 00m	360	161	0.315	23.900	22.715	1.185	Green & Amp plus Shallow WT models
20	4.5	270	4h 30m	270	141	0.276	23.900	22.676	1.224	Green & Amp plus Shallow WT models
20	12	720	4h 00m	240	133	0.259	23.900	22.659	1.241	Clogged base model
20	9	540	4h 00m	240	130	0.254	23.900	22.654	1.246	Clogged base model
20	6	360	3h 00m	180	130	0.254	23.900	22.654	1.246	Clogged base model
20	36	2160	6h 00m	360	129	0.251	23.900	22.651	1.249	Clogged base model
20	30	1800	6h 00m	360	126	0.246	23.900	22.646	1.254	Clogged base model
20	24	1440	4h 00m	240	123	0.240	23.900	22.640	1.260	Clogged base model
20	18	1080	3h 00m	180	122	0.239	23.900	22.639	1.261	Clogged base model
20	4.5	270	2h 45m	165	121	0.236	23.900	22.636	1.264	Clogged base model
20	3	180	2h 30m	150	119	0.233	23.900	22.633	1.267	Green & Amp plus Shallow WT models
20	3	180	2h 00m	120	119	0.233	23.900	22.633	1.267	Clogged base model
20	48	2880	4h 00m	240	119	0.232	23.900	22.632	1.268	Clogged base model
20	2	120	1h 40m	100	112	0.219	23.900	22.619	1.281	Clogged base model
20	2	120	1h 50m	110	108	0.211	23.900	22.611	1.289	Green & Amp plus Shallow WT models
20	1.5	90	1h 25m	85	104	0.203	23.900	22.603	1.297	Clogged base model
20	1.5	90	1h 25m	85	99	0.194	23.900	22.594	1.306	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	94	0.185	23.900	22.585	1.315	Clogged base model
20	72	4320	8h 00m	480	94	0.184	23.900	22.584	1.316	Clogged base model
20	0.75	45	0h 45m	45	89	0.175	23.900	22.575	1.325	Clogged base model
20	1	60	1h 00m	60	89	0.173	23.900	22.573	1.327	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	83	0.163	23.900	22.563	1.337	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	80	0.157	23.900	22.557	1.343	Clogged base model
20	0.4167	25	0h 25m	25	76	0.149	23.900	22.549	1.351	Clogged base model
20	0.5	30	0h 30m	30	75	0.147	23.900	22.547	1.353	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	71	0.139	23.900	22.539	1.361	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	70	0.137	23.900	22.537	1.363	Clogged base model
20	0.3333	20	0h 20m	20	65	0.128	23.900	22.528	1.372	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	62	0.122	23.900	22.522	1.378	Clogged base model
20	0.25	15	0h 15m	15	58	0.114	23.900	22.514	1.386	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	53	0.103	23.900	22.503	1.397	Clogged base model
20	0.1667	10	0h 10m	10	49	0.097	23.900	22.497	1.403	Green & Amp plus Shallow WT models
100	**72**	**4320**	**72h 00m**	**4320**	**485**	**0.931**	**23.900**	**23.331**	**0.569**	**Green & Amp plus Shallow WT models**
100	48	2880	48h 00m	2880	478	0.919	23.900	23.319	0.581	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	463	0.891	23.900	23.291	0.609	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	449	0.864	23.900	23.264	0.636	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	430	0.828	23.900	23.228	0.672	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	404	0.780	23.900	23.180	0.720	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	367	0.710	23.900	23.110	0.790	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	327	0.633	23.900	23.033	0.867	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	272	0.528	23.900	22.928	0.972	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	239	0.464	23.900	22.864	1.036	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	199	0.387	23.900	22.787	1.113	Green & Amp plus Shallow WT models
100	6	360	4h 00m	240	193	0.376	23.900	22.776	1.124	Clogged base model
100	9	540	4h 30m	270	190	0.370	23.900	22.770	1.130	Clogged base model
100	12	720	4h 30m	270	188	0.366	23.900	22.766	1.134	Clogged base model
100	4.5	270	4h 00m	240	186	0.362	23.900	22.762	1.138	Clogged base model
100	3	180	2h 45m	165	180	0.351	23.900	22.751	1.149	Clogged base model
100	2	120	1h 55m	115	173	0.337	23.900	22.737	1.163	Green & Amp plus Shallow WT models
100	2	120	1h 50m	110	171	0.334	23.900	22.734	1.166	Clogged base model
100	18	1080	5h 00m	300	167	0.326	23.900	22.726	1.174	Clogged base model
100	24	1440	6h 00m	360	163	0.317	23.900	22.717	1.183	Clogged base model
100	30	1800	6h 00m	360	162	0.316	23.900	22.716	1.184	Clogged base model
100	36	2160	6h 00m	360	161	0.315	23.900	22.715	1.185	Clogged base model
100	1.5	90	1h 30m	90	158	0.309	23.900	22.709	1.191	Clogged base model
100	1.5	90	1h 30m	90	157	0.306	23.900	22.706	1.194	Green & Amp plus Shallow WT models
100	48	2880	4h 00m	240	142	0.277	23.900	22.677	1.223	Clogged base model
100	1	60	1h 00m	60	141	0.274	23.900	22.674	1.226	Clogged base model
100	1	60	1h 00m	60	136	0.265	23.900	22.665	1.235	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	133	0.260	23.900	22.660	1.240	Clogged base model
100	0.75	45	0h 45m	45	128	0.249	23.900	22.649	1.251	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	121	0.236	23.900	22.636	1.264	Clogged base model
100	72	4320	8h 00m	480	116	0.227	23.900	22.627	1.273	Clogged base model
100	0.5	30	0h 30m	30	115	0.225	23.900	22.625	1.275	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	115	0.224	23.900	22.624	1.276	Clogged base model
100	0.4167	25	0h 25m	25	109	0.213	23.900	22.613	1.287	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	107	0.209	23.900	22.609	1.291	Clogged base model
100	0.3333	20	0h 20m	20	102	0.199	23.900	22.599	1.301	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	96	0.188	23.900	22.588	1.312	Clogged base model
100	0.25	15	0h 15m	15	91	0.179	23.900	22.579	1.321	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	81	0.159	23.900	22.559	1.341	Clogged base model
100	0.1667	10	0h 10m	10	77	0.152	23.900	22.552	1.348	Green & Amp plus Shallow WT models

Project Details	
Project	Hammond Park
Job Number	242591
Task	Barfield Road
Designer	RLR

Location	Cockburn

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Barfield	1211	0.9	1090	
			0	
			0	
Total	1211		1090	

Sump Details		
GWL	22.000	m AHD
Depth to GWL from base	1.300	m
Max Allowable TWL	23.900	m AHD
Sump Base Level	23.300	m AHD
Sump Width at base	0.5	m
Sump Length at base	121.1	m
Side Slope	6.0	1 in --

Permeability			
Soil Permeability, K	1.0	m/d	
Permeability Clogged Layer	0.15	m/d	0.15
Thickness of Clogged Layer	50	mm	200
Porosity	0.25		0.25
Initial Degree of Saturation	14.5%		30.0%
Effective Porosity, n	21.4%		
Reduction Factor - Shallow	0.800		0.800
Reduction Factor - GreenAmpt	0.333		0.600
Reduction Factor - Clogged	1.000		1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details			
Weir Coefficient, Cd			1.7
Weir Length		m	
Weir Level		m AHD	

SUMMARY OUTPUT										
ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	**6**	**360**	**3h 00m**	**180**	**47**	**0.213**	**23.900**	**23.513**	**0.387**	**Clogged base model**
20	12	720	4h 00m	240	46	0.213	23.900	23.513	0.387	Clogged base model
20	9	540	3h 30m	210	46	0.211	23.900	23.511	0.389	Clogged base model
20	36	2160	6h 00m	360	46	0.210	23.900	23.510	0.390	Clogged base model
20	30	1800	6h 00m	360	44	0.207	23.900	23.507	0.393	Clogged base model
20	18	1080	3h 00m	180	44	0.205	23.900	23.505	0.395	Clogged base model
20	36	2160	6h 00m	360	43	0.205	23.900	23.505	0.395	Green & Amp plus Shallow WT models
20	24	1440	4h 00m	240	43	0.204	23.900	23.504	0.396	Clogged base model
20	12	720	4h 30m	270	43	0.204	23.900	23.504	0.396	Green & Amp plus Shallow WT models

ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	4.5	270	2h 30m	150	43	0.204	23.900	23.504	0.396	Clogged base model
20	30	1800	6h 00m	360	43	0.203	23.900	23.503	0.397	Green & Amp plus Shallow WT models
20	6	360	3h 00m	180	43	0.203	23.900	23.503	0.397	Green & Amp plus Shallow WT models
20	3	180	2h 00m	120	43	0.202	23.900	23.502	0.398	Clogged base model
20	48	2880	4h 00m	240	43	0.202	23.900	23.502	0.398	Clogged base model
20	9	540	4h 00m	240	42	0.202	23.900	23.502	0.398	Green & Amp plus Shallow WT models
20	24	1440	6h 00m	360	40	0.196	23.900	23.496	0.404	Green & Amp plus Shallow WT models
20	2	120	1h 40m	100	40	0.196	23.900	23.496	0.404	Clogged base model
20	18	1080	5h 00m	300	40	0.195	23.900	23.495	0.405	Green & Amp plus Shallow WT models
20	48	2880	4h 00m	240	40	0.194	23.900	23.494	0.406	Green & Amp plus Shallow WT models
20	72	4320	32h 00m	1920	39	0.191	23.900	23.491	0.409	Green & Amp plus Shallow WT models
20	4.5	270	2h 30m	150	38	0.191	23.900	23.491	0.409	Green & Amp plus Shallow WT models
20	3	180	2h 00m	120	38	0.189	23.900	23.489	0.411	Green & Amp plus Shallow WT models
20	1.5	90	1h 25m	85	37	0.188	23.900	23.488	0.412	Clogged base model
20	2	120	1h 40m	100	35	0.181	23.900	23.481	0.419	Green & Amp plus Shallow WT models
20	1	60	1h 00m	60	34	0.178	23.900	23.478	0.422	Clogged base model
20	1.5	90	1h 25m	85	33	0.173	23.900	23.473	0.427	Green & Amp plus Shallow WT models
20	72	4320	4h 00m	240	33	0.173	23.900	23.473	0.427	Clogged base model
20	0.75	45	0h 45m	45	32	0.172	23.900	23.472	0.428	Clogged base model
20	1	60	1h 00m	60	30	0.166	23.900	23.466	0.434	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	29	0.162	23.900	23.462	0.438	Clogged base model
20	0.75	45	0h 45m	45	29	0.162	23.900	23.462	0.438	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	28	0.157	23.900	23.457	0.443	Clogged base model
20	0.5	30	0h 30m	30	26	0.153	23.900	23.453	0.447	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	25	0.149	23.900	23.449	0.451	Clogged base model
20	0.4167	25	0h 25m	25	25	0.148	23.900	23.448	0.452	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	23	0.142	23.900	23.442	0.458	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	23	0.139	23.900	23.439	0.461	Clogged base model
20	0.25	15	0h 15m	15	21	0.133	23.900	23.433	0.467	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	19	0.125	23.900	23.425	0.475	Clogged base model
20	0.1667	10	0h 10m	10	18	0.120	23.900	23.420	0.480	Green & Amp plus Shallow WT models
100	**36**	**2160**	**36h 00m**	**2160**	**82**	**0.294**	**23.900**	**23.594**	**0.306**	**Green & Amp plus Shallow WT models**
100	48	2880	48h 00m	2880	81	0.292	23.900	23.592	0.308	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	75	0.280	23.900	23.580	0.320	Green & Amp plus Shallow WT models
100	72	4320	68h 00m	4080	75	0.280	23.900	23.580	0.320	Green & Amp plus Shallow WT models
100	6	360	4h 00m	240	68	0.265	23.900	23.565	0.335	Clogged base model
100	9	540	4h 30m	270	67	0.262	23.900	23.562	0.338	Clogged base model
100	6	360	4h 30m	270	67	0.262	23.900	23.562	0.338	Green & Amp plus Shallow WT models
100	12	720	4h 30m	270	66	0.260	23.900	23.560	0.340	Clogged base model
100	9	540	4h 30m	270	66	0.259	23.900	23.559	0.341	Green & Amp plus Shallow WT models
100	4.5	270	4h 00m	240	65	0.259	23.900	23.559	0.341	Clogged base model
100	24	1440	24h 00m	1440	65	0.258	23.900	23.558	0.342	Green & Amp plus Shallow WT models
100	12	720	8h 00m	480	64	0.257	23.900	23.557	0.343	Green & Amp plus Shallow WT models
100	3	180	2h 30m	150	64	0.256	23.900	23.556	0.344	Clogged base model
100	4.5	270	4h 15m	255	63	0.253	23.900	23.553	0.347	Green & Amp plus Shallow WT models
100	2	120	1h 50m	110	61	0.249	23.900	23.549	0.351	Clogged base model
100	18	1080	8h 00m	480	61	0.249	23.900	23.549	0.351	Green & Amp plus Shallow WT models
100	3	180	2h 45m	165	59	0.245	23.900	23.545	0.355	Green & Amp plus Shallow WT models
100	18	1080	5h 00m	300	59	0.243	23.900	23.543	0.357	Clogged base model
100	30	1800	6h 00m	360	57	0.239	23.900	23.539	0.361	Clogged base model
100	36	2160	6h 00m	360	57	0.239	23.900	23.539	0.361	Clogged base model
100	1.5	90	1h 25m	85	57	0.239	23.900	23.539	0.361	Clogged base model
100	24	1440	6h 00m	360	56	0.238	23.900	23.538	0.362	Clogged base model
100	2	120	1h 50m	110	56	0.236	23.900	23.536	0.364	Green & Amp plus Shallow WT models
100	1.5	90	1h 25m	85	51	0.225	23.900	23.525	0.375	Green & Amp plus Shallow WT models
100	1	60	1h 00m	60	51	0.224	23.900	23.524	0.376	Clogged base model
100	48	2880	4h 00m	240	51	0.224	23.900	23.524	0.376	Clogged base model
100	0.75	45	0h 45m	45	48	0.217	23.900	23.517	0.383	Clogged base model
100	1	60	1h 00m	60	46	0.212	23.900	23.512	0.388	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	44	0.206	23.900	23.506	0.394	Green & Amp plus Shallow WT models
100	0.5	30	0h 30m	30	44	0.206	23.900	23.506	0.394	Clogged base model
100	0.4167	25	0h 25m	25	42	0.200	23.900	23.500	0.400	Clogged base model
100	0.5	30	0h 30m	30	40	0.196	23.900	23.496	0.404	Green & Amp plus Shallow WT models
100	72	4320	8h 00m	480	39	0.193	23.900	23.493	0.407	Clogged base model
100	0.3333	20	0h 20m	20	39	0.192	23.900	23.492	0.408	Clogged base model
100	0.4167	25	0h 25m	25	39	0.191	23.900	23.491	0.409	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	36	0.184	23.900	23.484	0.416	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	35	0.180	23.900	23.480	0.420	Clogged base model
100	0.25	15	0h 15m	15	33	0.173	23.900	23.473	0.427	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	30	0.163	23.900	23.463	0.437	Clogged base model
100	0.1667	10	0h 10m	10	28	0.158	23.900	23.458	0.442	Green & Amp plus Shallow WT models

Project Details	
Project	Hammond Park
Job Number	242591
Task	Residential Lot 32
Designer	RLR

Location	Cockburn

Catchment Area Details				
Land Form	Area (m2)	Runoff Coeff	Aimp (m2)	Comments
Residential Lot	8962	0.65	5825	
			0	
			0	
Total	8962		5825	

Sump Details		
GWL	22.000	m AHD
Depth to GWL from base	1.000	m
Max Allowable TWL	24.500	m AHD
Sump Base Level	23.000	m AHD
Sump Width at base	20	m
Sump Length at base	15	m
Side Slope	4.0	1 in --

Permeability			
Soil Permeability, K	1.0	m/d	
Permeability Clogged Layer	0.15	m/d	0.15
Thickness of Clogged Layer	50	mm	200
Porosity	0.25		0.25
Initial Degree of Saturation	14.5%		30.0%
Effective Porosity, n	21.4%		
Reduction Factor - Shallow	0.800		0.800
Reduction Factor - GreenAmpt	0.333		0.600
Reduction Factor - Clogged	1.000		1.000

Outlet Pipe Details (free outfall)		
Entrance Type		
Diameter		mm
Length		m
Upstream IL		m AHD
Downstream IL		m AHD
Ds		m
Pipe Slope		m/m

Entrance Type 1 - Square edge with headwall
Entrance Type 2 - Socket (Grove) end with headwall
Entrance Type 3 - Socket (Grove) end projecting

Weir Details			
Weir Coefficient, Cd			1.7
Weir Length		m	
Weir Level		m AHD	

SUMMARY OUTPUT										
ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	**72**	**4320**	**72h 00m**	**4320**	**639**	**1.254**	**24.500**	**24.254**	**0.246**	**Green & Amp plus Shallow WT models**
20	48	2880	48h 00m	2880	608	1.213	24.500	24.213	0.287	Green & Amp plus Shallow WT models
20	36	2160	36h 00m	2160	578	1.171	24.500	24.171	0.329	Green & Amp plus Shallow WT models
20	30	1800	30h 00m	1800	551	1.132	24.500	24.132	0.368	Green & Amp plus Shallow WT models
20	24	1440	24h 00m	1440	515	1.080	24.500	24.080	0.420	Green & Amp plus Shallow WT models
20	18	1080	18h 00m	1080	472	1.017	24.500	24.017	0.483	Green & Amp plus Shallow WT models
20	12	720	12h 00m	720	414	0.923	24.500	23.923	0.577	Green & Amp plus Shallow WT models
20	9	540	9h 00m	540	363	0.838	24.500	23.838	0.662	Green & Amp plus Shallow WT models
20	6	360	5h 30m	330	312	0.748	24.500	23.748	0.752	Green & Amp plus Shallow WT models
20	4.5	270	4h 15m	255	288	0.704	24.500	23.704	0.796	Green & Amp plus Shallow WT models
20	12	720	4h 30m	270	275	0.679	24.500	23.679	0.821	Clogged base model
20	36	2160	6h 00m	360	270	0.668	24.500	23.668	0.832	Clogged base model

ARI	Storm Duration		Critical Time		Storage Required	Water Depth, H	Allowable TWL	TWL	Freeboard	Critical Model
(years)	(hours)	(min)	(h:m)	(min)	(m3)	(m)	(m AHD)	(m AHD)	(m)	
20	9	540	4h 00m	240	269	0.667	24.500	23.667	0.833	Clogged base model
20	6	360	4h 00m	240	267	0.663	24.500	23.663	0.837	Clogged base model
20	30	1800	6h 00m	360	265	0.659	24.500	23.659	0.841	Clogged base model
20	3	180	2h 45m	165	259	0.648	24.500	23.648	0.852	Green & Amp plus Shallow WT models
20	24	1440	6h 00m	360	257	0.643	24.500	23.643	0.857	Clogged base model
20	18	1080	5h 00m	300	255	0.640	24.500	23.640	0.860	Clogged base model
20	4.5	270	2h 45m	165	247	0.623	24.500	23.623	0.877	Clogged base model
20	48	2880	4h 00m	240	246	0.621	24.500	23.621	0.879	Clogged base model
20	3	180	2h 30m	150	241	0.612	24.500	23.612	0.888	Clogged base model
20	2	120	1h 55m	115	231	0.592	24.500	23.592	0.908	Green & Amp plus Shallow WT models
20	2	120	1h 45m	105	225	0.579	24.500	23.579	0.921	Clogged base model
20	1.5	90	1h 30m	90	211	0.549	24.500	23.549	0.951	Green & Amp plus Shallow WT models
20	1.5	90	1h 25m	85	209	0.544	24.500	23.544	0.956	Clogged base model
20	72	4320	8h 00m	480	207	0.541	24.500	23.541	0.959	Clogged base model
20	1	60	1h 00m	60	188	0.501	24.500	23.501	0.999	Clogged base model
20	1	60	1h 00m	60	185	0.495	24.500	23.495	1.005	Green & Amp plus Shallow WT models
20	0.75	45	0h 45m	45	177	0.476	24.500	23.476	1.024	Clogged base model
20	0.75	45	0h 45m	45	173	0.466	24.500	23.466	1.034	Green & Amp plus Shallow WT models
20	0.5	30	0h 30m	30	159	0.434	24.500	23.434	1.066	Clogged base model
20	0.5	30	0h 30m	30	154	0.423	24.500	23.423	1.077	Green & Amp plus Shallow WT models
20	0.4167	25	0h 25m	25	150	0.414	24.500	23.414	1.086	Clogged base model
20	0.4167	25	0h 25m	25	145	0.403	24.500	23.403	1.097	Green & Amp plus Shallow WT models
20	0.3333	20	0h 20m	20	138	0.385	24.500	23.385	1.115	Clogged base model
20	0.3333	20	0h 20m	20	133	0.374	24.500	23.374	1.126	Green & Amp plus Shallow WT models
20	0.25	15	0h 15m	15	123	0.348	24.500	23.348	1.152	Clogged base model
20	0.25	15	0h 15m	15	118	0.338	24.500	23.338	1.162	Green & Amp plus Shallow WT models
20	0.1667	10	0h 10m	10	103	0.300	24.500	23.300	1.200	Clogged base model
20	0.1667	10	0h 10m	10	100	0.291	24.500	23.291	1.209	Green & Amp plus Shallow WT models
100	**72**	**4320**	**72h 00m**	**4320**	**962**	**1.638**	**24.500**	**24.638**	**-0.138**	**Green & Amp plus Shallow WT models**
100	48	2880	48h 00m	2880	933	1.608	24.500	24.608	-0.108	Green & Amp plus Shallow WT models
100	36	2160	36h 00m	2160	900	1.571	24.500	24.571	-0.071	Green & Amp plus Shallow WT models
100	30	1800	30h 00m	1800	866	1.532	24.500	24.532	-0.032	Green & Amp plus Shallow WT models
100	24	1440	24h 00m	1440	822	1.482	24.500	24.482	0.018	Green & Amp plus Shallow WT models
100	18	1080	18h 00m	1080	769	1.420	24.500	24.420	0.080	Green & Amp plus Shallow WT models
100	12	720	12h 00m	720	689	1.320	24.500	24.320	0.180	Green & Amp plus Shallow WT models
100	9	540	9h 00m	540	610	1.215	24.500	24.215	0.285	Green & Amp plus Shallow WT models
100	6	360	6h 00m	360	502	1.061	24.500	24.061	0.439	Green & Amp plus Shallow WT models
100	4.5	270	4h 30m	270	459	0.996	24.500	23.996	0.504	Green & Amp plus Shallow WT models
100	3	180	3h 00m	180	405	0.910	24.500	23.910	0.590	Green & Amp plus Shallow WT models
100	6	360	4h 30m	270	396	0.896	24.500	23.896	0.604	Clogged base model
100	9	540	4h 30m	270	391	0.887	24.500	23.887	0.613	Clogged base model
100	12	720	4h 30m	270	387	0.879	24.500	23.879	0.621	Clogged base model
100	4.5	270	4h 00m	240	381	0.869	24.500	23.869	0.631	Clogged base model
100	3	180	2h 45m	165	364	0.841	24.500	23.841	0.659	Clogged base model
100	2	120	1h 55m	115	357	0.828	24.500	23.828	0.672	Green & Amp plus Shallow WT models
100	18	1080	8h 00m	480	352	0.820	24.500	23.820	0.680	Clogged base model
100	2	120	1h 50m	110	342	0.803	24.500	23.803	0.697	Clogged base model
100	24	1440	6h 00m	360	340	0.800	24.500	23.800	0.700	Clogged base model
100	30	1800	6h 00m	360	337	0.794	24.500	23.794	0.706	Clogged base model
100	36	2160	6h 00m	360	334	0.789	24.500	23.789	0.711	Clogged base model
100	1.5	90	1h 30m	90	323	0.768	24.500	23.768	0.732	Green & Amp plus Shallow WT models
100	1.5	90	1h 30m	90	316	0.755	24.500	23.755	0.745	Clogged base model
100	48	2880	4h 00m	240	292	0.710	24.500	23.710	0.790	Clogged base model
100	1	60	1h 00m	60	279	0.686	24.500	23.686	0.814	Clogged base model
100	1	60	1h 00m	60	277	0.683	24.500	23.683	0.817	Green & Amp plus Shallow WT models
100	0.75	45	0h 45m	45	263	0.655	24.500	23.655	0.845	Clogged base model
100	0.75	45	0h 45m	45	259	0.648	24.500	23.648	0.852	Green & Amp plus Shallow WT models
100	72	4320	8h 00m	480	250	0.630	24.500	23.630	0.870	Clogged base model
100	0.5	30	0h 30m	30	237	0.605	24.500	23.605	0.895	Clogged base model
100	0.5	30	0h 30m	30	232	0.594	24.500	23.594	0.906	Green & Amp plus Shallow WT models
100	0.4167	25	0h 25m	25	225	0.579	24.500	23.579	0.921	Clogged base model
100	0.4167	25	0h 25m	25	220	0.568	24.500	23.568	0.932	Green & Amp plus Shallow WT models
100	0.3333	20	0h 20m	20	210	0.547	24.500	23.547	0.953	Clogged base model
100	0.3333	20	0h 20m	20	205	0.536	24.500	23.536	0.964	Green & Amp plus Shallow WT models
100	0.25	15	0h 15m	15	188	0.502	24.500	23.502	0.998	Clogged base model
100	0.25	15	0h 15m	15	184	0.491	24.500	23.491	1.009	Green & Amp plus Shallow WT models
100	0.1667	10	0h 10m	10	159	0.435	24.500	23.435	1.065	Clogged base model
100	0.1667	10	0h 10m	10	155	0.426	24.500	23.426	1.074	Green & Amp plus Shallow WT models

APPENDIX 3

Bushfire Management Plan

Bushfire Management Plan

Lot 32 Barfield Road, Hammond Park

Prepared for
WSP | Parsons Brinckerhoff

27 August 2015

BPAD
Bushfire
Planning & Design
Accredited Practitioner
Level 3

DOCUMENT TRACKING

Item	Detail
Project Name	Bushfire Management Plan, Lot 32 Barfield Road, Hammond Park
Project Number	15SGB_2143
Project Manager	Mark Vile Suites 1 and 2, 49 Ord Street West Perth WA 6005
Prepared by	Bruce Horkings
Technical review by	Daniel Copland
Approved by	Daniel Copland
Status	Draft for comment
Version Number	2
Last saved on	27 August 2015

This report should be cited as 'Eco Logical Australia August 2015. *Bushfire Management Plan, Lot 32 Barfield Road, Hammond Park*. Prepared for WSP | Parsons Brinckerhoff.'

Contents

List of figures

List of tables

1 Introduction

1.1 Project overview

Eco Logical Australia Pty Ltd (ELA) was engaged by WSP | Parsons Brinkerhoff to prepare a site specific Bushfire Management Plan (BMP), incorporating a bushfire hazard assessment, and associated analysis of Lot 32 Barfield Road, Hammond Park (herein called the subject site). This report contributes to the assessment portfolio required for the Structure Plan (SP) submission for subdivision development of this site.

The Structure Plan for the subject site, reflecting the District Structure Plan (DSP), identifies the proposed land use for part of a high school and medium density residential area. The high school footprint takes two-thirds of the site while the residential development is contained within the remaining third, closest to Barfield Road.

1.2 Scope

This site specific BMP and associated assessments and analysis are of the subject site and surrounding area to a minimum of 100 m from the site boundary. The subject site is approximately 4 hectares and is located approximately 25 kilometres south of the Perth CBD within the municipality of City of Cockburn. **Figure 1** displays the subject site.

The need for a bushfire hazard assessment has been identified by the City of Cockburn as the subject site contains, and is adjacent to, bushfire prone land. Bushfire prone land are those lands that contain or are within 100 m of bushfire prone vegetation, being areas of unmanaged grassland, scrub or wooded vegetation of certain size and spatial characteristics.

Bushfire threat to life and property is typically mitigated by a suite of bushfire protection measures including the provision and maintenance of Building Protection Zones, bushfire resistant building construction design and materials, fire-fighter access and occupant egress, water supply and other services. The aim of the assessment is to assess the bushfire hazard and risk relevant to the subject site and provide bushfire protection recommendations that are compliant with the *Planning for Bushfire Risk Management Guidelines (*Draft, May 2014*)* (herein referred to as PBRMG). Reference where appropriate is also given to *Planning for Bushfire Protection Guidelines* (Edition 2, 2010) (herein referred to as PBP) based on the draft status of current guidelines.

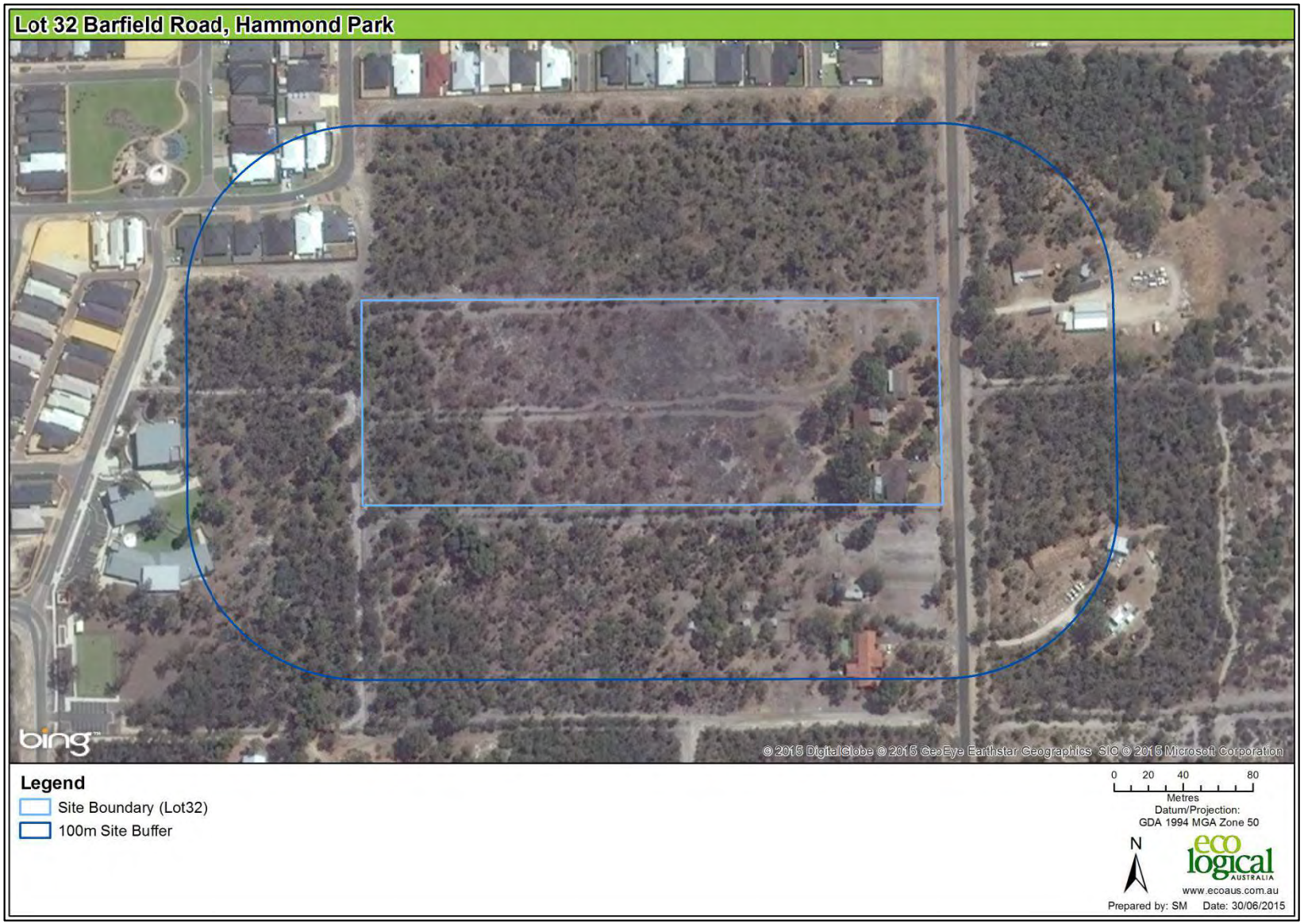


Figure 1: Location of subject site

1.3 Planning context

The bushfire planning statutory regulations in Western Australia were in a state of flux during time of assessment and report preparation. Both the *State Planning Policy (SPP) 3.7: Planning for Bushfire Risk Management* and the *Planning for Bushfire Risk Management Guidelines* were currently in a draft format with a planned date of release in September 2015. Furthermore, the Bushfire Risk Management Plan (2014-2019) for the City of Cockburn is also in draft form.

The three guiding documents for this assessment are:

- *State Planning Policy (SPP) 3.7: Planning for Bushfire Risk Management (draft);*
- *Planning for Bushfire Risk Management Guidelines and appendices (draft);and*
- *AS 3959-2009 Construction of buildings in bushfire-prone areas (including Amendments 1-3).*

In reviewing the planning context it is noted a number of extensive Fire / Bushfire Management Plans have been undertaken for surrounding lots as part of the structure planning process. **Figure 2** shows the extent of the approved District Structure Plan.

1.4 Objectives

In its current state, the subject site is relatively undeveloped as is the surrounding lands. Residential development is located to the north, east and west with the remainder of lands used for rural-residential purposes.

The relevancy of undertaking a Bushfire Management Plan and recommending 'achievable and measurable goals' is limited at this stage, as the requirement for a BMP is based upon urban development as shown in the District Structure Plan (**Figure 2**).

This report undertakes a bushfire hazard assessment of the current state of the subject site and surrounding lands and provides recommendations for post development. It also addresses the required bushfire protection criteria in general terms. These are to be incorporated into any preliminary development design and at this stage a BMP and associated assessment under AS 3959 has increased relevancy.

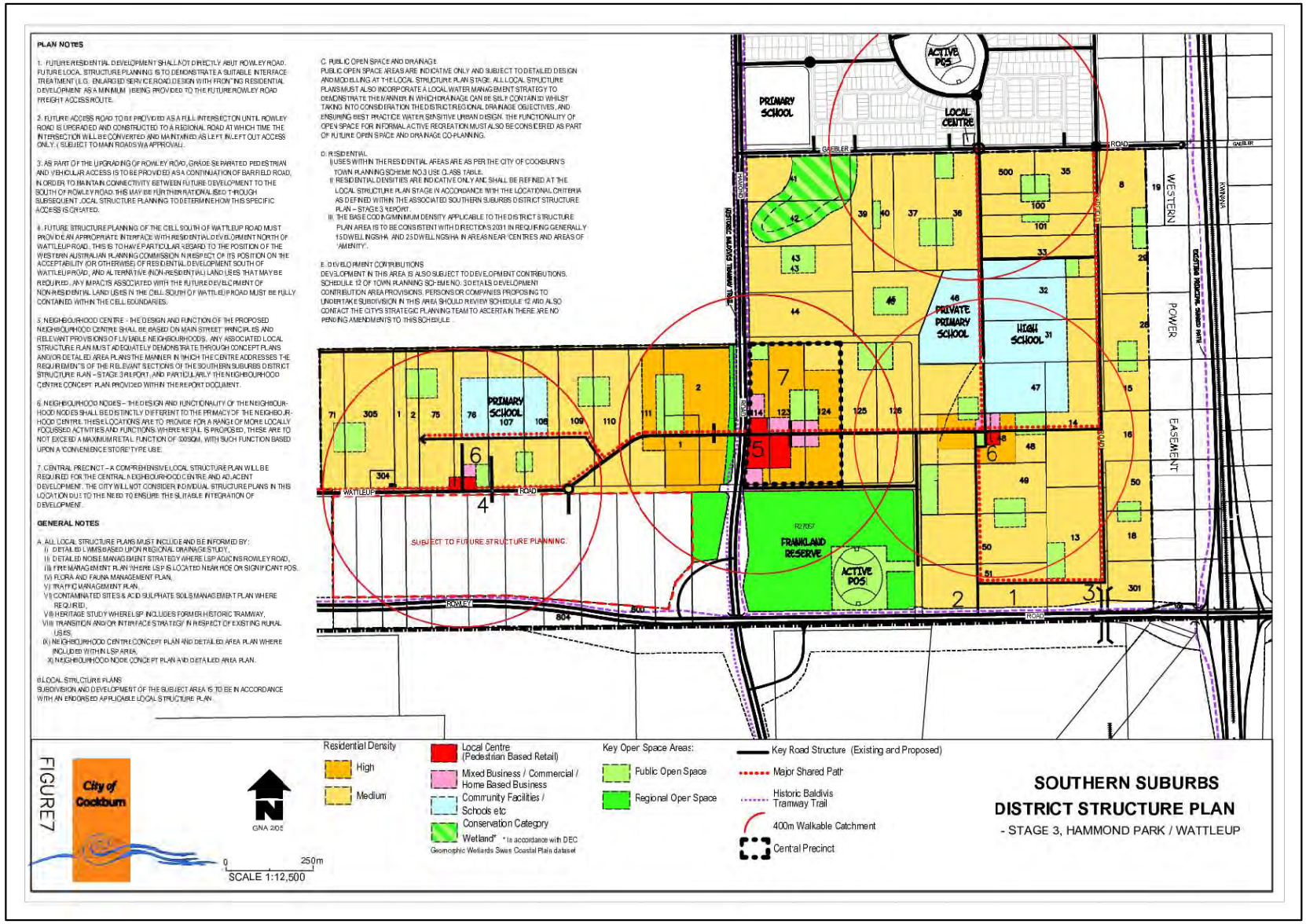


Figure 2: District Structure Plan

2 Description of subject area

2.1 General

The subject site (Lot 32, Barfield Road, Hammond Park) is approximately 4 hectares and is located approximately 25 kilometres south of the Perth CBD within the municipality of City of Cockburn. The subject site is of a rural-residential nature with woodland and grassland vegetation within and adjoining. Residential urban development exists to the north, east and west of the subject site. The surrounds are identified within the District Structure Plan for medium density urban development alongside a large area for a High School.

2.2 Topography

The subject site is generally of a flat nature with some minor undulation. The surrounding area is similar with a small area of upslope (<5 degrees) to the north-west.

2.3 Bushfire fuels

Bushfire fuels within the subject site and its surrounds include woodland and grassland vegetation types as assessed using the vegetation descriptions in AS 3959. Some of these areas have been disturbed by residential development or disturbance around existing semi-rural dwellings, grazing and general use. After development occurs, the nearest potential bushfire hazard is to the east of Barfield Road however, some of this area is identified within the District Structure Plan for medium urban development and thus a separation of 150 metres would exist. The closest retained bushfire hazard to the site, is the public reserve 'Frankland Park' some 550 metres south-west of the subject site.

Fuel load sampling was not undertaken due to its relevancy to the development and that the subject site and surrounds is to be an urban residential development with any remaining open space managed in a reduced fuel state (Low Threat).

The bushfire hazard assessment addresses this topic further in **Section 3.2**.

2.4 Land uses

The current land use is rural-residential with the surrounding allotments of similar nature or undeveloped. Urban residential development is found to the north, east and west of the subject site.

The proposed land use as part of the approved District Structure Plan (**Figure 2**) is a combination of medium density residential subdivision and part of a large High School area.

2.5 Access

Currently the site has direct access to Barfield Road, being a two-way sealed road contained within an approximate 20 metre wide road reserve.

Future development will allow the creation of further roads with connection to the existing road infrastructure and required to meet the applicable standards. The bushfire related standards are addressed in **Section 3.4.3**.

2.6 Water supply

The area is currently supplied by a reticulated water system and any future development will be required to meet the appropriate standards for residential water supply system including hydrants. The bushfire related standards are addressed in **Section 3.4.4**.

3 Bushfire assessment

3.1 Overview

The PBRMG defines the approach required for mapping the bushfire hazard, and lists the performance criteria and acceptable solutions for specific bushfire protection criteria or fire mitigation strategies required for development within a bushfire hazard area.

There are four bushfire protection criteria that reflect the achievement pathway of addressing the four fundamental policy measures of *SPP 3.7*. These criteria must be addressed to give effect to the objectives of *SPP 3.7* and PBRMG alongside an acceptable and compliant level of bushfire protection within an SP.

Although it is not possible to fully assess the compliance of an SP against the detailed requirements of the performance criteria and acceptable solutions, they are referred to as a guide to inform future phases of the planning process including subdivision.

3.2 Bushfire hazard assessment

A bushfire hazard assessment map has been prepared following the methodology within PBRMG (**Figure 3**) and displays the hazard rating of the site and adjoining land based on the pre-development state. **Figure 4** shows the expected hazard assessment map post-development.

The pre development map identifies the area containing either woodland or grassland vegetation and is rated either Extreme or Moderate and existing developed areas rated as Low. The post development mapping shows that the subject site and most of the surrounds will in fact have a Low Hazard rating with the nearest Extreme rating being approximately 150 metres to the east.

With a bushfire hazard rating of Low upon full residential development pursuant to the Southern Suburbs District Structure Plan – Stage 3, bushfire planning measures contained in SPP 3.7 and PBRMG do not apply. However, it is recommended that bushfire measures be considered throughout the planning development process.

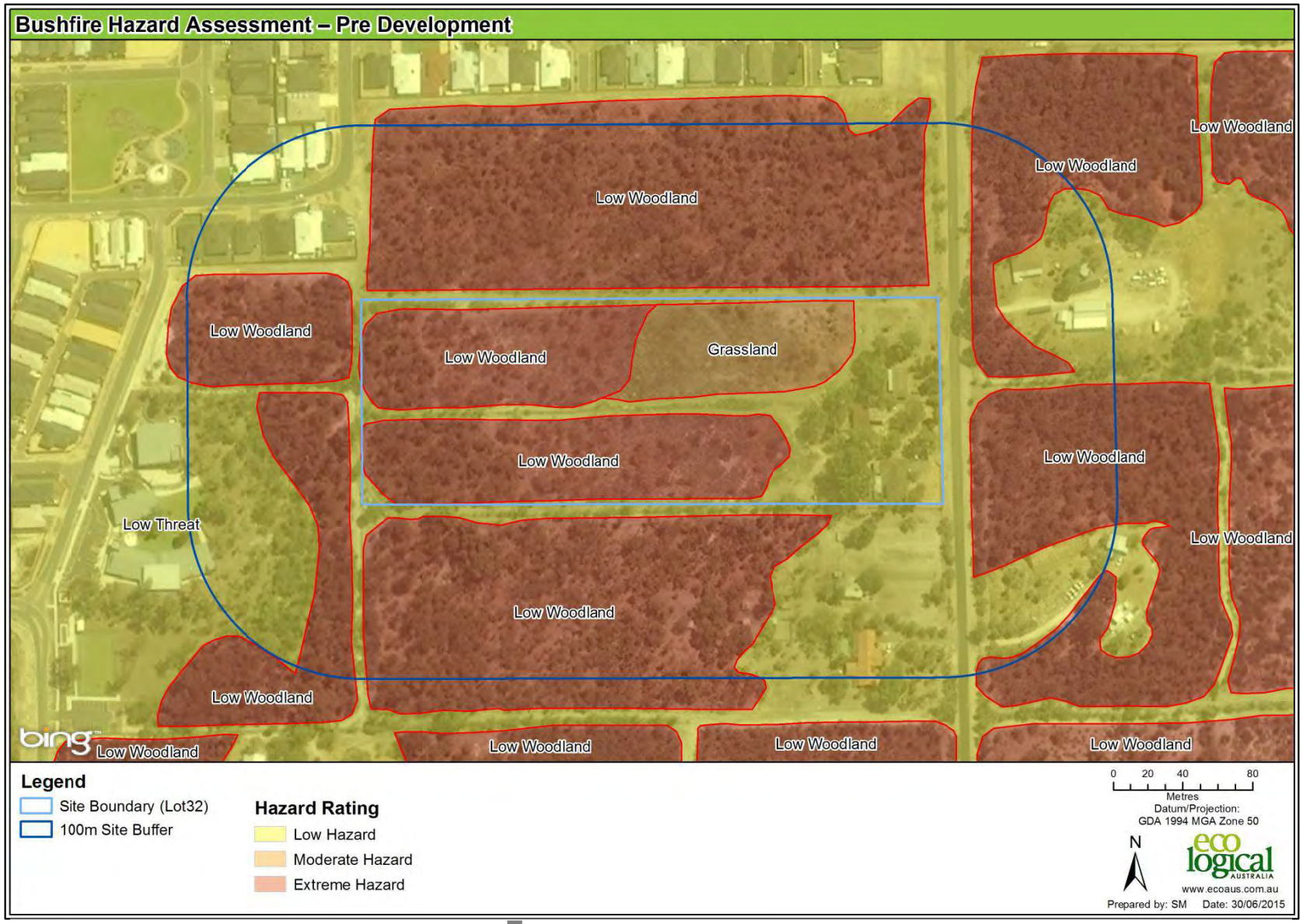


Figure 3: Bushfire hazard assessment - pre development

Figure 4: Bushfire hazard assessment - post development

3.3 Bushfire Attack Level (BAL) assessment

Using the bushfire hazard parameters from **Section 3.2** and other site specific data, the Bushfire Attack Levels (BALs), in accordance with AS 3959, have been determined for the subject site.

The nearest bushfire hazard, after development, is approximately 150 m to the east and 550 m to the south. This bushfire hazard is outside of the 100 m assessment criteria as identified in AS 3959. The assumption made for the BAL assessment is that vegetation, during the time of development, would be retained on the eastern side of Barfield Road, all other bushfire hazard vegetation would be cleared at the start of the construction. The residential subdivision component of the subject site would be located to the immediate west of Barfield Road.

Below in **Table 1** is the BAL summary for the above scenario and demonstrates that subdivision development in that case would achieve a construction requirement ≤ BAL-29 and a Building Protection Zone utilising Barfield Road. **Figure 5** demonstrates the BAL mapping for this scenario.

The determination of the BALs also allows the calculation of the minimum Building Protection Zone between a building and the hazard, being the combined distance of BAL-FZ and BAL-40.

Table 1: BAL assessment (scenario one)

Vegetation Classification	FDI	Slope	Separation Distance	BAL	Building Protection Zone
Woodland	80	Upslope / Flat land	18.5 m	BAL-29	14 m

A second scenario may occur with the retention of vegetation within the designated 'high school zone' (to the west of the residential development) whilst the residential subdivision is occurring. This will create a bushfire hazard adjoining the residential area but separated by a 16 m carriageway.

Below in **Table 2** is the BAL summary for the above scenario and demonstrates that subdivision development in that case would achieve a construction requirement ≤ BAL-29 and a Building Protection Zone utilising the new road. **Figure 5** demonstrates the BAL mapping for this scenario.

The determination of the BALs also allows the calculation of the minimum Building Protection Zone between a building and the hazard, being the combined distance of BAL-FZ and BAL-40

Table 2: BAL assessment (scenario two)

Vegetation Classification	FDI	Slope	Separation Distance	BAL	Building Protection Zone
Woodland	80	Upslope / Flat land	16 m	BAL-29	14 m

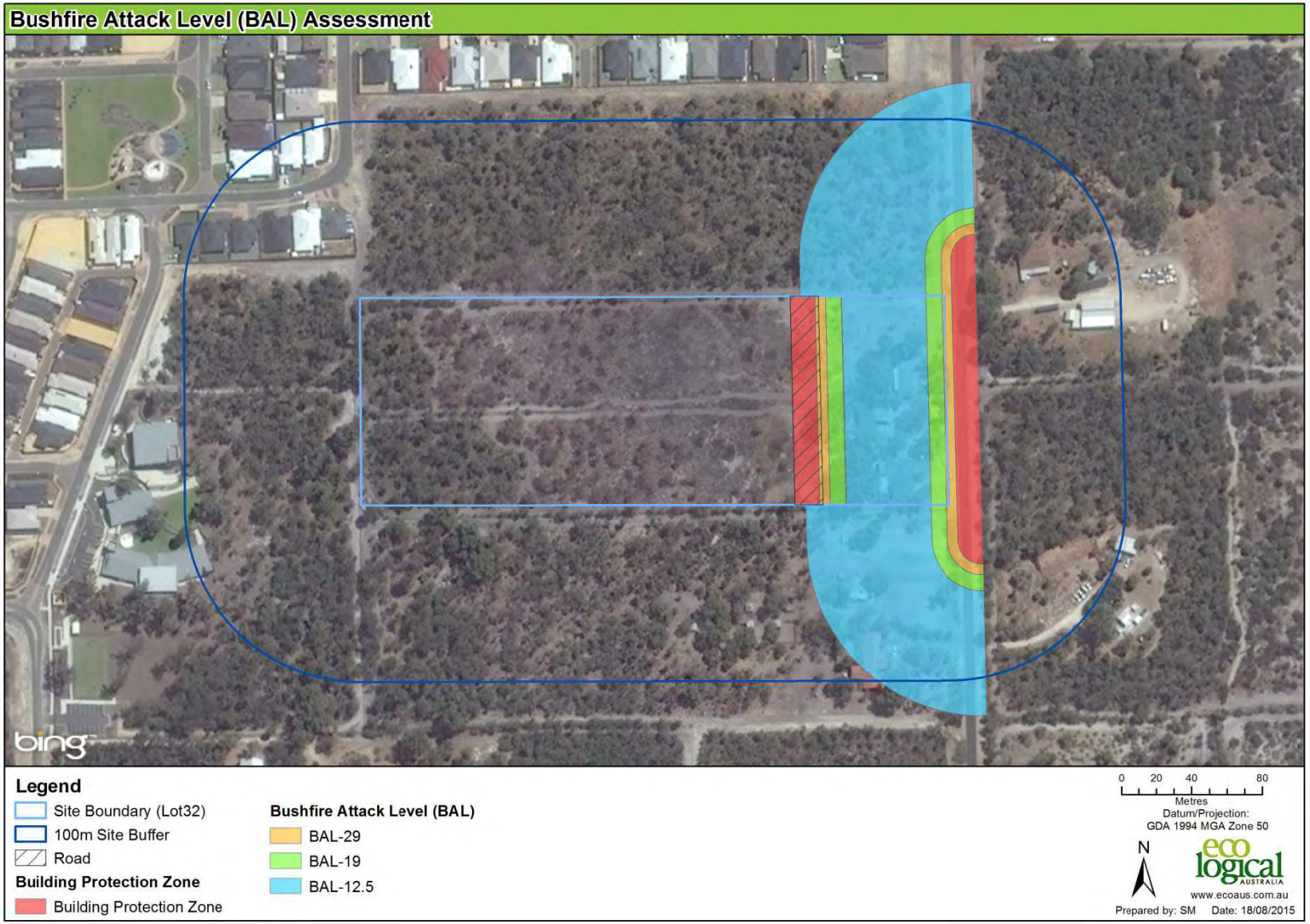


Figure 5: BAL Assessment

3.4 Bushfire protection criteria

This section assesses the subject site against the PBRMG performance criteria and acceptable solutions for future development. Four management elements of a future subdivision are to be assessed:

- Location;
- Siting and design of development;
- Vehicular access; and
- Water.

This assessment gives rise to a suite of recommendations to be incorporated into the SP and future development of the site. For each element, the intent of the measure is listed alongside the performance principle (P), acceptable solution (A) and a response of how this development can comply.

The challenge in assessing the subject site against each bushfire protection element is that the proposal is at the Structure Plan phase, and as such the design is in a preliminary stage. The assessment recommendations and acceptable solutions are to be integrated into this preliminary development stage to ensure any bushfire protection issues and measures are dealt with at an early stage.

As noted in **Section 3.2**, with a bushfire hazard rating of Low in post development, bushfire planning measures contained in SPP 3.7 and PBRMG do not apply. However, it is recommended that bushfire measures be considered throughout the planning development process.

3.4.1 Element 1: Location

Intent:

To ensure that the subdivision, development or land use is located in areas with the least possible risk of bushfire, to help minimise risk to people, property and infrastructure.

Performance Principle (P1):

The subdivision, development or land use is located in an area where the bushfire hazard assessment classification is or will be moderate or low, and the risk can be managed.

Acceptable Solution (A1.1): Development location

The subdivision, development or land use is located in an area that is not subject to either an extreme bushfire hazard level classification, or a Bushfire Attack Level of BAL-40 or BAL-FZ.

Response:

Development will not be subject to an Extreme bushfire hazard level as demonstrated in **Section 3.2**. The BAL determination is discussed in **Section 3.3**. Development will not be within BAL-40 or BAL-FZ areas. These BALs in combination will form the minimum Building Protection Zone between future buildings and a hazard. A future development will have the capacity to accommodate the minimum Building Protection Zone.

3.4.2 Element 2: Siting and design of development

Intent:

To ensure that the siting of development minimises the level of bushfire impact.

Performance Principle (P2):

The siting and design of the subdivision, development or land use (including paths and landscaping) is appropriate to the level of bushfire risk that applies to the site and minimises the bushfire risk to people, property and infrastructure.

Acceptable Solution (A2.1): Hazard separation – moderate bushfire hazard level

Every building is sited a minimum distance of 100 metres from any vegetation classified in AS 3959 as forests, woodlands, closed shrub, open shrub, mallee/mulga and rainforest and 50 metres from unmanaged grassland, or has its construction standard increased to align with the appropriate BAL for that location. Where a building cannot be located a minimum distance of 100m from the vegetation the building must be constructed to the higher standard as described in AS 3959.

Response:

With regards to the District Structure Plan, the final development outcome will most likely see a hazard separation of > than 100 metres. Where this does not occur, either due to staged development or a change in the overall design, buildings can be assessed for their BAL and achieve BAL-29 or less as demonstrated in **Section 3.3**.

Acceptable Solution (A2.2): Building protection zone

Every building is surrounded by a building protection zone which should be depicted on submitted plans. Building Protection Zones are to meet the following requirements:

a. *width: 20 metres measured from any external wall of the building or building envelope, increasing with slope;*
b. *location: within the boundaries of the lot on which the building is situated;*
c. *fuel load: reduced to and maintained at 2 tonnes per hectare;*
d. *trees (crowns) meet minimum separation distance in BCA;*
e. *no tall shrubs or trees located within 2 metres of a building;*
f. *no tree crowns overhanging the building; and*
g. *fences and sheds within the building protection zone are constructed using non-combustible materials (e.g. iron, brick, limestone).*

Response:

The Building Protection Zone will be achieved with either the Acceptable Solution above or a performance based solution where the zone aligns with AS 3959. This would consist of the BAL-FZ and BAL-40 combined width. Due to the density of the urban subdivision, the building protection zones will be shared across allotments and the adjoining Barfield Road. The fuel management specifications listed above can be achieved with future subdivision.

Acceptable Solution (A2.3): Hazard separation zone

Every building and its contiguous building protection zone is surrounded by a hazard separation zone that meets the following requirements:

a. *minimum width: 80 metres, measured from the outer edge of the building protection zone;*

b. *location: within the boundaries of the lot on which the building is situated or, where this is not possible or desirable, within the boundaries of the development precinct in which the building is proposed to be located; and*

c. *fuel load: reduced to and maintained at between 5 and 8 tonnes per hectare for jarrah/marri dominated forest and woodlands, below 12-15t/ha in mallee heath and below 15t/ha in karri forest.*

The extent of the hazard separation zone must be depicted on submitted plans.

Response:

Separation from the bushfire hazard will be > 150 metres. Where the development is to be staged a cleared and managed buffer of at least 100 metres is required.

3.4.3 Element 3: Vehicular access

Intent:

To ensure that the vehicular access serving a subdivision/development is available during a bushfire event.

Performance Principle (P3):

The internal layout, design and construction of public and private vehicular access in the subdivision/development allows emergency and other vehicles to move through it easily and safely at all times.

Acceptable Solution (A3.1): Two access routes

Two different vehicular access routes are provided, both of which connect to the public road network, provide access and egress to two different destinations and are available to all residents/the public at all times and under all weather conditions.

Response:

The SP allows this road design criteria to be achievable in future development where required.

Acceptable Solution (A3.2): Public roads

Public roads are to meet the requirements in Table 1, Column 1.

Response:

The SP allows this road design criteria to be achievable in future development where required.

Acceptable Solution (A3.3): Cul-de-sac (including dead-end roads)

Should not be used in bushfire-prone areas. Where no alternative exists, the following requirements are to be achieved:

- *requirements in Table 1, Column 2;*
- *maximum length: 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than 8 lots are serviced and the emergency access way is no more than 600 metres); and*
- *turn-around area requirements, including 21 metre diameter head.*

Response:

The SP allows this road design criteria to be achievable in future development where required.

Acceptable Solution (A3.4): Battle axes

Battle axe access legs should be avoided in bushfire-prone areas. Where no alternative exists, the following requirements are to be achieved:

- *requirements in Table 1, Column 3;*
- *maximum length: 600 metres; and*
- *minimum width: 6 metres*

Response:

The SP allows this road design criteria to be achievable in future development where required.

Acceptable Solution (A3.5): Private driveways

Constructed private driveways are to meet the following requirements:

- *requirements in Table 1, Column 4;*
- *required where a house site is more than 50 metres from a public road;*
- *passing bays: every 200 metres with a minimum length of 20 metres and a minimum width of 2 metres (ie. the combined width of the passing bay and constructed private driveway to be a minimum 6 metres); and*
- *turn-around areas designed to accommodate type 3.4 fire appliances and to enable them to turn around safely every 500 metres and within 50 metres of a house.*

Response:

The SP allows this road design criteria to be achievable in future development where required.

Acceptable Solution (A3.6): Emergency access ways

Where access ways do not provide through access to a public road, emergency access ways are to be provided for alternative links to public roads during emergencies. They are to meet the following requirements:

- *requirements in Table 1, Column 5;*
- *no further than one kilometre from a public road;*
- *provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency; and*
- *must be signposted.*

Response:

The SP allows this road design criteria to be achievable in future development where required.

3.4.4 Element 4: Water

Intent:

To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

Performance Principle (P4):

The subdivision, development or land use is provided with a permanent and secure water supply that is sufficient for fire fighting purposes.

Acceptable Solution (A4.1): Reticulated areas

The subdivision, development or land use is provided with a reticulated water supply, together with fire hydrants, in accordance with the specifications of the relevant water supply authority and DFES.

Response:

The site is within a reticulated water supply area and thus can be '*provided with a reticulated water supply, together with fire hydrants, in accordance with the specifications of the relevant water supply authority and DFES'.*

Acceptable Solution (A4.2): Non-reticulated areas

Water tanks with a hydrant or standpipe are provided and meet the following requirements:

- *volume: 50,000 litres per tank;*
- *ratio of tanks to lots: minimum 1 tank per 25 lots (or part thereof);*
- *tank location: tanks are located no more than two kilometres to the furthest house site within the residential development to allow a 2.4 fire appliance to achieve a 20 minute turnaround time at legal road speeds;*
- *hardstand and turn-around areas suitable for a 3.4 fire appliance are provided within 3 metres of each water tank; and*
- *water tanks and associated facilities are vested in the relevant local government.*

Response:

Not applicable as the site meets acceptable solution A4.1.

4 Recommendations and conclusion

4.1 Recommendations

Below are recommendations based on the bushfire assessment for the Structure Plan (SP) detailing subdivision development of Lot 32 Barfield Road, Hammond Park.

1. All vegetation to be cleared at the initial subdivision construction stage. If vegetation is retained within the 'high school zone' (west of residential development) whilst development of the residential zoned land is occurring, then further assessment may be required at the subdivision stage where some lots may require BAL-29 construction. A further option is the subdivision is staged in a manner where the final stage occurs once the vegetation to the west is removed;

2. If the subdivision is to be undertaken in a staged manner:

    a. a cleared and managed 100 metre buffer between the residential zoned land and bushfire prone vegetation is required;

    b. at least two access routes are required to allow for access and egress to two different destinations;

3. If a Building Protection and Hazard Separation Zones are required:

    a. They will be less than 20 m and 80 m, respectively. The BAL-FZ and BAL-40 zones in combination form the Building Protection Zone that provides the required setback from the bushfire hazard and prevents construction of buildings in zones higher than BAL-29;

4. Vehicular access controls required for future subdivision and development are recommended and achievable;

5. Fuel management requirements within the Building Protection Zone required for future subdivision and development are recommended and achievable; and

6. Water supply controls required for future subdivision and development are recommended and achievable.

4.2 Conclusion

The bushfire hazard assessment has mapped the hazard and identified bushfire hazard controls to address the hazard and risk that comply with the PBRMG. Although bushfire protection measures are not required due to the development being located within a low hazard area post development and any remaining classified vegetation being greater than 150 m way, measures are still recommended.

Building Protection Zones less than that prescribed by the acceptable solutions of the PBRMG are proposed for the site. The proposed protection zone will be equivalent of the AS 3959 BAL-40 and BAL-FZ zones in combination. Other bushfire hazard controls (such as those related to vehicular access and water supply) are also recommended.

In conclusion the proposed SP is capable of providing a level of bushfire hazard management for future development proportional to the post development risk.

References

Standards Australia. 2005. *Fire hydrant installations - System design, installation and commissioning*, AS2419.1, Fourth edition 2005, SAI Global, Sydney.

Standards Australia. 2008. *The storage and handling of LP Gas*, AS/NZS 1596:2008, Fourth edition 2005, SAI Global, Sydney.

Standards Australia. 2009. *Construction of buildings in bushfire-prone areas, AS 3959-2009*. SAI Global, Sydney.

Western Australian Planning Commission (WAPC). 2014. *Planning for bushfire Risk management Guidelines (Draft May 2014) (including appendices)*. WAPC, Perth.

Western Australian Planning Commission (WAPC). 2014. *State Planning Policy No. 3.7: Planning for Bushfire Risk Management (SPP 3.7) (Draft May 2014)*. WAPC, Perth.

ecological AUSTRALIA

ISO 14001 Environmental Management

AS/NZS 4801:2001 Occupational Health and Safety Management

ISO 9001 Quality Management

HEAD OFFICE
Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

SYDNEY
Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

HUSKISSON
1/51 Owen Street
Huskisson NSW 2540
T 02 4443 5555
F 02 4443 6655

CANBERRA
Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

NEWCASTLE
Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

NAROOMA
5/20 Canty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

COFFS HARBOUR
35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

ARMIDALE
92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

MUDGEE
Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

PERTH
Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

WOLLONGONG
Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

GOSFORD
Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897

DARWIN
16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

BRISBANE
PO Box 1422
Fortitude Valley QLD 4006
T 0400 494 366

1300 646 131
www.ecoaus.com.au