WELLARD

RESIDENTIAL

LOCAL STRUCTURE PLAN

NOVEMBER 2024

CLE Town Planning + Design

This page has been left blank intentionally

ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Kwinana
Town Planning Scheme No.2

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

28 September 2012

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: **19 OCTOBER 2030**

WELLARD RESIDENTIAL LOCAL STRUCTURE PLAN

Prepared by:

Level 2
2 Abbotsford Street
West Leederville WA 6007
PO Box 796
Subiaco WA 6904
Tel: 9382 1233
Web: www.cleplan.com.au

Project No. 2263Rep49F

November 2024

Table of Amendments

Amendment No.	Summary	Date Approved by the WAPC
1.	Introduce Lot 506 Johnson Road, Wellard within the Wellard Residential Local Structure Plan by applying a residential density of R30, along with two areas of POS. Amend the Wellard Residential Local Structure Plan to: • Update LSP map to include Lot 506 Johnson Road (Page 86); • Insert Amendment 1 – Addendum Report, including corresponding Part 1 – Implementation and Part 2 – Explanatory sections; • Update Executive Summary and Table of Contents to reference Amendment 1 (Page 14); • Update Table 1 (Land Ownership and Legal Description) to include Lot 506 Johnson Road (Page 21); • Update Figure 14 (Public Open Space) (Page 62); and • Update Table 2 (Public Open Space and Drainage Summary) (Page 64).	19 December 2024

LANDOWNER

Wellard Residential Pty Ltd

PROJECT TEAM

Project Management - Wellard Residential Pty Ltd

Planning and Urban Design - CLE Town Planning + Design

Environmental Assessment - PGV Environmental

Groundwater and Drainage - Emerge Associates

Engineering Infrastructure and Services - JDSI Consulting Engineers

Traffic and Transport - Bruce Aulabaugh Traffic Engineering

Acoustic Assessment - Lloyd George Acoustics

Bush Fire Protection - South West Fire Services

Landscaping - Urban Landscaping

Visual Analysis - EPCAD

TABLE OF CONTENTS

1.0 PLANNING BACKGROUND

1.1 Introduction and Purpose
1.2 Land Description
1.2.1 Location
1.2.2 Area and Land Use
1.2.3 Legal Description and Ownership
1.3 Planning Framework
1.3.1 Zoning & Reservations
1.3.2 Structure Planning
1.3.3 Policies
1.3.4 Previous Approvals & Decisions
1.4 Context Analysis

2.0 SITE CONSIDERATIONS

2.1 Environmental Assets & Constraints
2.2 Landform & Soils
2.3 Ground Water & Surface Water
2.4 Fire Management
2.5 Noise Management
2.6 Heritage
2.7 Area of Landscape Protection

3.0 LOCAL STRUCTURE PLAN

3.1 Plan Overview & Land Use Description
3.2 Residential
3.2.1 Housing Principles
3.2.2 Lot Yield Estimates
3.2.3 Residential Density Coding
3.2.4 Development Standards: R Code Variations
3.2.5 Landscape Protection Area
3.3 Activity Centres
3.4 Movement Network
3.4.1 Network, Capacity and Arterial Access
3.4.2 Local Street Cross Sections and Traffic Management Treatments
3.4.3 Public Transport
3.4.4 Pedestrians & Cyclists

3.5 Public Open Space

3.5.1 Open Space Provision & Schedules

3.5.2 Urban Water Management & Open Space

3.5.3 Description of Open Space Areas

3.5.4 Special Streetscapes

3.6 Urban Water Management

3.7 Infrastructure Co-ordination, Servicing & Staging

3.7.1 Wastewater

3.7.2 Water supply

3.7.3 Power Supply

3.7.4 Gas Supply

3.7.5 Telecommunications

3.7.6 Infrastructure Funding

3.7.7 Earthworks and Staging

3.8 Environmental Response

3.8.1 Wetland Management

3.8.2 Trees, Vegetation, Flora Management

3.8.3 Fauna Management

3.9 Acoustic Attenuation

3.10 Bush Fire Prevention

4.0 STATUTORY PLANNING IMPLEMENTATION

4.1 Status of the Local Structure Plan

4.2 Detailed Area Plans

4.3 General Subdivision and Development Requirements

4.4 Management Plans

TABLE OF CONTENTS - AMENDMENT 1 - ADDENDUM REPORT

PART ONE - IMPLEMENTATION

1.0 STRUCTURE PLAN AREA & OPERATION

1.1 Application Area & Approval
1.2 Relationship with Statutory Planning Framework
1.3 Structure Plan Content

2.0 PURPOSE

3.0 SUBDIVISION & DEVELOPMENT REQUIREMENTS

3.1 Land Use Zones & Reserves
3.1.1 Structure Plans Zones
3.1.2 Road Reserves
3.1.3 Public Open Space
3.2 Density & Development
3.2.1 Density & R-Codes
3.2.2 Local Development Plans
3.3 Other Requirements
3.3.1 Bushfire Management
3.3.2 Developer Contributions
3.3.3 Water Resource Management

4.0 ADDITIONAL DETAILS

4.1 Studies to be required under condition of subdivision approval

PART TWO - EXPLANATORY

1.0 PURPOSE OF AMENDMENT

2.0 BACKGROUND

2.1 Area & Land Use
2.2 Ownership & Title Details
2.3 Location & Surrounding Context

3.0 PLANNING FRAMEWORK

4.0 PROPOSAL

4.1 Zoning & Land Use
4.2 Residential & Built Form
4.3 Movement Network
4.4 Environmental
4.4.1 Topography, Landform & Soils
4.4.2 Flora & Vegetation
4.4.3 Fauna
4.4.4 Wetlands
4.5 Water Management
4.5.1 Stormwater Management
4.5.2 Groundwater Management
4.6 Public Open Space
4.7 Bushfire Hazard Management
4.8 Servicing

5.0 CONCLUSION

LIST OF FIGURES

1. Site Plan and Orthophoto
2. Location Plan
3. District Land Use And Transport Context
4. Metropolitan Region Scheme
5. City of Kwinana Town Planning Scheme 2
6. Jandakot Structure Plan
7. Draft Eastern Residential Intensification Concept Plan
8. LSP Development Concept Plan
9. Street Types
10. Street Cross Section – Local Distributor
11. Street Cross Section – Key Local Access Street
12. Street Cross Section – Local Access Street
13. Bus Route
14. Public Open Space
15. Landscape Concept
16. Special Streetscape Cross Section (23m reserve)
17. Special Streetscape Cross Section (18m reserve)
18. Indicative Drainage Areas
19. Wetland Interface Cross Section 1
20. Wetland Interface Cross Section 2
21. Wetland Boundaries
22. Quiet House Design
23. Local Structure Plan

APPENDICES

1. Environmental Assessment – PGV Environmental
2. Road Traffic Acoustic Assessment – Lloyd George Acoustics
3. Fire Management Plan – Southwest Fire Services
4. Environmental Protection Authority advice 29 March 2010
5. Traffic and Transport Assessment – Bruce Aulabaugh
6. Infrastructure and Servicing Strategy – JDSi
7. Local Water Management Strategy – Emerge Associates
8. Landscaping Strategy – Urban Landscaping
9. Landscape and Visual Study - EPCAD
10. Public Open Space Schedule
11. Walkable Catchment Plan

APPENDICES - ADDENDUM (AMENDMENT 1)

1. Local Water Management Strategy – Emerge Associates
2. Engineering Services Report – JDSi
3. Bushfire Management Plan – Emerge Associates
4. Landscape Masterplan – Emerge Associates
5. Environmental Report – Emerge Associates
6. Traffic Impact Assessment – PJA

EXECUTIVE SUMMARY

The Wellard Residential Local Structure Plan (LSP) allows for the creation of a diverse and vibrant urban community within an urban infill setting that responds to the surrounding land use context, natural environment, and State Government infill targets.

The LSP area covers approximately 73ha over Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and Lots 2, 10, and 1 Johnson Road, Wellard ("the subject land"), of which approximately 61.5ha is zoned Urban under the MRS, with the balance zoned Rural. The LSP establishes a robust statutory planning framework that provides a comprehensive guide for future land use and development, whilst recognising the site's context within the strategic planning framework, as well as its physical setting.

The urbanisation and development of the subject land provides further opportunities to maximise the catchment to existing and planned infrastructure through consolidation of urban development, while satisfying State Government infill housing targets, and recognising the natural setting of the land. The wider area between the Kwinana town centre and the Kwinana Freeway has been subject to extensive growth and urban consolidation over the past decade. As a result essential infrastructure is either already in place, or is capable of being extended into the subject land, making it a logical choice for urban infill.

The Minister for Planning approved amendment 1189/57 to the Metropolitan Region Scheme on 30 November 2010 to rezone approximately 89ha of Rural zoned land in Wellard to Urban Deferred. A portion of the Urban Deferred land including the LSP area was subsequently transferred to Urban zone in October 2011.

In considering MRS amendment 1189/57, the Environmental Protection Authority (EPA) set the level of assessment as 'Scheme Not Assessed' and advised that a 50m buffer to the Environmental Protection Policy (EPP) wetland, the southern portion of which sits within the north eastern corner of the LSP, is sufficient to protect and retain the core values of the wetland area. The LSP complies with this requirement.

The LSP responds to the current strategic planning framework provided by the Jandakot Structure Plan, and the draft Eastern Residential Intensification Concept (ERIC). The LSP recognises and elaborates on the key principles of these strategies to provide a statutory mechanism for their implementation.

The LSP allows for the creation of approximately 770-820 dwellings over approximately 61.5ha of Urban zoned land, located between Wellard Road and Johnson Road, to the south of the Bollard Bulrush Wetland. Overall the Plan allows for the provision of approximately 11 hectares of public open space, plus an additional 10ha of wetland core area, achieving an ideal balance between useable

passive and active open space, as well as recognising significant vegetation and drainage requirements within public open space reserves, and providing view corridors from Homestead Ridge to the west of the subject land. Of the gross urban zoned area the LSP area delivers 18% open space. In accordance with Liveable Neighbourhoods, once appropriate credits are applied 15.4% open space is provided.

Once developed, the LSP area will provide a broad range of housing choice and a variety of lot product. Medium density housing options will be located around key areas of public open space, adjoining primary school and local centre, and adjacent to planned public transport routes, balanced with transitional densities away from core infrastructure and adjoining the Bollard Bulrush Wetland and Bush Forever, recognising that these environmental features do not provide the context for high density development. The LSP achieves an appropriate density for residential development in greenfields locations, in the context of the Bollard Bulrush wetland core and Tramway Reserve to be ceded free of cost to the Crown, and given the proposed betterment of the wetland buffer, Tramway Reserve and POS areas within the LSP.

The LSP is environmentally responsive, recognising areas of mature vegetation in passive areas of open space, and providing a suitable interface to the Bush Forever reserve to the south through a combination of road reserves and public open space. The LSP also provides a similar interface to the Bollard Bulrush Wetland to the north, meeting EPA wetland buffer requirements, ensuring that the urban land uses are clearly delineated from the wetland areas. Drainage has been designed to be consistent with pre-development flows into the Wetland area and the Peel Main Drain, ensuring that the development will not impact on any downstream wetlands or waterways through a reduction in drainage volumes or water quality.

The LSP demonstrates a clear and legible hierarchy of roads that respond to the existing road network and the City of Kwinana's traffic forecasting and modelling. The internal road network provides permeable east-west and north-south connections via a primary local distributor and local access streets, ensuring that traffic flows and volumes are distributed appropriately throughout the estate.

The LSP demonstrates and confirms that the subject land can be readily serviced, with essential infrastructure already available in the area. Furthermore, given the large majority of the land is in single ownership, cost sharing for provision of infrastructure is not in any way prohibitive to development, and can be addressed through standard agreements with service providers.

This page has been left blank intentionally

Table 1 – Land Use Summary

ITEM	DATA	SECTION NUMBER
Total area covered by the structure plan	81.62ha	Plan A
Area of each land use proposed: Zones • Residential Reserves • Rural • Parks and Recreation/Drainage • Road Reserves	 39.35ha 9.52ha 2.41ha 19.73ha	Section 3.1 and Plan A
Estimated number of dwellings	939	Section 3.2
Estimated Residential Density Liveable Neighbourhoods & Perth and Peel@ 3.5 million	13.5 dwellings per gross urban zoned hectare & 23.9 dwellings per residential site hectare	Section 3.2
Estimated population	2629 (2.8 people per household)	Section 3.2
Number of high schools	0	Section 3.1 and Plan A
Number of primary schools	0	Section 3.1 and Plan A
Amount of Public Open Space	10.83ha (14.6%) Unrestricted – 8.66ha Restricted – 1.57ha	Section 3.5

Addendum (Amendment 1)

Amendment 1 to the Wellard Residential Local Structure Plan looks to introduce Lot 506 Johnson Road into the structure plan area, by extending the R30 density code to facilitate residential development within the subject site. The amendment also proposes to introduce two additional areas of public open space within the subject site to complement the established open space network, to provide a shared drainage function in a manner that will not compromise active and passive recreational uses. The surrounding road network is capable of connecting into the site, with a network of access roads, consistent with the existing structure plan being proposed within the subject site. This amendment has been progressed to facilitate future subdivision and development over Lot 506 to reflect its 'Development' zoning under the City of Kwinana Local Planning Scheme 2.

As part of the preparation of the LSP, the following reports, assessments and management plans have been prepared, and are summarised in the LSP report, with full copies included as technical appendices.

1. Environmental Assessment Report (including Wetland Management Strategy)

2. Transport and Access Strategy

3. Local Water Management Strategy

4. Landscape Concept Plan and Open Space Strategy

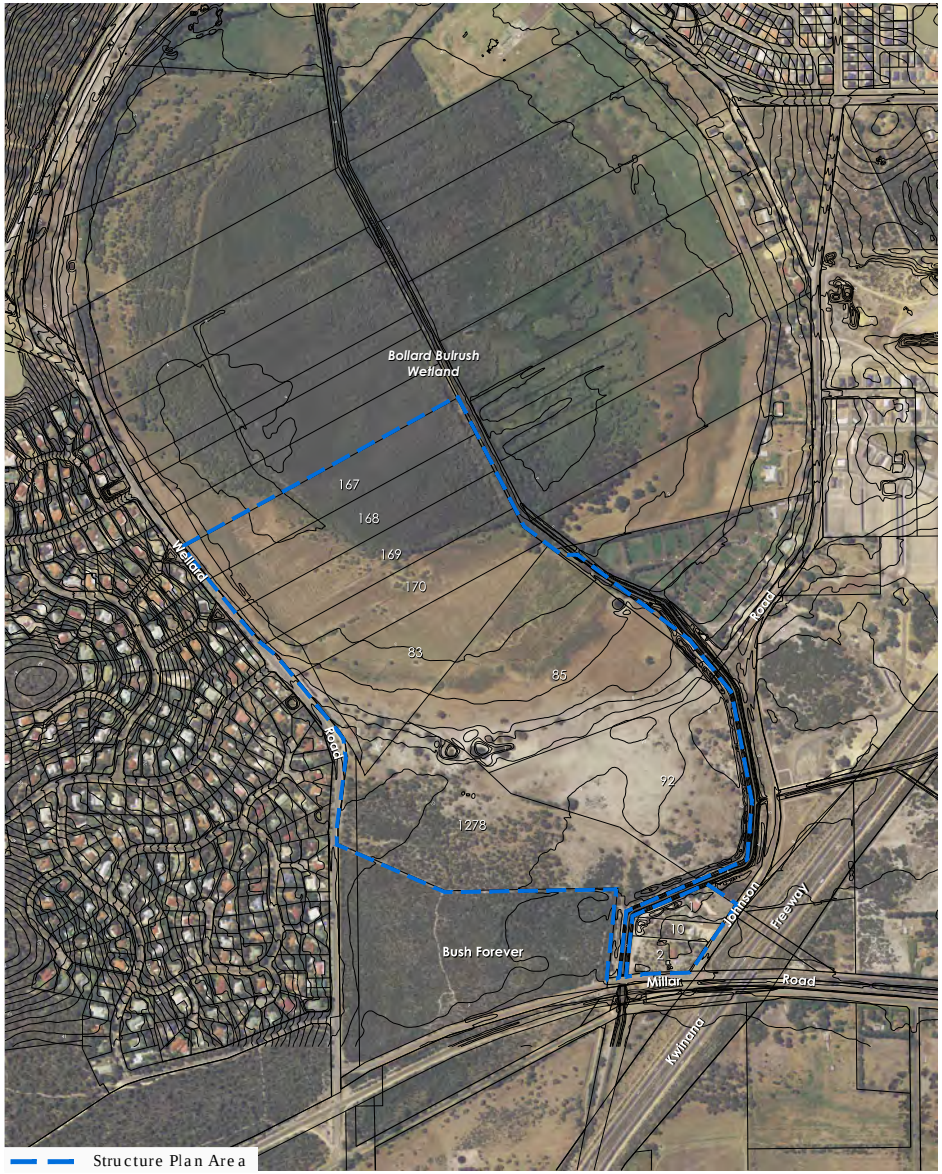
5. Servicing and Infrastructure Strategy

6. Road and Traffic Acoustic Assessment

7. Fire Management Plan

8. Landscape and Visual Study

These strategies and reports comprehensively address all of the applicable planning considerations, and demonstrate that the subject land is capable of supporting urban development in the form proposed via this LSP.



SITE PLAN & ORTHOPHOTO

2263-72-01 (01.09.2011), nts

Wellard Residential : Figure 1

1.0 PLANNING BACKGROUND

1.1 Introduction and Purpose

This Local Structure Plan (LSP) has been prepared on behalf of Wellard Residential Pty Ltd, and is lodged with the City of Kwinana pursuant to clause 6.17 of Town Planning Scheme No.2.

The purpose of this LSP is to provide a broad statutory planning framework to guide future subdivision, development, and use of the subject land. The LSP draws on the current strategic planning framework, and refines the level of detail in order to ensure that environmental, social, economic and infrastructure issues are comprehensively addressed, and that a clear and robust statutory framework is provided.

Preparation of this LSP has involved extensive consultation with the City of Kwinana, Department of Planning, Department of Education, Main Roads WA, Department of Water, Public Transport Authority and relevant service authorities. In addition the proponent has also met with adjoining owners who represent the Homestead Ridge Progress Association. The extensive consultation at the beginning of the process has ensured that the LSP addresses all matters raised by the various agencies prior to lodgement.

1.2 Land Description

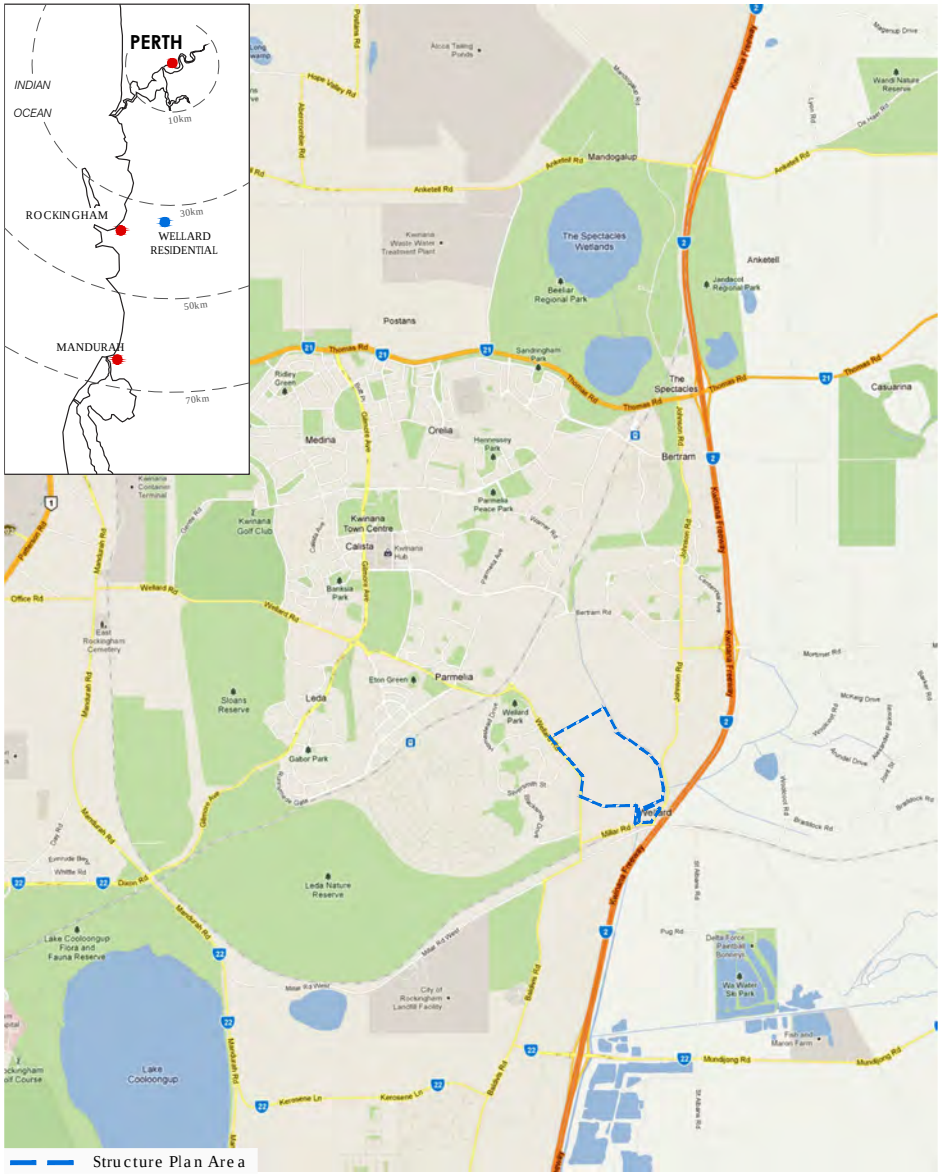
The LSP area encompasses all of Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and lots 2, 10 and 1 Johnson Road. A site plan and orthophoto is Figure 1.

The following sections provide a detailed description of the land and surrounds.

1.2.1 Location

The LSP area is located within the City of Kwinana, approximately 32km south of the Perth CBD, and 2km south east of the Kwinana town centre, identified as a Secondary Centre under WAPC's State Planning Policy 4.2 – Activity Centres for Perth and Peel. A location plan showing the subject land within the Kwinana district is Figure 2.

The areas between the Kwinana town centre and the Kwinana Freeway have been subject to extensive growth and urban consolidation over the past decade. As a result of the extensive consolidation in this area, essential infrastructure is either already in place, or is capable of being extended into the subject land. New housing estates are either planned, under construction, or completed surrounding the site at Bertram, Casuarina, Wellard Village, Wellard East, and Emerald Park (Wellard West).



Source: Google Maps 2011

LOCATION PLAN

2263-73-01 (01.09.2011), 1:50,000 @ A4

Wellard Residential : Figure 2

Further infill development is also underway in the Kwinana town centre, Parmelia, and Orelia. The urbanisation of the subject land provides further opportunities to maximise the catchment to existing and planned infrastructure through consolidation of urban development, and to achieve state government infill housing targets.

Figure 3 provides a District Context Plan, showing the context of the surrounding endorsed local structure plans and the strategic planning framework of the WAPC's Outer Metropolitan Perth and Peel Sub-regional Strategy.

The Wellard locality is largely defined by Bertram Road to the north, Wellard Road to the west, the Kwinana Freeway to the east, and Millar Road to the south. The surrounding infrastructure and proximity to the Kwinana town centre afford excellent opportunities to provide a large scale urban infill project.

The subject land is broadly bounded by Bush Forever Area 349 to the south west, the Peel Main Drain to the east, Wellard Road to the west, the Bollard Bulrush Wetland to the north east, and Lot 87 Wellard Road to the north west. An unconstructed portion of road reserve forms a portion of the north eastern boundary of the LSP area, and can be utilised to provide access and servicing of the LSP area.

Lots 1, 10 and 2 Johnson Road are separated from the balance of the site via the Peel Main Drain, which forms the western boundary to these lots. These lots all have frontage and access to Johnson Road, while Lot 2 also has direct frontage to Millar Road. These lots are under separate ownership to the balance of the LSP area, and have been included in the LSP at the request of the City of Kwinana.

1.2.2 Area and Land Use

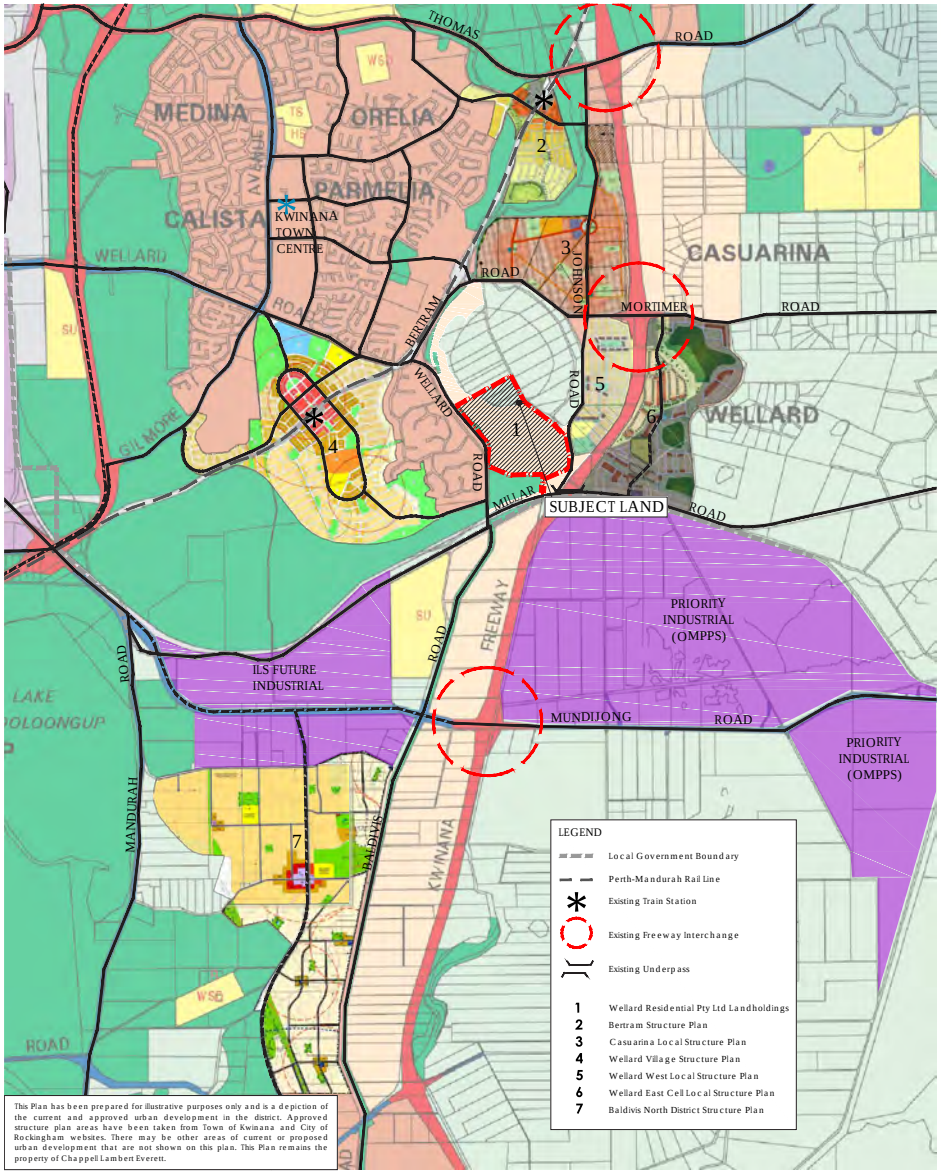
The LSP area provides a gross area of approximately 73.82ha. This includes 11 freehold lots ranging in size from 0.7ha to 15ha.

The land is predominantly cleared, and has historically been used for grazing of livestock, and other agricultural purposes.

1.2.3 Legal Description and Ownership

The LSP area comprises of Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and Lots 1, 10, and 2 Johnson Road in Wellard. Wellard Residential Pty Ltd is the sole beneficial landowner of the large majority of the subject land, with the exception of Lots 1, 10 and 2 Johnson Road, which are privately owned.

Table 1 provides the legal description and ownership of the subject land.



Source: Google Maps 2011

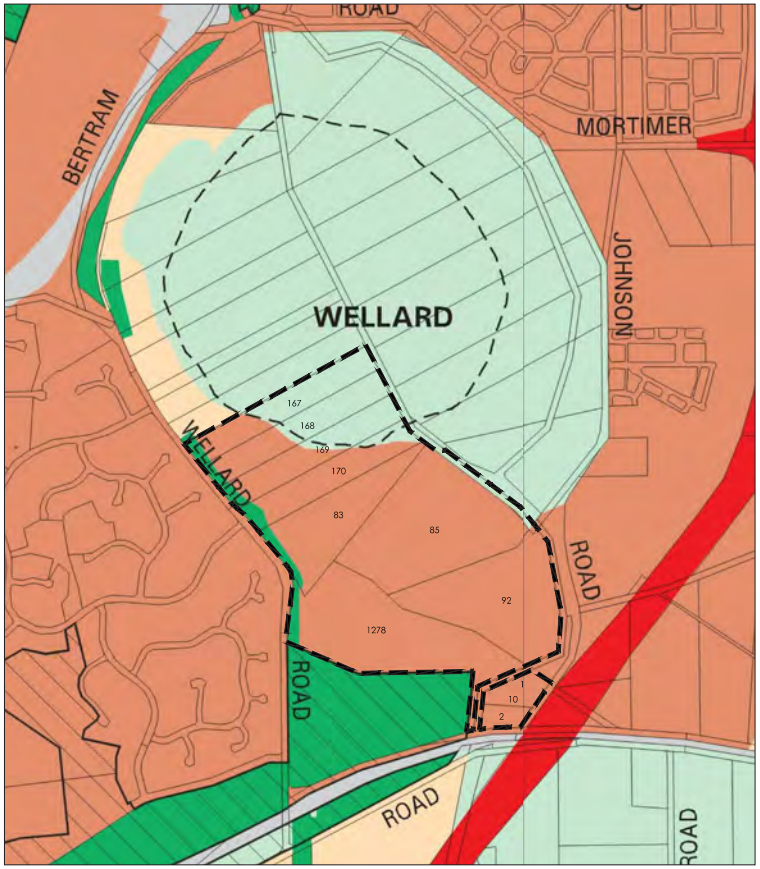
DISTRICT LAND USE AND TRANSPORT CONTEXT

2263-74-01 (01.09.2011), nts

Wellard Residential : Figure 3

Table 2 – Land Ownership and Legal Description

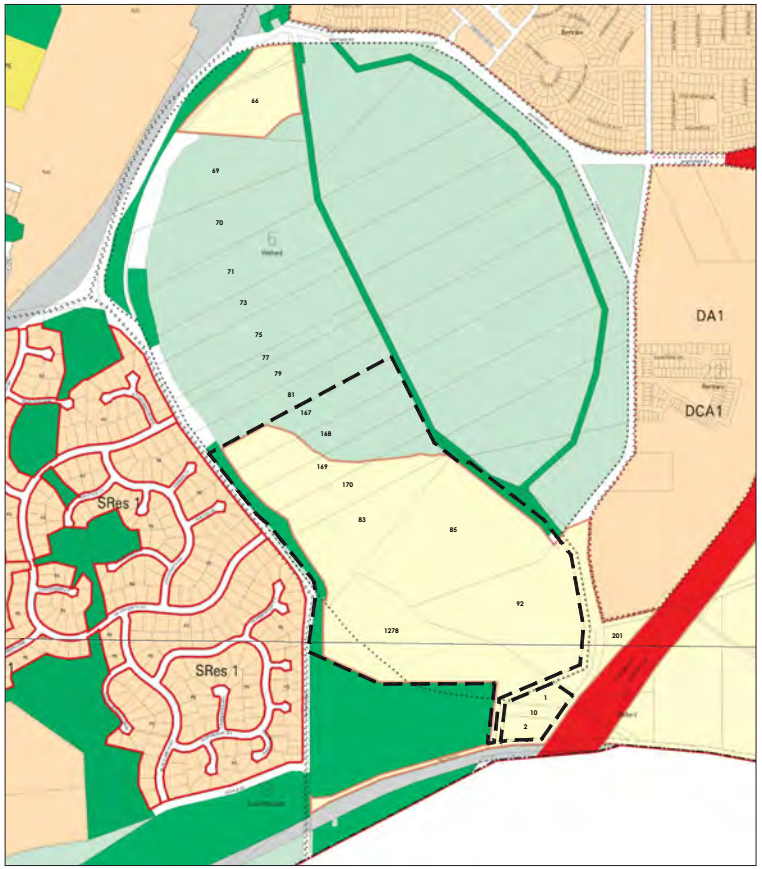
Lot Number	Plan Number	Area zoned Urban	Rural zone and Parks and Recreation Reserve	Lot Area (Total 81.67ha)	Landowner
167 Wellard Road	202766	1.7161	3.732	5.4481ha	Wellard Residential Pty Ltd
168 Wellard Road	202766	2.0774	3.3378	5.4152ha	Wellard Residential Pty Ltd
169 Wellard Road	202766	2.5738	2.7959	5.3697ha	Wellard Residential Pty Ltd
170 Wellard Road	202766	4.1189	1.1977	5.3166ha	Wellard Residential Pty Ltd
83 Wellard Road	202766	7.1171	0.5927	7.7098ha	Wellard Residential Pty Ltd
85 Wellard Road	202641	15.1150	0	15.1150ha	Wellard Residential Pty Ltd
1278 Wellard Road	144366	14.2084	0.6471	14.8555ha	Wellard Residential Pty Ltd
92 Wellard Road	202645	11.9780	0	11.9780ha	Wellard Residential Pty Ltd
506 Johnson Road	71000	7.8510	0	7.8510ha	Wellard Residential Pty Ltd
Total Wellard Residential Landholdings		**58.9047**	**12.3032**	**79.0589ha**	
2 Johnson Road	65344	1.0326	0	1.0326ha	Seth Anthony Bombara
10 Johnson Road	65115	0.6943	0	0.6943ha	Amanda Rogers
1 Johnson Road	65344	0.8881	0	0.8881ha	Roy Anthony Eddleston
Total LSP Area		**61.5197**	**12.3032**	**81.6739ha**	



METROPOLITAN REGION SCHEME

2263-75A-01 (23.04.2012, nts

Wellard Residential : Figure 4



MRS Reserves
Parks and Recreation
Primary Regional Roads
Structure Plan Area

Local Scheme Reserves
Park Recreation & Drainage
Public Purposes

Zones
Development
Special Residential
Residential
Special Rural
Rural A

TOWN OF KWINANA - TOWN PLANNING SCHEME No. 2

2263-76A-01 (24.04.2012), nts

Wellard Residential : Figure 5

1.3 Planning Framework

1.3.1 Zoning & Reservations

Metropolitan Region Scheme

The Metropolitan Region Scheme (MRS) currently zones the bulk of the subject land as Urban. 9.7ha in the north east corner of the site is zoned Rural, while a 2.42ha strip adjacent to Wellard Road is reserved for Parks and Recreation, reflecting the existing 'Kwinana Tramway Reserve'.

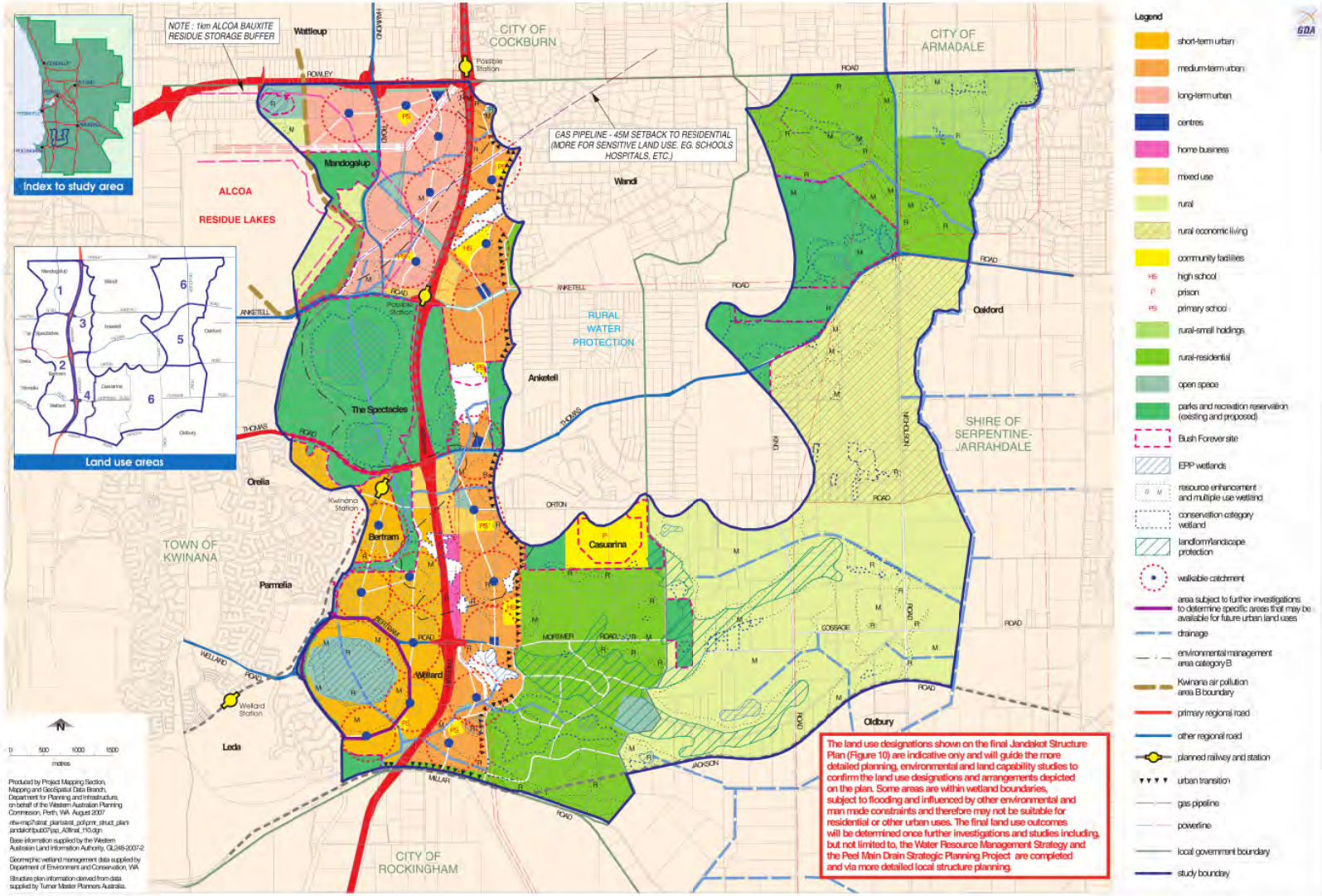
The Bush Forever Area 349, located to the south of the subject land, is reserved for Parks and Recreation. The Bollard Bulrush Wetland and Peel Main Drain to the north and east is currently zoned Rural, though it is understood that the wetland area may also be reserved for Parks and Recreation as part of a future MRS amendment.

Figure 4 shows the current MRS zoning.

City of Kwinana Town Planning Scheme No.2

The City of Kwinana Town Planning Scheme No.2 (TPS 2) currently zones the large majority of the subject land Development, with the exception of the Tramway Reserve on the western boundary, which is shown as Parks and Recreation (MRS) Reserve, and the Bollard Bulrush Wetland core area which is zoned Rural A. The Peel Main Drain is reserved under TPS 2 for Parks, Recreation and Drainage.

A plan showing the current zonings under TPS 2 is Figure 5.



Source: WAPC jsp07o3.pdf

2263-77-01 (02.09.2011), nts

JANDAKOT STRUCTURE PLAN

Wellard Residential : Figure 6

1.3.2 Structure Planning

Jandakot Structure Plan

The subject land is included within the area covered by the Jandakot Structure Plan, a sub-regional structure plan prepared by the WAPC in 2007. The Jandakot Structure Plan provides a broad strategic planning framework to guide future region and local scheme amendments, and local structure plans.

Importantly the Jandakot Structure Plan broadly identifies the entire area of the subject land and surrounds as 'Short Term Urban'. The Jandakot Structure Plan is Figure 6. Many of the more detailed principles of the Jandakot Structure Plan have now been addressed & clarified through the draft Eastern Residential Intensification Concept and as part of the MRS amendment to rezone the land to Urban Deferred, and subsequent transfer to Urban.

Eastern Residential Intensification Concept District Structure Plan (draft)

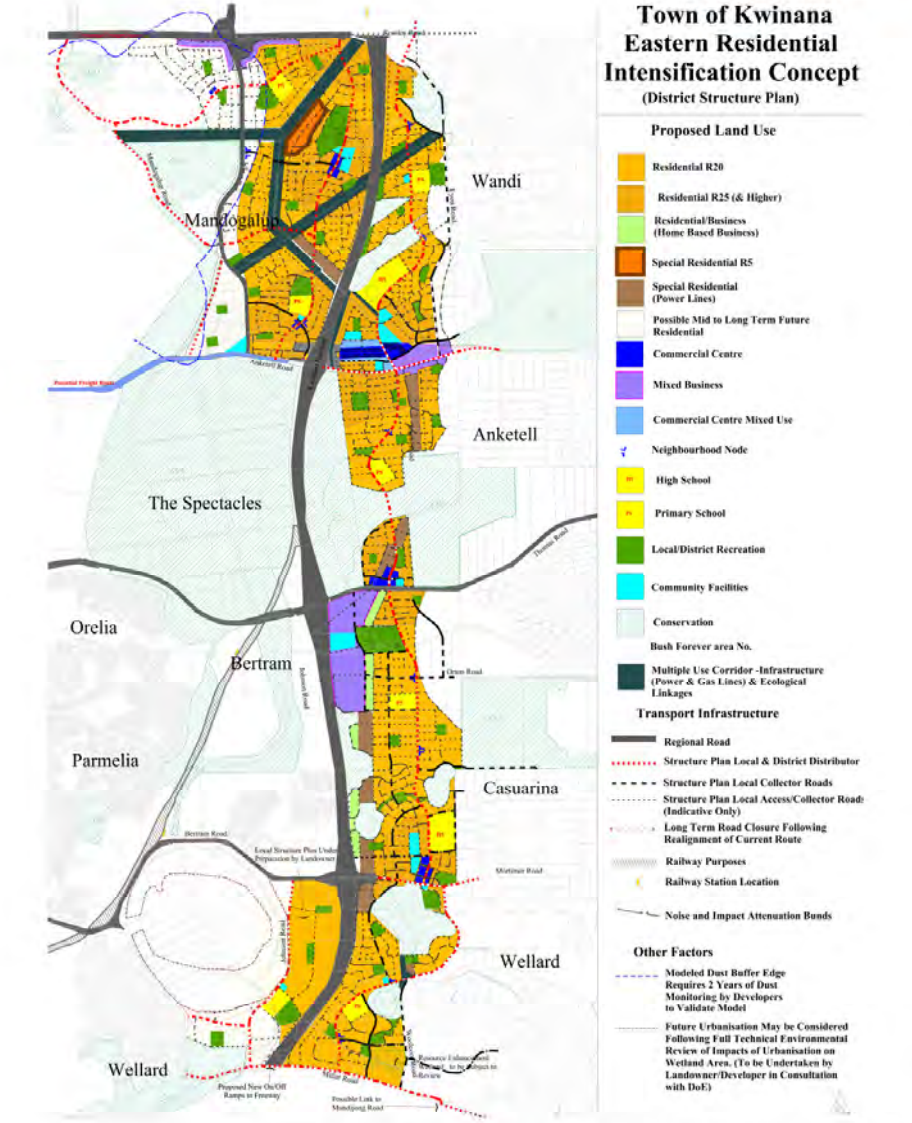
The Eastern Residential Intensification Concept (ERIC) was prepared as a draft by the City of Kwinana in 2005. The ERIC has not been formally adopted by the City of Kwinana or the WAPC following advertising, though it is understood that it is still used as an operational guide for urban development and structure planning by the City. A copy of the draft ERIC is Figure 7.

The draft ERIC is a district level structure plan and identifies a number of urban cells, and provides a broad strategic framework guiding land use, infrastructure and environmental management for each cell.

The LSP area is located within the Wellard (west) cell with the majority of the land identified as 'Possible Mid to Long Range Future Residential'. The draft ERIC notes that future urbanisation over the balance of the land may be considered following full technical environmental review of the impact of urbanisation on the EPP wetland area. Further discussion on the EPP wetlands and the technical environmental review is included in Appendix 1. Importantly, this work has now occurred and is reflected in the Urban zoning of the land.

Other key elements of the draft ERIC which are applicable to the LSP area include:

- Recognition that the subject land has sufficient elevation from groundwater and the wetland area to indicate that it has the potential for urbanisation;
- A half diamond interchange to the Kwinana Freeway at the existing Millar Road underpass (which Main Roads have since confirmed will not be provided);
- Proposed realignment of Johnson Road, crossing the Peel Main Drain and passing through the LSP area. The alignment has been refined in the LSP to connect north south to Millar Road as requested and agreed with the City of Kwinana;



DRAFT EASTERN RESIDENTIAL INTENSIFICATION CONCEPT PLAN

Wellard Residential : Figure 7

- An east / west local distributor connecting the realigned Johnson Road with Wellard Road, reflected in the LSP;
- A primary school and district open space located to the east of the LSP area and Johnson Road.

Further discussion on these elements and how they are addressed through the LSP is provided in part 3 of this report.

1.3.3 Relevant WAPC Policies & LSP Response

The following sections summarise those government policies and strategies that are relevant to the urbanisation and development of the LSP area.

SPP 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning

The LSP area is located in close proximity to the Kwinana Freeway – an existing primary regional road and major transport corridor, as well as the Mundijong Freight railway line. As such, the proposal must be considered in the context of SPP 5.4, which guides noise sensitive development in proximity to major transport routes.

An assessment of the site in the context of both the Kwinana Freeway and the Mundijong rail line confirmed that the easternmost portions of the LSP area are affected by traffic noise generated by the Kwinana Freeway. The same investigation confirmed that the LSP area is not affected by noise or vibration generated by the Mundijong rail line.

In accordance with SPP5.4, a Road Traffic Acoustic Assessment has been prepared by Lloyd George Acoustics. The Acoustic Assessment is prepared in accordance with the parameters of SPP 5.4, and identifies the portions of the LSP area that will require additional noise mitigation / quiet house design. The Acoustic Assessment is included as Appendix 2 to the LSP.

Planning for Bush Fire Protection Guidelines

The WAPC and FESA released Planning for Bush Fire Protection guidelines in May 2010 as a means of outlining the matters that need to be addressed through the planning process in order to protect life and property in the event of a bush fire.

The LSP shares its southern boundary with Bush Forever Area 349. In accordance with the guidelines, a Fire Management Plan (FMP) has been prepared by Southwest Fire Services, refer Appendix 3. The FMP identifies a combination of wider road reserves, building setbacks, and built form treatments in accordance with Australian Standard AS3959 as the best means of ensuring adequate fire protection for future development in affected areas.

The FMP has been prepared in consultation with the City of Kwinana fire and building officers, who have confirmed that those lots that are deemed to be affected are to be constructed in accordance with AS3959 construction standards, as determined and required by the City of Kwinana.

1.3.4 Previous Approvals & Decisions

The WAPC resolved in 2010 to amend the MRS to rezone the Wellard Urban Precinct (west), including the LSP area, to Urban Deferred. This decision was informed by a submission presented by the previous landowners and their consultant team.

Prior to rezoning the land, the proposed amendment was referred to the Environmental Protection Authority (EPA) to determine the level of assessment. The EPA reviewed the proposal, and subsequently set the level of assessment as 'Scheme Not Assessed', noting that a 50m buffer to the EPP Lake will provide adequate protection to the EPP lake and wetland. A copy of the EPA advice is Appendix 4. The LSP provides a minimum 50m buffer to the EPP lake and wetland in accordance with the EPA advice. A portion of the Precinct, including the LSP area has since been transferred to Urban zone.

1.4 Context Analysis

As demonstrated in the District Context Plan at Figure 3, the subject land is one of the last remaining undeveloped sites west of the Freeway within the City of Kwinana that is suitable for urban development. The LSP provides an excellent opportunity to further consolidate urban development in the area, and to ensure that land use and infrastructure planning is integrated and coordinated throughout the district. This is further demonstrated in the sections below.

1.4.1 Transport Routes

The site has convenient access to a number of existing north-south and east-west transport routes, providing strong linkages to a range of activity centres, employment nodes, public transport, and recreational areas.

The Kwinana Freeway provides the primary north-south transport route. The Freeway can be readily accessed via interchanges at Mortimer Road to the north, and Mundijong Road to the south.

Wellard Road has been identified by the City of Kwinana as a future District Distributor, providing a secondary north-south route. Early discussions with the City have indicated an anticipated ultimate traffic volume for Wellard Road in the vicinity of 15 000 vehicles per day at capacity. The LSP provides controlled access to Wellard Road via a roundabout or priority T intersection, ensuring that the future community has a convenient access to the district distributor. A secondary access to Wellard Road is proposed further to the north, improving access and permeability for the north western lots. This access has been identified as a full movement priority T intersection, though it is recognised that it could potentially be downgraded to a left in / left out when Wellard Road is constructed as a dual carriageway with a divided median.

The City of Kwinana has also identified Johnson Road as a local distributor within the district hierarchy. Johnson Road is expected to carry relatively low volumes of north-south traffic, with an estimated volume of 1 260 - 2 100 vehicles per day at capacity. Consistent with the draft ERIC, the LSP proposes to realign Johnson Road through the centre of the LSP area, enhancing the function of the local distributor. Discussions with the City have confirmed anticipated volumes for the realigned Johnson Road will not exceed 3 000 vpd.

East-west transport routes are currently provided via Millar Road to the south, including a Freeway underpass linking the future industrial area to the south east with the Kwinana town centre and surrounds. The LSP provides a direct connection to Millar Road via the realigned portion of Johnson Road.

Bertram Road also provides an east-west connection further to the north, linking Wellard Village to the Kwinana Freeway at the Mortimer Road interchange.

A comprehensive Traffic and Transport Assessment has been prepared by Bruce Aulabaugh, traffic consultant, and is included as Appendix 5. The Traffic and Transport Assessment identifies the existing transport routes and road hierarchy, and ensures that the LSP is appropriately integrated into the existing network.

1.4.2 Services and Infrastructure

As demonstrated in the servicing strategy included as Appendix 6, the subject land can be readily serviced, with essential infrastructure already available in the area. The servicing strategy demonstrates how infrastructure provision to the LSP area can be integrated with the existing infrastructure in the broader district. As such, servicing and timely provision of service infrastructure is not a constraint to development.

1.4.3 Activity Centres and Employment Nodes

The LSP area is located in close proximity to a number of activity centres and employment nodes, ensuring good accessibility to commercial services, and providing excellent opportunities to achieve employment self sufficiency targets prescribed in Directions 2031 and Beyond.

The Kwinana Secondary Centre (approx 4km) and Rockingham Strategic Metropolitan Centre (approx 12km) are both easily accessible from the LSP area, providing employment opportunities, as well as convenient access to commercial and retail services, and community facilities. A small local centre is planned for Emerald Park (Wellard West), located immediately to the north-east of the LSP area adjacent to Johnson Road and approximately 500m from the centre of the LSP area. The local centre will provide local convenience facilities to the future community within the LSP area.

There are a number of major existing employment nodes in the Kwinana and Rockingham areas including the Western Trade Coast, Kwinana Industrial Area, Australian Marine Complex, Kwinana Secondary Centre, Rockingham Strategic Metropolitan Centre, and Jandakot airport. In addition, there are expansive areas of planned industrial development including Latitude 32 industrial area, North-East Baldivis, and East Rockingham. Development of the subject land is a logical solution to increasing the local employment catchment, which is critical to achieving the employment self sufficiency targets set by Directions 2031 and Beyond.

1.4.4 Reserves, Open Space and Community Infrastructure

The LSP area has excellent access to a range of regional and district level open space and community infrastructure. The land is bounded to the south and west by regional MRS Parks and Recreation reserves, providing a variety of regional level passive open space within proximity to the site.

The LSP area also has good access to district active open space, with the Orelia district open space in close proximity, and the planned sub-regional open space at Thomas Oval also easily accessible from the LSP area.

A local sporting ground along with a sporting pavilion is identified in the Wellard West (Emerald Park) Local Structure Plan to be located in the southern portion of the Emerald Park estate. This active open space is within a walkable catchment of the LSP area and provides a complimentary local active open space for the LSP area.

The City of Kwinana has prepared an amendment to TPS 2 which creates a mechanism for the provision for regional, district and local level community facilities included via a development contribution plan (DCP). The DCP is informed by a draft Community Infrastructure Plan that identifies the specific type and location of community infrastructure to be funded via the DCP.

In addition to the infrastructure identified in the DCP, there is a planned government primary school immediately to the west of the subject land in Emerald Park, which can service the subject land once developed. The Department of Education was consulted during the preparation of the LSP, and confirmed that the primary school would have sufficient capacity to accommodate the future population of the LSP area. The Department intends to construct the school by 2013/2014 in recognition of the growing population in the area. The school is co-located with approximately 3.5ha of active open space, providing for the planned local sporting facility and pavilion.

The King's College is an existing private K-12 school located to the north of the site between Bertram Road and the northern end of the Bollard Bulrush Wetland, while there are numerous existing government primary and secondary schools in the area that are easily accessible from the subject land.

2.0 SITE CONSIDERATIONS

2.1 Environmental Assets & Constraints

The subject land is substantially unconstrained and environmental factors affecting the land, including protection of wetlands, groundwater, drainage, and bushfire management can be managed through standard mechanisms via the implementation of management plans at the subdivision stage.

A comprehensive Environmental Assessment Report (EAR) has been prepared by PGV Environmental, and is included as Appendix 1. The EAR includes a vegetation survey, flora and fauna analysis, desktop heritage analysis and wetland management strategy. The EAR concludes that:

- There are no Threatened Ecological Communities, Declared Rare and Priority Flora species within the LSP area.
- There are no fauna species of conservation significance within the LSP area.
- The development buffers provided to the EPP Lake (50m) and Resource Enhancement Wetland (30m), in accordance with the EPA's advice and DEC standard recommendation, are sufficient to ensure that development of the LSP area will not compromise the ecological values of the Bollard Bulrush Wetland.
- There is limited remnant vegetation on the site due to historic clearing and grazing. The existing vegetation condition is predominantly classified as 'Completely Degraded', with only a small pocket of vegetation in the south-west corner of the LSP, adjacent to the Bush Forever reserve that is classified as 'Very Good', which is recognised in the LSP concept.
- The LSP area currently contains introduced plant species that are classified as 'Declared' weeds under the Agriculture and Related Resources Protection Act 1976. Development of the subject land will create opportunities to manage and eradicate these species.

The City of Kwinana has advised that the adjacent Bush Forever Area 349 may contain suitable foraging habitat for Carnaby's Black Cockatoo.

2.2 Landform & Soils

The topography and soil types within the LSP area are similar to surrounding urban areas and are not constraints to development. The ultimate earthworks design will respect the current landform through the minimisation of retaining walls, and recognition of the general fall of the site from south to north towards the Bollard Bulrush wetland.

The LSP area is predominantly flat, supporting varying geomorphological features of the wetland depression in the northern corner of the LSP area, and the relatively low relief sand dunes in the south. The northern edge of the LSP area adjacent to the Bollard Bulrush Wetland has a level of approximately 4m AHD. The southern portion of the site is higher than the Bollard Bulrush Wetland, with a level of between 5 and 10m AHD. The highest points are located in the southern portion of the site on Lot 1278, and towards the Johnson Road portion of the LSP area. The relatively flat nature of the site ensures that the site can be drained and serviced without the need for substantial retaining, or significant changes to the topography.

Soil types within the LSP area range from Bassendean and Spearwood sands, and sandy silts typical of the Beeliar Wetland chain. The south and west of the LSP area are predominantly sandy soils, providing free draining soils suitable for urban development. Further discussion on soil types and drainage is provided in sections 3.4 and 3.5 and the Local Water Management Strategy at Appendix 7.

2.3 Ground & Surface Water

Management of ground and surface water is comprehensively addressed through the Local Water Management Strategy (LWMS) at Appendix 7, and is not a constraint to development. The LWMS is consistent with the DWMS, which was approved by the Department of Water in August 2011.

The existing hydrological conditions are summarised below, while the key principles of the LWMS are outlined in section 3.5 of the LSP.

Surface water flows are currently conveyed across the LSP area via a series of local drains and sheet flow, to discharge into the Bollard Bulrush wetland and Peel Main Drain. The Wetland area provides detention storage, slowing the flows before entering the Peel Main Drain.

Groundwater flows are generally towards the Bollard Bulrush Wetland and Peel Main Drain. Maximum Groundwater Levels (MGLs) range from 5.01m AHD in the south, to 4.23m AHD in the north of the LSP area. The majority of the LSP area is approximately 0.03m – 4.67m above the MGL, with the exception of the northernmost portion of the LSP area, where the ground level and MGL meet, coinciding with the edge of the Wetland. The earthworks and drainage strategy, in response to the MGL's, is discussed further in Section 3.6.7.

The LWMS proposes to retain pre-development flow rates to ensure that water quality and quantity is not adversely affected.

2.4 Fire Management

In accordance with the recommendations of the WAPC's Planning for Bush Fire Protection Guidelines, a Fire Management Plan (FMP) has been prepared by Southwest Fire Services, and is included as Appendix 3. The FMP concludes that bush fire risk is not a constraint to development in the LSP area, and any risk can be managed through the implementation of an adequate hazard separation zone, and by requiring minimum standards of construction for those dwellings that abut the hazard separation zone.

In accordance with the FMP, the LSP ensures that adequate separation is provided between Bush Forever Area 349 and the future urban area via a 23m wide road interface. The combination of the 23m road interface and 6m building setback provides an adequate hazard separation zone in accordance with the Bush Fire Protection Guidelines. As agreed with the City of Kwinana fire and building officers, the first row of houses facing the Bush Forever reserve are to be constructed to satisfy the BAL-12.5 construction standard in accordance with AS 3959, to provide adequate protection in the event of a bush fire. This can be addressed via a Detailed Area Plan or other statutory mechanism as a condition of subdivision.

2.5 Noise Management

The site is in close proximity to the Kwinana Freeway and the Mundijong freight rail line, and as such, the development proposal must have regard to the WAPC's SPP 5.4 – Road and Rail Transport Noise and Freight Considerations in Land Use Planning.

An Acoustic Assessment has been prepared by Lloyd George Acoustics in accordance with SPP 5.4, and is included as Appendix 2 to the LSP. The Assessment uses detailed noise modelling to determine any potential impact from the adjoining Freeway and rail line on noise sensitive uses. The Assessment concludes that while portions of the LSP area are deemed to be affected by Freeway noise, this is not a constraint to development and can be addressed through a combination of open space buffers, noise walls and quiet house design.

The southernmost portion of Lot 2 Johnson Road is affected by noise from the freight rail line. Again, this is not a constraint to development, and can be addressed through a combination of open space buffers, noise walls and quiet house design.

Impacts of rail vibration have also been taken into consideration as part of a preliminary desktop assessment. The nearest residential dwelling will be greater than 25m from the rail line, and as such satisfy the DEC's requirements with respect to rail vibration.

2.6 Heritage

Previous surveys for Aboriginal archaeological and ethnographic sites, as well as a search of the Department of Indigenous Affairs database, have not identified any archaeological sites in the LSP area.

The City of Kwinana's Municipal Heritage Inventory (MHI) identifies the Tramway Reserve, forming the western boundary of the LSP area, as having cultural heritage significance for its historic context as a supply route. There are no buildings or structures within the Tramway Reserve that have recognised heritage significance.

The MHI identifies the tramway reserve as a 'Management Category B' site, and notes that its significance arises from its historic value as a former tramway alignment. The MHI describes this category as having to provide a "high level of protection for places of considerable cultural heritage significance to the City of Kwinana."

As noted previously, the Tramway Reserve is reserved under the Metropolitan Region Scheme for Parks and Recreation. The LSP does not propose any development within the Reserve; however, there are opportunities to incorporate the Reserve into the broader open space network, and to improve the reserve as part of the LSP so that the heritage significance can be suitably recognised.

The MHI also identifies the 'Wellard Swan/Bollard Bulrush Swamp' as having cultural heritage significance for its Aesthetic and Historic value. The Swamp is listed as Management Category A. The LSP does not propose any development or modification to the Swamp, and as such its significance remains intact.

A desktop heritage assessment is included in Appendix 1.

2.7 Area of Landscape Protection

The LSP area and broader surrounds fall within an 'Area of Landscape Protection' pursuant to clause 6.16 of TPS 2. An Area of Landscape Protection is a form of Special Control Area under the Scheme, and prescribes matters to which Council should have regard in considering development proposals. These matters include:

a. the overall impact of the proposed development on the landscape amenity of the area;

b. the need for an overall management plan prepared by Council in consultation with the affected landowners as a prerequisite to any Planning Approval being issued;

c. the extent to which any subdivision proposal should guarantee the protection of natural ecological features and areas of landscape amenity;

d. the desirability of minimizing the effect of new road construction, including earthworks and clearing of vegetation within road reserves.

In order to demonstrate that the proposal satisfies the abovementioned criteria, the proponent has undertaken a comprehensive Landscape and Visual Study, with a specific focus on Lots 167-169 Wellard Road, in the north western precinct of the LSP area. A copy of the Study is Appendix 9, and further discussion of the recommendations is included in section 3.2.5.

LSP DEVELOPMENT CONCEPT PLAN

2263-80A-01 (24.04.2012), nts

Wellard Residential : Figure 8

3.0 LOCAL STRUCTURE PLAN

3.1 Plan Overview & Land Use Description

The LSP presents an opportunity for robust and environmentally responsive urban development that respects the natural amenity of the area, while forming an important addition to the Wellard community as an infill development project.

The LSP Concept Plan at Figure 8 indicatively demonstrates how development could occur on the site consistent with the LSP principles and requirements, while the LSP Statutory Plan at Figure 23 provides the statutory framework and development principles, based on the Concept Plan. The Concept Plan represents just one way development could occur within the framework of the statutory plan; the final subdivision plan will be a further refinement of the concept plan, consistent with the statutory plan.

The fundamental principles of the LSP are:

- Enabling the creation of a diverse range of high quality housing choices that appeal to a broad section of the market, that address and survey public spaces and recognise the site's context adjoining a Wetland and Bush Forever.
- Providing robust urban form and land use response that recognises the site's location within the broader district context.
- Acknowledging the natural landscape through the inclusion of view corridors, extensive planting within the Tramway Reserve, and retention, where possible,of existing vegetation and ground levels within areas of open space throughout the site.
- Providing a range of services and infrastructure to support the future community.
- Delivering a permeable, interconnected road and path network encouraging and facilitating multi-modal transport outcomes.
- Addressing the principles of the draft ERIC through the realignment of Johnson Road.
- Delivering a network of public open space meeting local active and passive, conservation and drainage needs, as well as allowing for planned and unplanned community activity.
- Recognising high quality vegetation and landform within public open space throughout the LSP area.

Based on these principles, the LSP provides the framework for:

- Approximately 770-790 residential lots, and potentially up to 820 dwellings when including density sites, over the LSP area. Higher densities are focussed around neighbourhood connectors, public transport routes, and key areas of open space, and transitional densities providing a suitable interface to the wetland and Bush Forever, recognising they do not provide a context for high density development.

This page has been left blank intentionally

- Approximately 22ha of open space overall, including the Bollard Bulrush Wetland Core, Tramway Reserve, wetland buffers, wetland interface and remnant vegetation and neighbourhood parks.
- Approximately 12ha of public open space in addition to the Wetland Core, meeting active and passive recreation, drainage and cultural heritage objectives, as well as exceeding the 10% minimum public open space requirement of Liveable Neighbourhoods.
- Integration of the historic Tramway Reserve into the open space network, improving connectivity to communities to the north via an open space corridor, whilst also recognising the cultural heritage significance of the Tramway Reserve.
- Recognition of areas of remnant vegetation and mature trees within passive public open space.
- Provision of a managed interface to the EPP Lake and Resource Enhancement Wetland, ensuring that the development will not compromise the function of the wetland, and recognising the natural landform of the area. In accordance with the EPA's advice on MRS Amendment 1189/57 development is outside the 50m buffer to the EPP Lake. It addition the plan provides a 30m buffer to the Resource Enhancement Wetland.
- Provision of a managed interface to the Bush Forever reserve, ensuring the provision of adequate bush fire separation, management of introduced weeds, and controlled access.
- Inclusion of view corridors in open space and road reserve, recognising the views of the wetland area from Wellard Road and Homestead Ridge estate, as requested by the City of Kwinana.
- A permeable grid of local distributors and local access streets that is responsive to the existing district road hierarchy, while providing opportunities for future public transport, cyclist and pedestrian connections to the district network.
- Integration of the LSP area with the adjacent primary school and local sporting ground with senior oval through the realignment of Johnson Road, and provision of a crossing over the Peel Main Drain, as requested and agreed with the City of Kwinana.

3.2 Residential

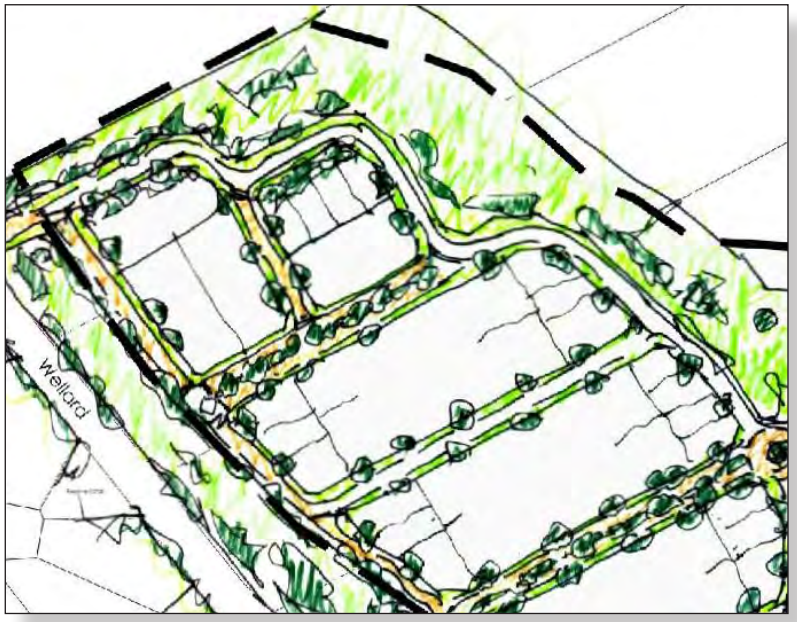
3.2.1 Housing Principles

The LSP provides a structure for the delivery of a diverse range of climate responsive housing, achieving residential density targets specified under state policy.

A diverse mix of lot and housing typologies will be achieved. There may be opportunities for the proponent to build out pockets of housing to deliver a range of housing types and amenity. The following provides a brief description of the housing typologies that could be delivered within the LSP area.

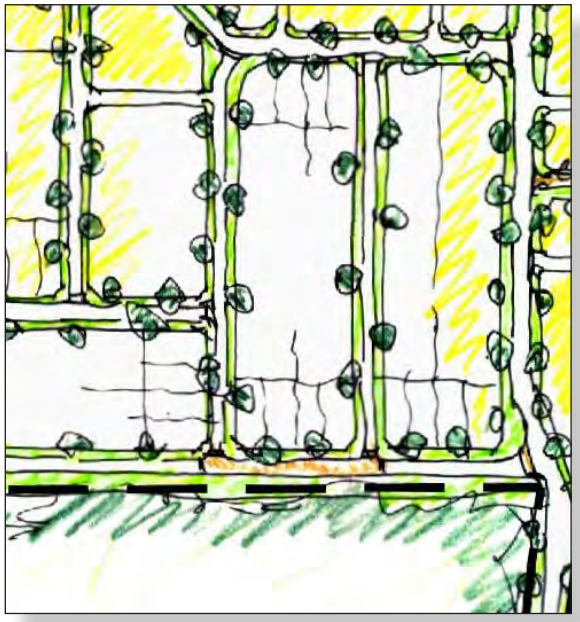
Traditional Home Site Examples

TRADITIONAL HOME SITES	
Typical Width	17m+
Typical Depth	30m +
Area	600m^2 to 900m^2
Residential Density Code	Residential R20
Built Form Control	• Residential Design Codes • DAP's • Design Guidelines
Built Form Delivery	• Single dwellings • Typically sold as land only



Contemporary Front Loaded Lot Examples

CONTEMPORARY FRONT LOADED LOTS	
Typical Width	12.5m -17m
Typical Depth	• 30m • 22 - 25m
Area	300m^2 to 600m^2
Residential Density Code	Residential R30
Built Form Control	• Residential Design Codes
Built Form Delivery	• Single dwellings • Typically sold as land only

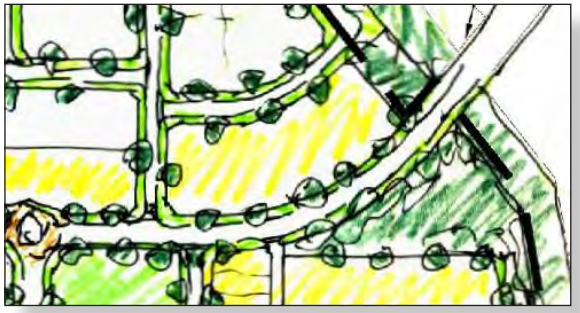


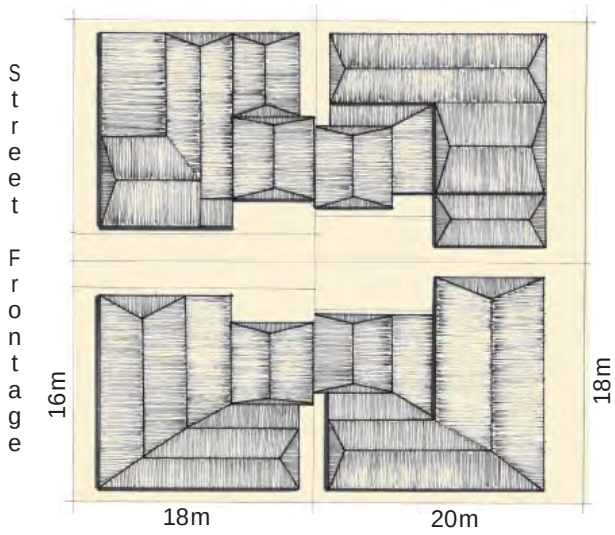
Cottage Lot Housing Examples

COTTAGE LOT HOUSING	
Typical Width	7.5m - 12m
Typical Depth	28m to 30m
Area	210m^2 to 360m^2
Lane access	Rear laneway provided for vehicular access
Residential Density Code	• Residential R30/R50 • Opportunities for corner duplex lots at R50 to improve surveillance of laneways and secondary streets
Built Form Control	• Residential Design Codes • Detailed Area Plans
Built Form Character and Delivery	• Single and grouped dwellings • Potential for studios over garages • Lots less than 10m wide typically built out and sold as a house and land package • Opportunities for innovative delivery of housing on narrow lots • Opportunities for terrace housing abutting POS

Four Pack Housing Examples

FOUR PACK HOUSING	
Typical Width	36m
Typical Depth	38m
Area	• 1368m² • front lots 288m² • rear lots 360m² (excluding access leg)
Residential Density Code	Residential R50
Built Form Control	• Residential Design Codes • DAP's
Built Form Delivery	• Single and grouped dwellings • Potential for studios over garages • Typically built out and sold as house and land packages • Rear dwellings have primary frontage to the rear





The delivery of quality housing is a key objective, ensuring the housing style and character reflects the amenity and attributes of the area. Key principles will be housing that addresses and surveys public spaces, incorporation of solar passive design principles for private outdoor living areas and ensuring garages / carports are appropriately located. This will be implemented through Detailed Area Plans, discussed in Section 3.2.4 and potentially Design Guidelines (to be determined by the proponent).

3.2.2 Lot Yield and Density Estimates

The LSP will deliver a range of densities, housing types and tenures to facilitate residential yields commensurate with the strategic and statutory planning framework, as well as the site's location within the broader district context.

The LSP has the potential to realise approximately 770-790 residential lots, or up to 820 dwellings, at densities ranging from R20 to R50, based on the following principles:

- The majority of the LSP area has a density code of R30, providing opportunities to deliver traditional front loaded lots, ranging in size from approximately 300m^2 – 600m^2.
- Larger lots are located in the north western portion of the site, coded R20, ensuring a suitable transition to the rural land to the north. Lot sizes are likely to range from 600m^2 up to approximately 900m^2, providing a suitable transition in lot sizes between the contemporary lots to the south and east, and potential larger lots to the north.
- Medium density R50 coded lots are located through the centre of the LSP area adjacent to the central open space, the planned east-west bus route, as well as primary school and local centre to the east. This coding provides opportunities to deliver contemporary cottage style housing with rear lane access, as well as grouped housing options. Single house lot sizes will generally range from 200 m^2 up to 360 m^2.

Directions 2031 and Beyond recommends a housing density target of 15 dwellings per gross urban zoned hectare. The need for density targets to encourage more efficient and effective housing is acknowledged. However, it is important that the application of these targets recognises the impact of site specific constraints on the ability to actually deliver density.

The LSP recognises the need to deliver specific densities, and balances this with the recognition of a number of site specific environmental and land use constraints including:

- Wetland conservation buffers including EPP lake buffers and Resource Enhancement wetland buffers;
- Bush fire separation setbacks;

- Freeway noise buffers;
- A 20m wide strip of urban land connecting Millar Road to the LSP area that is not sufficiently wide to allow for urban development, other than the construction of a road;
- City of Kwinana requirements for lower density 'transition zone' and inclusion of view corridors in the north western portion of the site;
- Retention of 1 in 100 year stormwater runoff and retaining existing site hydrology;
- Provision of approximately 14% of the gross site area as multi-purpose public open space, in addition to the tramway reserve.

Once these land constraints are taken into consideration, the actual developable residential area is considerably less than the gross urban area.

In addition, consistent with the existing strategic planning framework, the LSP does not include any provision for activity centres, rail stations or employment generators which would warrant a higher density response.

Despite this the LSP delivers the potential for approximately 14.14 dwellings per gross urban hectare based on ceding of the Bollard Bulrush Wetland Core and the Tramway Reserve, and deduction of public open space areas in excess of 10% of the gross urban area, on the basis of the betterment of the wetland buffer, Tramway Reserve and Public Open Space.

3.2.3 Residential Density Coding

Allocation of residential density codings across the LSP area establishes a flexible framework for a diverse range of housing types. Density codes are allocated based on the following criteria:

- In recognition of the value in retaining view corridors, providing a more traditional housing type, and a suitable interface to the Wetland and land to the north, the north-west portion of the site is R20.
- The R20 density coding transitions to a base coding of R30 across the balance of the development area allowing for both traditional and cottage lots.
- Densities of up to R50 are located closest to the central open space and key transport routes.

3.2.4 Development Standards: R Code Variations

Detailed Area Plans (DAPs) will be prepared as condition of subdivision approval for select lots to ensure the delivery of quality built form and allow variations to the Residential Design Codes to facilitate medium density housing. DAPs will be prepared for:

- Residential R50 density sites
- Cottage Lots
- Lots directly abutting public open space
- R20 coded lots in area of Landscape Protection

A series of R Code variations have been developed to support the delivery of the standard small cottage lot (R50) housing typologies outlined above.

These provisions are subject to further discussions to determine optimum built form outcomes for the development, and DAP's require approval by the local authority at subdivision stage.

The following outlines the key provisions and provides a brief explanation as to their application and benefit.

Setbacks - Reduced setbacks to the primary street for lots with vehicular access to a public laneway (2m minimum and 4m maximum, with porticos, verandahs or similar permitted to 1.5m);

At present the R Codes require an average 4m setback from the primary street with a minimum of 2m to the dwelling in areas coded R50.

The variations propose a minor relaxation to the front setback requirements with the 4m setback a maximum rather than average to facilitate flexibility in building design, as well as reinforcing engagement with the public realm. In particular, the setback variation will:

- bring the dwellings forward to address and engage with the street in a more interactive manner than a traditional street setback
- allow 'tight' urban streetscapes, consistent with the urban context for laneway lots
- allow efficient siting and sizing of the private open space/ outdoor living areas at the rear of the dwelling, maximising the use of land, and reducing unusable open space.

Boundary Walls - Permitted boundary walls on both side boundaries (with the exception of laneway and street boundaries) in accordance with the following table:

BOUNDARY WALLS		
Description	**Max. Height**	**Max Length**
Dwelling – Single Storey	3.5 m	No Limit
Dwelling – Two Storey	6.5 m	12 m
Garage – Single Storey	3.5 m	7 m
Garage – Two Storey (with portion of dwelling above)	6.5 m	7 m

The R Codes currently allow as of right a single storey boundary wall for up to two thirds of the length of one boundary within R50 coded areas, with no second storey boundary walls. This precludes terrace style development, restricts design options on smaller lots where efficient use of space is critical, and discourages two storey development. Greater flexibility is needed if housing forms are to respond to density and solar imperatives.

Allowance for walls on both side boundaries for the length of the boundary is proposed, with a restricted length of 12m for the second storey, or 7m where the garage is incorporated as part of the two storey development. This allowance provides sufficient flexibility to encourage two storey built form, while achieving a reasonable level of amenity protection for adjoining properties.

Private Open Space - *Minimum open space provided reduced to a minimum of 30% of the site area.*

The R Codes currently require 45% of the site to be retained as open space at R50, which severely limits single storey dwelling design on smaller lots, undermining affordability imperatives.

A variation in the minimum open space provision to 30% is necessary to successfully achieve and implement terrace housing, facilitating the delivery of affordable and diverse dwellings.

Reductions in open space are contingent upon provision of an outdoor living area of 20m² with minimum dimension of 4m.

Design for Climate - *The overshadowing provisions shall not apply.*

Greater flexibility in regards to overshadowing requirements has been incorporated as a necessary prerequisite to achieving the densities and housing diversity outlined in this report.

The standards for overshadowing applicable to lower density areas cannot reasonably be applied in the same way in higher density precincts without severely impacting on the quality of dwellings. For example, the overshadowing provisions would limit, or in some

situations preclude the majority of single storey development on the 8m and 10m wide cottage lots, and would preclude almost all two storey development. It is important that there is no disincentive to the construction of two storey dwellings to encourage this housing form. As such, the overshadowing standards do not apply.

Privacy – *The setback to major openings and unenclosed outdoor active habitable spaces (balconies, verandahs, terraces or other outdoor living areas) that have a floor level more than 0.5m above natural ground level and overlook any part of any other residential property behind its street setback line, shall be setback in direct line of slight with a cone of vision from a boundary to a minimum of 4.5m for all laneway lots.*

Like overshadowing, the standards for privacy applicable to lower density areas cannot be applied in the same way in higher density precincts without severely impacting on the quality of dwellings. For example, the 7.5m balcony privacy setback would preclude provision of balconies on almost all of the R50 lots due to the narrowness of lots.

Again, greater flexibility in regards to these requirements has been incorporated as a necessary prerequisite to achieving the densities and housing diversity. As such, the standard privacy provisions do not apply to the R30 and R50 areas, with a reduced privacy setback of 4.5m applying to major openings to all habitable spaces, including bedrooms and balconies. This approach is widely accepted by the building industry, local authorities and WAPC in other new residential communities.

Public Open Space – *Dwellings and major structures on lots adjoining public open space to be setback between 2 and 3m, dwellings designed to address the open space and outbuildings abutting open space of materials that complement the dwelling.*

Typically the interface to public open space will be via roads; however in some instances direct lot frontage can provide increased surveillance, activity and diversity to the public spaces. Lots adjoining open space will be provided in accordance with Liveable Neighbourhoods principles.

Where lots do interface with open space it is critical to ensure the adjoining housing addresses and adds value to the open space. This includes appropriate setbacks and major openings addressing the space, rather than nil setbacks and blank walls. It is also important to ensure outbuildings do not undermine the amenity of the interface.

Surveillance - Surveillance of laneways and secondary streets is required through appropriate building design, location of major openings to habitable spaces, and inclusion of lofts/studios.

Secondary street fencing will be visually permeable in accordance with the City of Kwinana's Residential and Subdivision Guidelines Policy 3.3.30.

The DAP's could be complemented by Design Guidelines prepared and implemented by the developer for particular housing precincts. This will be determined at subdivision stage by Wellard Residential.

3.2.5 Landscape Protection Area

The north western precinct of the LSP area, comprising lots 167 – 169 Wellard Road falls within an Area of Landscape Protection pursuant to TPS 2, and has been identified by the City of Kwinana as an area requiring a specific design and built form response in order to ensure that the landscape amenity is retained.

At the request of the City of Kwinana, the landowners have prepared a Landscape and Visual Study in order to identify the most appropriate design and built form response for this precinct. A copy of the Landscape and Visual Study is Appendix 9.

The Landscape and Visual Study recommends the following design and built form control features for this north western precinct:

- Inclusion of an open space interface on the northern boundary of lot 167 to provide a transition to the land to the north, and a view corridor to the wetland, corresponding with the Farrier Court cul-de-sac on the opposite side of Wellard Road;
- Reconfiguration of development on lot 167 to retain views towards the wetland when travelling south on Wellard Road, and to create an irregular urban edge;
- Inclusion of larger lots of approximately 600m² – 700m² on lot 167, providing a graduated transition to the Urban Deferred zoned land to the north;
- Inclusion of wider landscaped local road reserves of approximately 18-21 metres for those roads which align with public vantage points within the Homestead Ridge estate, preserving and framing views towards the wetland from the public realm;
- Development of a landscaped and vegetated visual screen within the Tramway Reserve adjacent to Wellard Road, retaining the existing character of the site and minimising any visual impact on those properties fronting Wellard Road.

The abovementioned elements have been incorporated into the LSP design to ensuring that the LSP respects the visual amenity of the area.

In addition to the urban design, the Study recommends restrictions on roof colour, limited to "dark recessive colours that are not visually prominent in respect to the local landscape." These additional recommendations relate to matters of detailed design, and can be addressed via Detailed Area Plans at subdivision and construction stage.

This page has been left blank intentionally

3.3 Activity Centres

As noted in section 1.4.3, the LSP area is located in close proximity to the planned Local Centre/Neighbourhood Node immediately to the north of the primary school on the eastern side of Johnson Road. The planned Local Centre is identified in the Wellard West Local Structure Plan as a small convenience store of approximately 100-200m2 GLA, with associated community based uses.

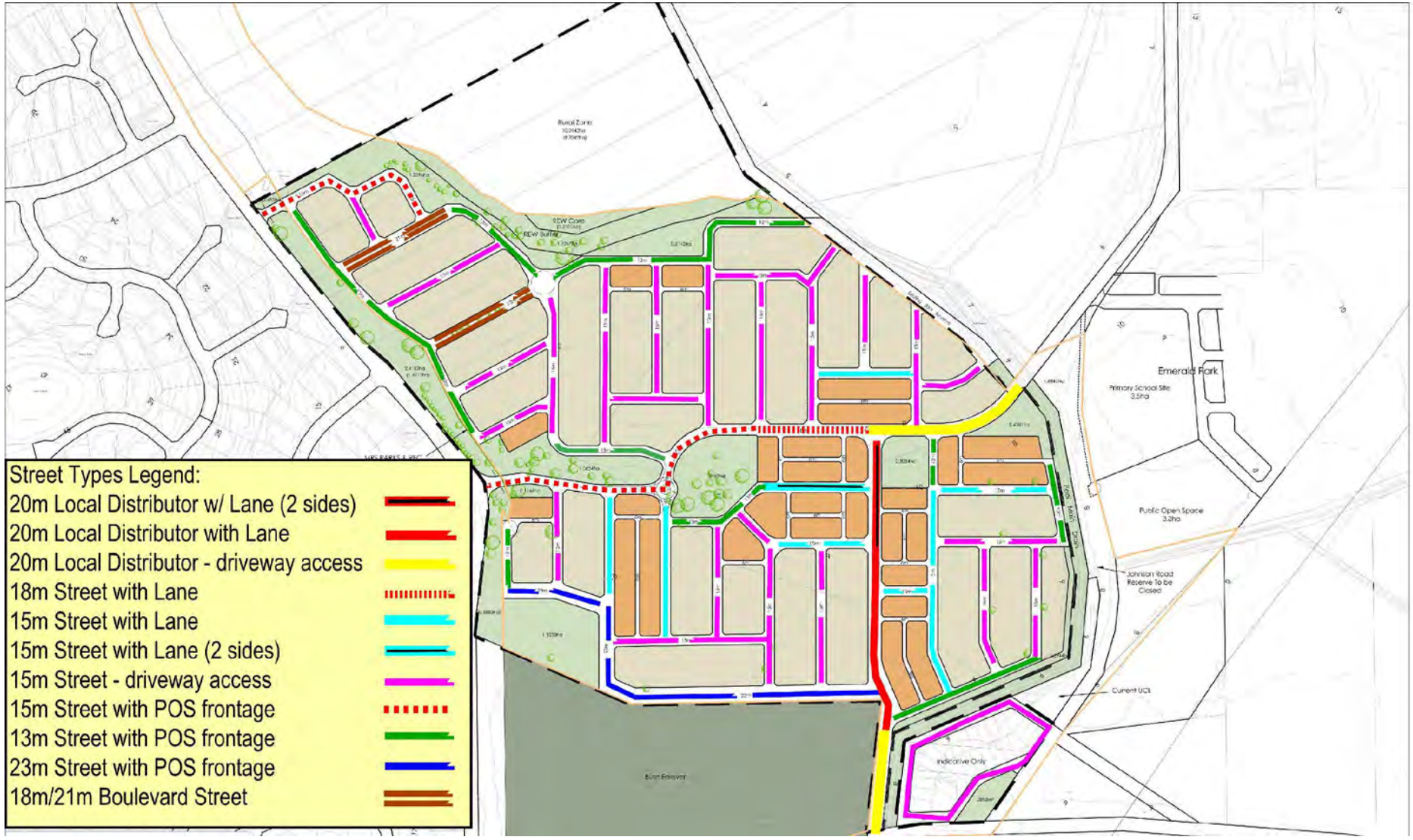
In general, the viability of Local Centres is typically determined by the following elements:

- The residential population within the walkable catchment;
- The amount of passing vehicle trade; and
- Competition with other centres in the locality.

The planned Local Centre has reasonable exposure to passing vehicle trade using Johnson Road, and has limited competition from other centres in the locality for local convenience retail. Considered in isolation however, the Local Centre has only a very limited population within the walkable catchment at present, due to the high proportion of non residential land uses within the catchment, including the Kwinana Freeway, and the Rural zoned land to the west of Johnson Road.

The Wellard Residential LSP will improve the viability of the planned Local Centre by:

- Increasing the residential population within the 800m walkable catchment of the Centre, thereby improving opportunities for local, non car-based patronage; and
- Increasing passing trade on Johnson Road through its realignment, and through the increase in residential population.



Source: Bruce Aulabagh Traffic Engineering & Transport Planning

2263-81A-01 (04.05.2012), nts

STREET TYPES

Wellard Residential : Figure 9

3.4 Movement Network

Traffic and transport aspects of the LSP have been analysed and assessed in the context of the information provided by the City of Kwinana, the Jandakot Structure Plan, the draft ERIC, and Element 2 of Liveable Neighbourhoods.

A detailed traffic and transport analysis has been prepared by Bruce Aulabaugh, Traffic Consultant, and is included as Appendix 5 to the LSP. The key findings and recommendations of the analysis are summarised below.

3.4.1 Road Network, Capacity and Arterial Road Access

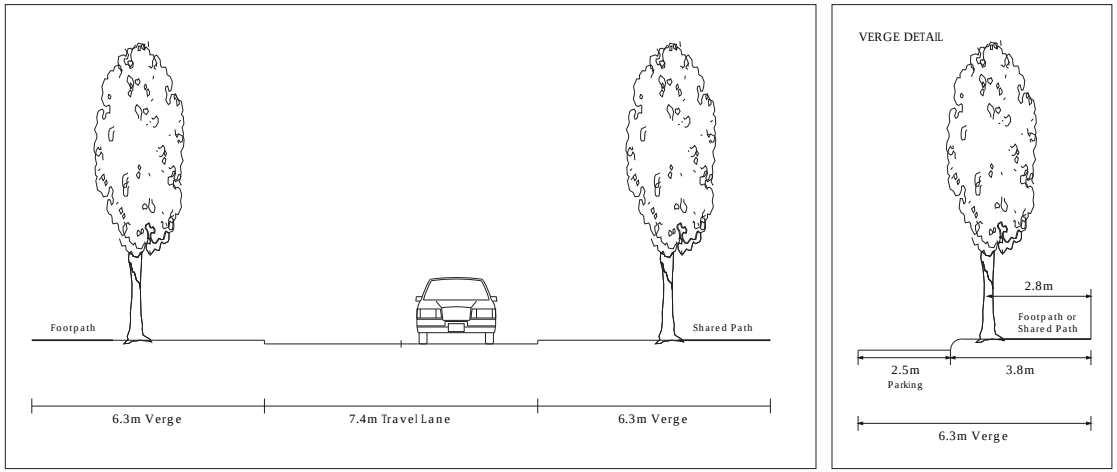
The Street Types plan in Figure 9 identifies the proposed local road network, including the identification of a hierarchy of local distributor roads and access streets within the LSP area.

The realigned Johnson Road is identified as a local distributor, connecting through the LSP area via a new crossing over the Peel Main Drain in the north eastern section, and passing through the LSP area to link with Millar Road in the south where Johnson Road terminates. The realigned Johnson Road is forecast to carry approximately 1800-2100 vehicles per day, significantly less than the Liveable Neighbourhoods 5,000 vpd threshold which limits direct vehicle access from residential lots. The Johnson Road alignment and treatment has been extensively discussed with the City of Kwinana, and the LSP reflects the agreed alignment.

The LSP provides a key local access road linking Wellard Road in the west with the realigned Johnson Road in the centre of the LSP area. This local access road is forecast to carry approximately 2,200 – 2,800 vpd, and provides a strong east-west link through the LSP area, without compromising the functional road hierarchy, or disrupting the local movement network throughout the LSP area.

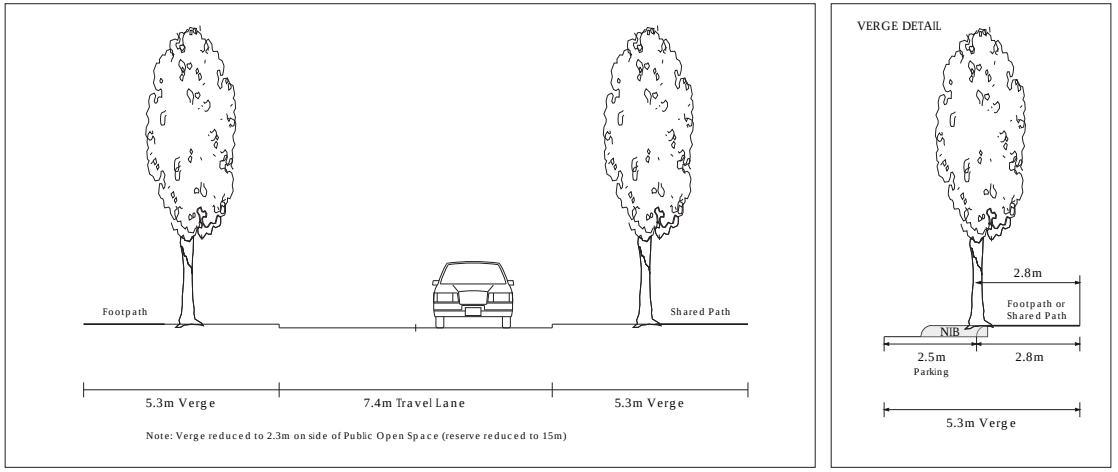
The remainder of the road network comprises of local access streets, supporting short trips for local traffic to and from the residential areas. The local road network is based on a modified grid layout, providing strong north-south and east-west connections throughout the LSP area. Perimeter local roads abutting the Bush Forever site to the south, and the wetland areas to the north provide a hard edge interface to these features, as well as allowing for local access. Traffic volumes on these 'interface' roads are estimated to be less than 1,000 vpd.

The estimated traffic volumes and road hierarchy are consistent with the City of Kwinana's latest traffic and transport planning, the draft ERIC, and the indicative volume range provided in Liveable Neighbourhoods.



STREET CROSS SECTION - LOCAL DISTRIBUTOR

Wellard Residential: Figure 10

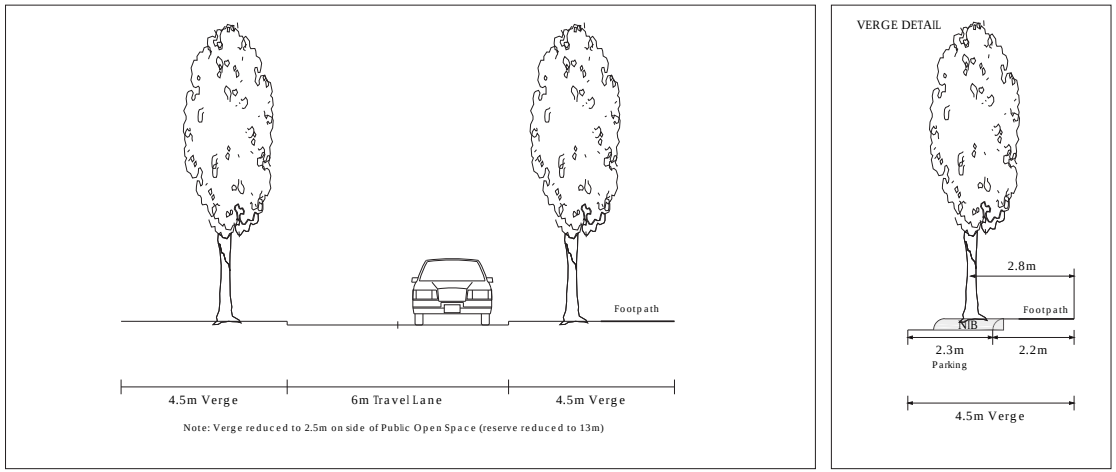


STREET CROSS SECTION - KEY LOCAL ACCESS STREET

Wellard Residential: Figure 11

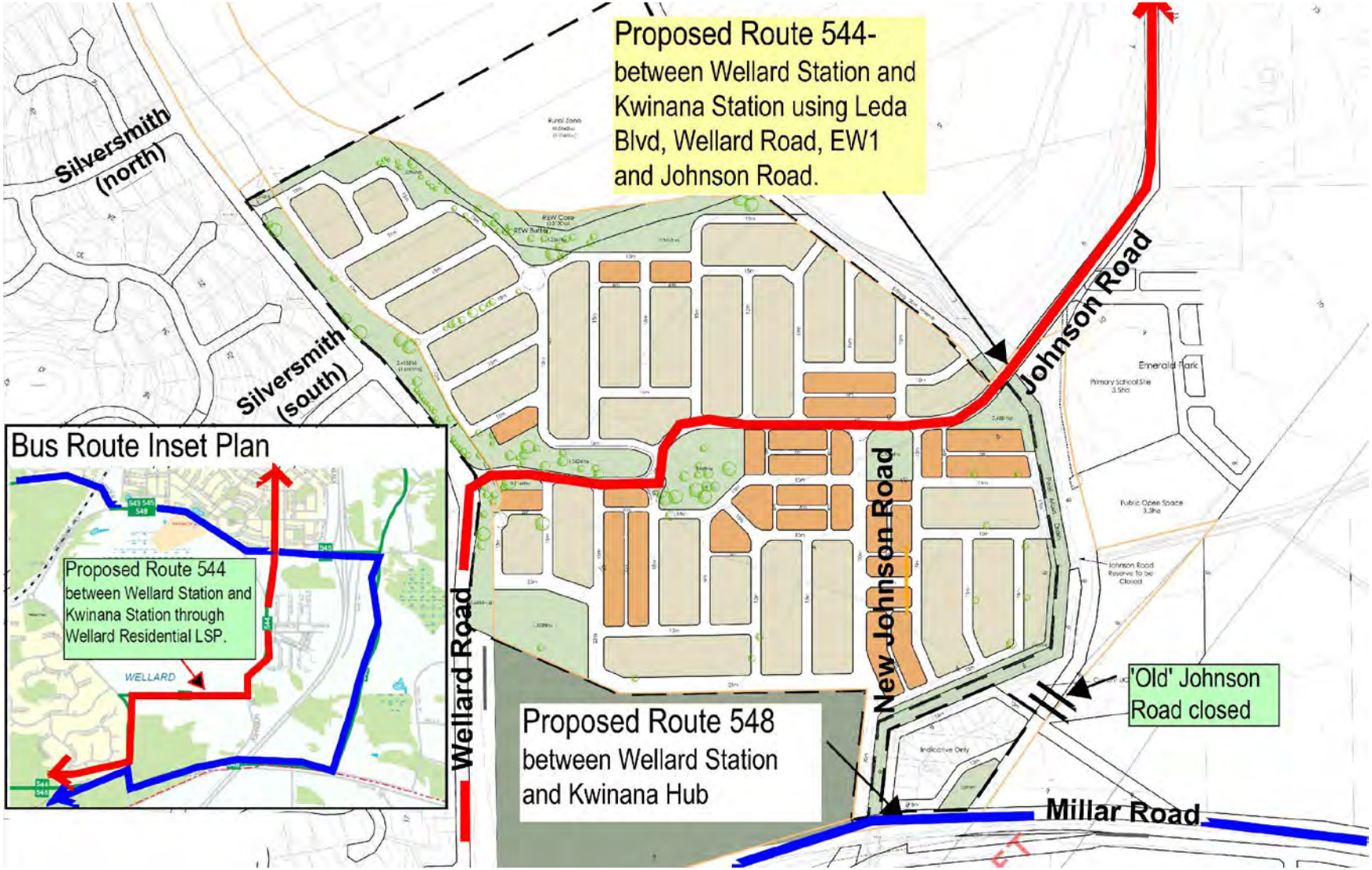
Access to the existing arterial road network is provided at four separate connections:

- A full movement T or roundabout access to Wellard Road to the west of the LSP area. Wellard Road is identified by the City of Kwinana as a district distributor road estimated to carry in excess of 16,000 vpd at ultimate capacity, at which point it will be upgraded to a four lane divided road. The preferred traffic control and intersection treatment will be confirmed at subdivision stage.
- A second access to Wellard Road to the north of the LSP area. This access will be a full movement T, and can be downgraded to a left in / left out when Wellard Road is upgraded, and a solid median is constructed.
- A full movement T or roundabout access to Millar Road via the realigned Johnson Road at the south of the LSP area. The existing Johnson Road / Millar Road intersection will remain, however the current Johnson Road reserve will be closed to the north of lot 10, and will provide local access only.
- The realignment of Johnson Road, a designated local distributor, through the centre of the LSP area will provide the fourth access point to the site. Access will be provided via a crossing over the Peel Main Drain, in the north eastern corner of the LSP area, connecting to the existing Johnson Road alignment immediately to the west of the planned primary school at Emerald Park estate.



STREET CROSS SECTION - LOCAL ACCESS STREET

Wellard Residential: Figure 12



Source: Bruce Aulabagh Traffic Engineering & Transport Planning

2263-85A-01 (04.05.2012), nts

BUS ROUTE

Wellard Residential : Figure 13

3.4.2 Local Street Cross Sections & Traffic Management Treatments

Local access streets will form the vast majority of local streets within the LSP area. The indicative cross sections for these access streets are consistent with Liveable Neighbourhoods cross sections figures 20-22, and range from 15m reserves to 18m for key local access streets, as well as allowing for reduced verges (typically 4.5m to 2.5m) for roads adjoining open space. Road reserve widths and design of access streets can be further refined at subdivision stage.

Wider local access streets of 18m - 21m have been introduced in order to provide view corridors from key aspects of the adjoining Homestead Ridge Estate. These streets will continue to function in the same manner as a typical local access street. These view corridors are discussed further in Section 3.5.4.

Figures 10 – 12 show indicative street cross sections.

Section 5.4 of Appendix 5 establishes traffic management treatments for the LSP area. Generally the intersections of higher volume access streets and local distributors will be controlled via single lane roundabouts, while lower order intersections will have priority control – either stop signs or give way.

In addition to road construction treatments, speed control devices will be implemented along the key local access street that connects Wellard Road with the realigned Johnson Road to ensure safe vehicle speeds commensurate with the residential surrounds. Speed control measures on planned bus routes will be designed in consultation with Transperth and the Public Transport Authority at detailed design stage, and will ensure that bus movements are not compromised.

3.4.3 Public Transport

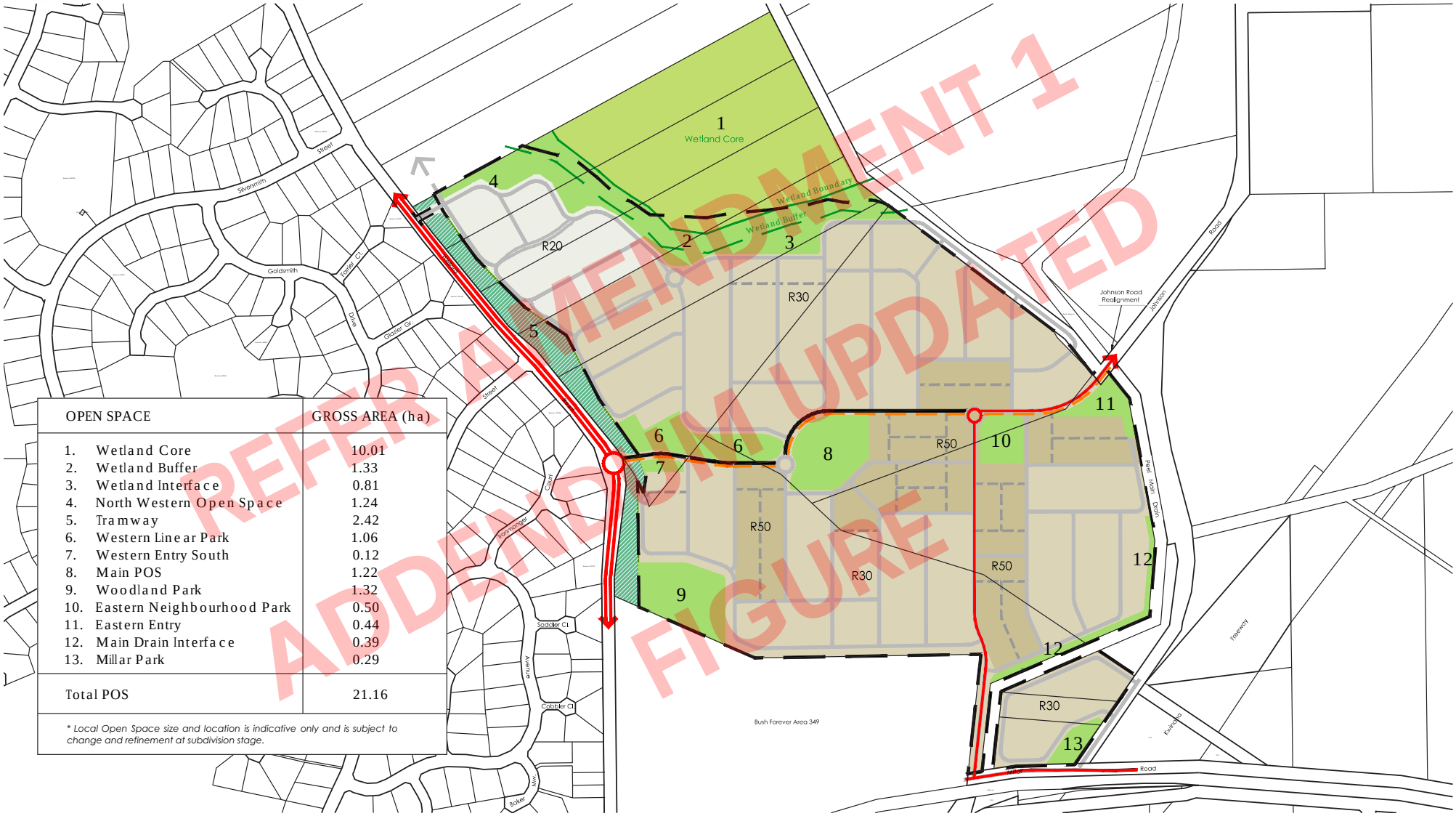
The LSP allows for a bus route connecting Wellard Road to the realigned Johnson Road via a key east-west local access street. This bus route has been planned and prepared in consultation with Transperth and the Public Transport Authority.

Proposed route 544 will connect Wellard Station with Kwinana Station, and will travel via Leda Boulevard and Wellard Road, before passing through the LSP area and connecting to Johnson Road.

Road reserve widths, street cross sections and traffic management devices have all taken the bus route into consideration, and will be refined at subdivision / detailed design stage in consultation with Transperth and the PTA.

The PTA and Transperth are also planning to create new bus route 548 connecting Wellard train station and the Kwinana town centre via the eastern side of the Kwinana Freeway. This route passes along Millar Road to the south of the LSP area.

Figure 13 shows the planned bus routes.



OPEN SPACE	GROSS AREA (ha)
1. Wetland Core	10.01
2. Wetland Buffer	1.33
3. Wetland Interface	0.81
4. North Western Open Space	1.24
5. Tramway	2.42
6. Western Linear Park	1.06
7. Western Entry South	0.12
8. Main POS	1.22
9. Woodland Park	1.32
10. Eastern Neighbourhood Park	0.50
11. Eastern Entry	0.44
12. Main Drain Interface	0.39
13. Millar Park	0.29
Total POS	21.16

** Local Open Space size and location is indicative only and is subject to change and refinement at subdivision stage.*

REFER AMENDMENT 1
ADDENDUM UPDATED
FIGURE

PUBLIC OPEN SPACE

2263-91A-01 (27.04.2012), nts

Wellard Residential : Figure 14

3.4.4 Pedestrians & Cyclists

The LSP makes provision for a comprehensive network of pedestrian and cycle facilities, allowing a safe, convenient and legible movement network. Key principles for cyclist and pedestrian movement are:

- The principle cycle network is aligned with the local distributor roads, providing a balance of on road cycle lanes in the higher traffic volume areas, and dual use paths within the road verges.
- The cycle network provides safe and convenient access to the existing regional Principal Shared Path that runs parallel to the Kwinana Freeway linking Perth CBD to Mandurah.
- Pedestrian footpaths provided on at least one side to all local streets.
- Key local access streets providing either footpath on one side and dual use path on the other, or footpaths on both sides.
- A shared path circumnavigating the LSP area, providing recreational access to key areas of open space, Bush Forever, and opportunities for northern connections via the Tramway Reserve.
- A strong pedestrian link following the eastern portion of the realigned Johnson Road, providing safe and convenient access to the adjoining primary school and local centre.
- Low speed zones will be provided around key pedestrian linkages and areas of high amenity to ensure a safe, pedestrian friendly environment.

3.5 Public Open Space

3.5.1 Open Space Provision & Schedules

There is a total of approximately 21.16ha of open space within the Wellard Residential land holding and LSP area, including approximately 10ha of Bollard Bulrush Wetland, zoned Rural under the MRS. This equates to 29% open space across the gross area of 73ha.

Once Liveable Nieghbourhoods credits are applied the open space provision is 15.4% exceeding the minimum 10% credited public open space requirement, refer Table 2, Figure 14 and Appendix 10.

The following outlines the key aspects of public open space provision based on Liveable Neighbourhoods requirements, with the detailed description of each open space type outlined in Section 3.5.3 below.

- Based on a Gross Subdivisible Area (gross site area less Rural zoned Wetland Core, and Parks and Recreation Reserve) of 61ha, the 10% open space requirement is 6.1ha.

Table 2 - Public Open Space and Drainage Summary

Wellard Residential Local Structure Plan – Public Open Space and Drainage Summary					
Park Name	**POS #**	**Gross POS Area**	**Total Deductions**	**Total Restricted Use POS**	**Total Unrestricted POS**
Wetland Core *(includes MRS Rural Zone & REW Core)*	1	10.01	10.01	0.00	0.00
Wetland Buffer	2	1.33	0.00	1.33	0.00
Wetland Interface	3	0.81	0.00	0.24	0.58
North Western Open Space	4	1.24	0.00	0.00	1.24
Tramway	5	2.42	0.00	0.00	2.42
Western Linear Park	6	1.06	0.00	0.00	1.06
Western Entry South	7	0.12	0.00	0.12	0.00
Main POS	8	1.22	0.09	0.25	0.88
Woodland Park	9	1.32	0.00	0.00	1.32
Eastern Neighbourhood Park	10	0.50	0.05	0.12	0.33
Eastern Entry	11	0.44	0.02	0.06	0.36
Main Drain Interface	12	0.39	0.03	0.36	0.00
Millar Park	13	0.29	0.03	0.04	0.22
TOTAL		**21.16**	**10.23**	**2.51**	**8.42**

REFER AMENDMENT 1
ADDENDUM UPDATED
SCHEDULE

1. Deductions include EPP Wetland and Buffer (MRS Rural Zone), RE Wetland Core, and 1 year 1 hour drainage areas in open space.
2. Restricted Use Open Space includes all drainage areas in POS for greater than 1 year 1 hour and up to 1 in 5 year storage areas, as well as all of the following:
   - Wetland buffer
   - Main Drain interface
   - Western Entry South
3. Refer to Appendix 10 for a full POS Schedule in accordance with Liveable Neighbourhoods requirements.

- The LSP provides 11.15ha of gross open space, with open space areas serving a shared drainage function, while not compromising the active and passive recreational uses.
- Approximately 0.22ha of open space will receive drainage for events occurring more frequently than the 1 in 1 year (1 hour) event, and as such is a deduction from the Gross Subdivisible Area in accordance with Liveable Neighbourhoods (LN R33).
- Liveable Neighbourhoods allows up to 2% of the 10% open space requirement to comprise of restricted use open space. The balance of restricted use open space becomes a deduction (LN R33).
- Based on the requirements of Liveable Neighbourhoods, a maximum of 1.25ha can be restricted use open space and a minimum of 5.02ha unrestricted open space.
- Approximately 0.86ha (7% of the total POS contribution) of open space will receive drainage from the 1 in 1 year to 1 in 5 year drainage event in landscaped infiltration basins and bio-retention areas, in accordance with water sensitive urban design principles. The 1 in 1 to 1 in 5 year drainage event is treated as restricted use open space in accordance with Liveable Neighbourhoods.
- Main Drain Interface and Western Entry South are small pocket parks providing local amenity and a drainage function and are entirely restricted use open space.
- The POS area within the Wetland Buffer is restricted use open space in accordance with Element R33 of Liveable Neighbourhoods.
- The Tramway Reserve is unrestricted open space in accordance with Element R8 of Liveable Neighbourhoods and will continue to be available as multi-purpose open space, providing a green link between the Bush Forever Reserve to the south, and the land to the north of the LSP area, as well as and allowing for an integrated path network throughout the reserve, in accordance with the City's Loop Trail network.
- All other POS areas are unrestricted open space, providing a range of passive and active functions, as well as recognising the existing environment through the retention of mature trees and vegetation. The total unrestricted use open space area is 8.42ha.

3.5.2 Urban Water Management & Open Space

The LSP adopts best practice urban water management principles through the integration of storm water detention and infiltration areas into public open space, creating multi-purpose areas, without compromising the amenity or functionality.

A Local Water Management Strategy (LWMS) has been prepared by Emerge Associates, and is included as Appendix 7 to the LSP.

KEY LANDSCAPE ELEMENTS AND FACILITIES

1. **Bollard Bulrush Wetland Conservation Area**
   - No landscaping to be done in this area.
   - Comprising EEP lake and buffer and REW core
2. **REW Wetland Buffer**
   - Informal wetland sensitive pedestrian path.
   - Weed eradication and revegetation using local natives.
3. **Wetland Interface**
   - Roadside drainage swales and infiltration basin to be planted with native buffer shrubs, mulched or with lawns depending on location.
   - Planting of native species trees and shrubs.
   - Interpretive signage and structure / lookout.
   - Mixture of soft and hardscape surfaces.
4. **Northwest Open Space**
   - Pedestrian links to adjacent residential areas.
   - Recreation facilities such as exercise equipment, community picnic shelters and furniture.
   - Mixture of soft and hard landscaping treatments.
   - Planting of native species.
   - Bore irrigation to lawn areas.
   - Informal kick about space.
   - Storm water treatment / nutrient stripping conveyance swale areas.
   - Connection pedestrian walkway and path to future development.
   - Retention of existing vegetation along wetland edge.
5. **Tramway Reserve**
   (Connecting Woodland Park, Tramway Reserve, Wetland Buffer and Loop Trail.)
   - Dense planting of native species to create vegetation buffer zone between existing and new sub-divisions.
   - Dense planting to Wellard Road with passive recreation and parkland.
   - Storm water treatment / nutrient stripping conveyance swale areas.
   - Pedestrian corridors and path systems.
   - Native non-irrigated planting areas adjacent to wetland areas.
   - Turf to be irrigated with bore water.
   - Mixture of soft and hardscape treatments.
   - Exercise equipment nodes and passive exercise grassed areas.
   - Interpretive signage referencing Tramways history.
6. **Western Linear Parkland**
   - Pedestrian links to adjacent residential areas.
   - Mixture of soft and hard landscaping treatments
   - Planting of native species.
   - Bore irrigation to lawn areas.
   - Informal kick about space.
   - Connecting path to Tramway Reserve.
   - Retention of mature trees where possible.
   - Grass infiltration basin and conveyance swales.
7. **Western Entry South**
   - Eastern extension of Tramway Reserve.
   - Allows for retention of existing mature vegetation.
8. **Main POS**
   - Pedestrian links to adjacent residential areas.
   - Recreation facilities such as playground, BBQ, community picnic shelters and furniture.
   - Playground areas separated into toddler-infant playground and school aged childrens playground.
   - Mixture of soft and hard landscaping treatments.
   - Planting of avenue trees to main vehicle access artery.
   - Planting of predominantly native species (except avenue trees).
   - Bore irrigation to all lawn areas.
   - Informal kick about open space.
   - Retention of existing trees through POS areas where possible.
   - Drainage swales to be planted with native buffer shrubs and mulched.
   - Exercise equipment node.
   - Grass infiltration basin.
9. **Woodland Park**
   - Retention of existing vegetation.
   - Pedestrian links to adjacent residential area.
   - Mixture of soft and hardscape areas.
   - Revegetation with indigenous plants.
   - Grassed conveyance swales.
10. **Eastern Neighbourhood Park**
    - Pedestrian links to adjacent residential areas.
    - Recreation facilities such as playground, BBQ, community picnic shelters and furniture.
    - Mixture of soft and hard landscaping treatments.
    - Planting of native species.
    - Bore irrigation to lawn areas.
    - Informal kick about space.
    - Grass infiltration basin and conveyance swales.
11. **Eastern Entry Statement and Parklands**
    - Entry from proposed Johnson Road realignment.
    - Feature statement signage and landscaping entry.
    - New entry bridge over Peel Main Drain (PMD).
    - Entry statement parks to western side of PMD to contain passive recreational amenities within the grassed infiltration basins.
    - Mixture of soft and hard landscaping treatments.
    - Planting of avenue trees to main vehicle access artery.
    - Bore irrigation for all avenue species and lawn areas.
    - Plant beds of predominantly native species.
12. **Main Drain Interface Park**
    - Pedestrian links to adjacent residential areas.
    - Mixture of soft and hard landscaping treatments.
    - Planting of native species.
    - Bore irrigation to lawn areas.
    - Opportunity for integration with Peel main drain if redeveloped.
13. **Millar Park**
    - To be landscaped by others.
14. **Western and Millar Roads Entries**
    - Feature entry signage, planting and roundabout from Wellard Road entry.
    - Planting to Millar Road entry.
    - Mixture of soft and hard landscaping treatments
    - Planting of avenue trees to main vehicle access artery.
16. **Special Streetscapes**
    - Selected median strip and verge streetscapes to view corridor streets at northern portion of site.
    - Median strip to be used for ancillary drainage facility.
    - Non deciduous exotic trees on roundabouts only. The rest of sub division planted with native species.
    - All street trees to have supplementary water only until established.

Source: Urban Landscaping Sept 2011

2263-96A-01 (04.05.2012), nts

LANDSCAPE CONCEPT MASTERPLAN

Wellard Residential : Figure 15

Part 7 of the LWMS sets out the stormwater management strategy, and details the key types of drainage methods and infrastructure to be included within areas of open space. Drainage in open space will be managed through bio-retention areas and infiltration basins, as described below.

- **Bio-retention areas** – Dedicated drainage areas within both road reserves and open space that will strip nutrients from storm water runoff before infiltrating back into the groundwater system. Generally bio retention areas will form small pockets of passive open space, comprising of dense, low level vegetation to assist in nutrient stripping, and to provide a visual feature within the broader open space area. Bio retention areas are included within the central POS areas, as well as the eastern entry POS adjacent to Johnson Road.

- **Infiltration basins** – used to detain and infiltrate stormwater runoff from major events, infiltration basins are large shallow basins within areas of open space. These basins can form either passive or active functions within the open space, and will generally be large, flat grassed areas, with side slopes not steeper than 1 in 6. Infiltration basins will be incorporated into the central POS areas, as well as adjacent to the Wetland buffer, and local parks south and east.

3.5.3 Description of Open Space Areas

The following provides a summary of the key characteristics for landscape distribution, function and design throughout the LSP area. A detailed Landscape Strategy is Appendix 8, and is shown as Figure 15.

North Western Open Space

- Approximately 1.2ha of informal active open space, providing opportunities for kick-about, as well as conveying drainage from Homestead Ridge to the Peel Main Drain.

- Provides a landscaped interface to the Urban Deferred land to the north, allowing for a transition zone between this land and the developed area to the south.

- Allows for a view corridor recognising key aspects from Homestead Ridge to the Wetland.

Tramway Reserve

- Approximately 2.4ha reserved for Parks and Recreation under the MRS, providing opportunities for active and passive recreation through provision of extensive path network.

- Creates opportunities for the extension of the Kwinana Loop Trail (Stage 4), forming part of a greater regional open space network.

- Allows for a 'green link', connecting the Bush Forever site with land to the north, providing opportunities for wildlife corridors.
- Opportunities for interpretive signage recognising the heritage significance of the historic Tramway Reserve.
- Conveys storm water runoff from the broader area towards the North Western Open Space.
- Provides a landscaped interface to Wellard Road, reducing vehicle noise, and contributing to the amenity of the area.
- Opportunities for an early planting program to be introduced to better screen temporary visual impacts asscoiated with earthworks, and the need for long term softening of proposed future development.

Western Linear Parkland

- 1.1ha of linear open space, retaining existing mature trees wherever possible.
- Provides a landscaped entry from Wellard Road, as well as forming the western portion of the east-west open space link through the centre of the LSP area.
- Opportunities for an integrated path network, picnic and barbeque areas, and passive recreation, with mature trees providing shade and amenity.

Main POS

- Forms a central focus for the future community, providing a 1.2ha space for formal and informal gatherings.
- Includes a variety of play equipment, communal bbq facilities, shaded picnic areas
- Existing mature flooded gums will be retained wherever possible, providing additional shade and amenity, as well as recognising the existing environment.
- Infiltration and bio-retention areas will be integrated with the surrounding open space, using a combination of turfed areas and native planting.
- Path networks connect the western areas with the open space and primary school to the east.

Wetland Interface

- A predominantly turfed area of approximately 0.8ha, providing a landscaped transition between the urban area and the wetland buffer to the north.
- Provides opportunities for informal active and passive recreation via turfed areas, and pedestrian pathways around the perimeter.

- Includes a useable infiltration area for the detention and treatment of stormwater runoff, retaining pre-development hydrology and ensuring water quality is maintained. Infiltration areas are shallow depressions with a broad base, ensuring that they remain useable.

Wetland Buffer

- Approximately 1.3ha of open space, providing suitable buffers to the Resource Enhancement Wetland.
- Provides opportunities to revegetate and enhance the wetland area, and allows for controlled access via pedestrian paths throughout.
- Pedestrian paths also provide a suitable separation between the buffer and the Wetland Interface, allowing for weed management and preventing introduced weeds from entering the wetland buffer and core.
- No drainage detention or infiltration proposed within the Wetland Buffer.

Eastern Entry

- 0.4ha of high amenity landscaped area, including a mixture of hard and soft landscape treatments, entry statement signage, and pedestrian connections across the Peel Main Drain linking to the primary school.
- Includes shallow, turfed infiltration areas to detain and infiltrate storm water before discharging into the Peel MainDrain via a controlled discharge.

Eastern Neighbourhood Park

- Provides an intimate community space of approximately 0.5ha, which complements the Main POS, and provides a secondary community meeting space.
- Includes landscaped infiltration and bio-retention areas which can double as informal active space.
- Provides an important link between the Main POS and the Eastern Entry, allowing for a continuous green corridor through the centre of the LSP area.

Woodland Park

- A 1.3ha area that recognises and retains good quality vegetation, and complements the adjacent Bush Forever reserve.
- Includes controlled access via pedestrian pathways, allowing for passive recreation throughout.

SPECIAL STREETSCAPE CROSS SECTION (21m Reserve)

2263-78A-01 (19.04.2012), nts

Wellard Residential : Figure 16

Main Drain Interface

- Local pocket park of approximately 4,000m², providing drainage infiltration areas, and opportunities for informal recreation.
- Provides opportunities for surveillance of the Peel Main Drain, and allows for future improvement of the Peel Main Drain subject to agreement of the Water Corporation as landowners.

Millar Park

- A local park of approximately 0.29ha located on the corner of Millar and Johnson Road.
- Provides adequate noise buffers from both the Kwinana Freeway and the Mundijong rail line, minimising impact on residential areas, and providing a high amenity open space to support the development of this cell.
- Includes useable infiltration areas, and an integrated pedestrian path.

3.5.4 Special Streetscapes

The LSP makes provision for streetscape treatments that provide a high level of public amenity through a combination of waterwise native and exotic tree species. Roadside swales and bio-retention areas will generally be planted with native shrubs to assist with nutrient stripping. Detailed landscape design for streetscape areas will be confirmed with the City of Kwinana at detailed design stage.

Wider road reserves of 21 metres and 18 metres have been provided in the north western precinct in order to provide view corridors from key aspects of the adjoining Homestead Ridge Estate. These wider roads align with key access roads on the opposite side of Wellard Road, ensuring views of the wetland from the public realm of Homestead Ridge Estate.

Figures 16 and 17 show indicative street cross sections of these special streetscapes, and demonstrate the use of extensive planting in both the road verge, and the central median. Medians range from 3 metres in the 18 metre reserve, to 6 metres in the 21 metre reserve, allowing for extensive planting and soft landscaping through the centre of the road. The road pavement can be provided with a different surface treatment to further delineate these special streetscape areas, and to promote a semi-rural feel to the area.

18m ROAD RESERVE

SPECIAL STREETSCAPE CROSS SECTION (18m Reserve)

2263-93A-01 (19.04.2012), nts

Wellard Residential : Figure 17

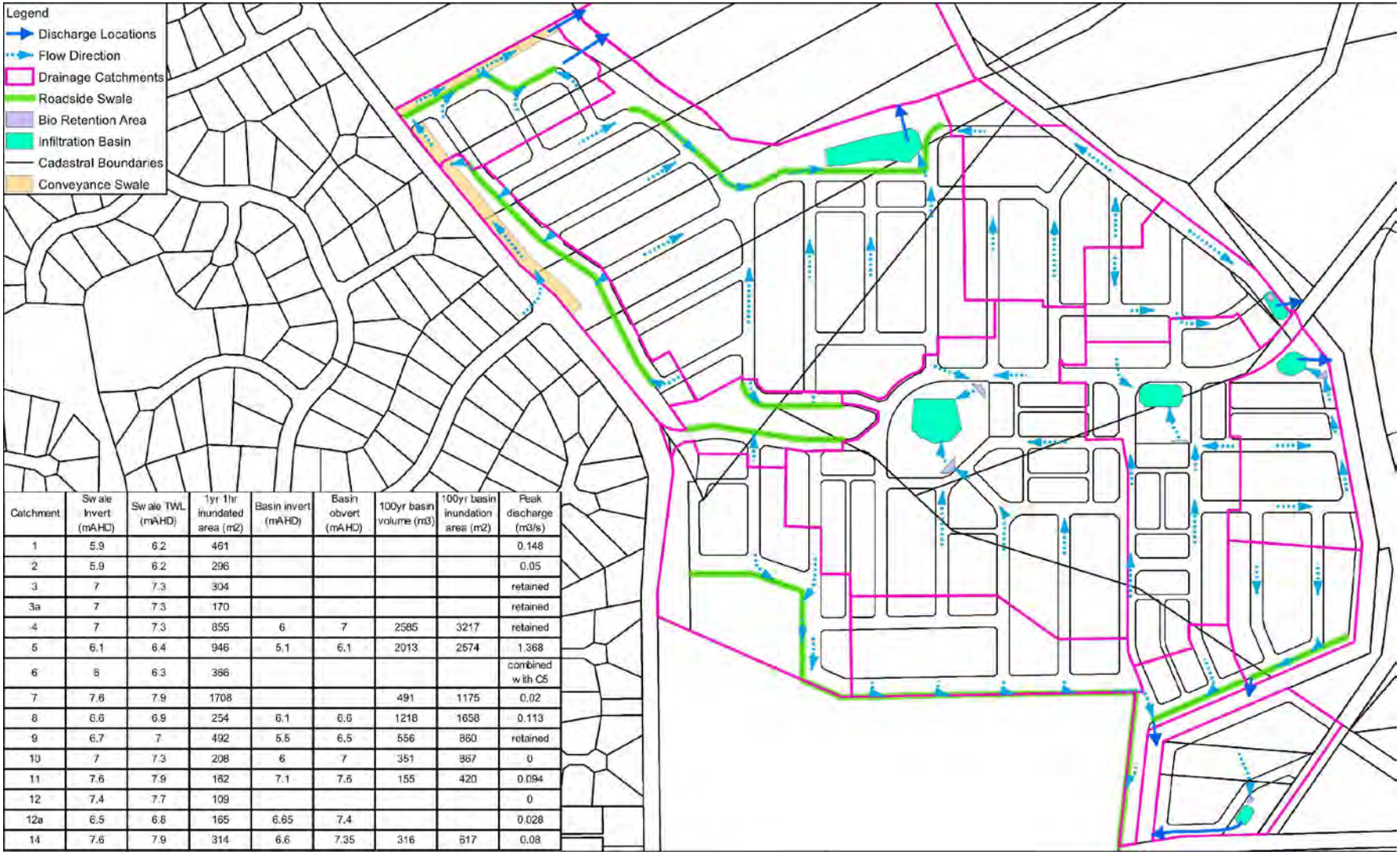
3.6 Urban Water Management

The LSP provides a framework that allows for best practice urban water management, and remains sensitive to the existing hydrology and natural environment.

This framework emphasises the application of water sensitive urban design to manage the way in which water within an urban context is utilised. This type of design aims to minimise the impact of urbanisation on the natural water cycle.

A Local Water Management Strategy (LWMS) has been prepared by Emerge Associates, and is included as Appendix 7. The LWMS demonstrates in detail how the LSP addresses urban water management, and water sensitive urban design. The key principles of the LWMS are:

- A total water cycle management approach to water management at the site has been developed based on detailed site-specific investigations, industry best-practice and relevant state and City of Kwinana policies relating to water management. The overall objective for water management is to mimic the hydrological regime that currently exists prior to urban development of the site.
- The predevelopment hydrology has been well characterised by the Jandakot DWMP and in the Bollard Bulrush DWMS and this has been further refined in the LWMS. Runoff from within the site has been well characterised. The high permeability of soils beneath the majority of the site will result in onsite infiltration for most rainfall events, and there is a minor flow into the Peel Main Drain during major events. A portion of the site is low-lying, and rainfall in this area drains to the Bollard Bulrush Swamp.
- The overall approach to surface water management at the site will be to mimic the natural environment. This will require onsite infiltration of minor (frequent) events, which will be achieved in lot-scale soakwells, roadside swales within road reserves and infiltration basins.
- While lots will be required to retain minor events within soakwells, all runoff which exceeds this will be conveyed first to roadside swales, located within road reserves. Where runoff cannot be captured within roadside swales it will be conveyed to a bio-retention area within the nearest downstream POS area. Water quality treatment requirements will be met within the lot soakwells, roadside swales and bio-retention areas. All other detention/retention requirements to ensure that the post-development environment mimics the predevelopment will be met by providing infiltration basins located within POS.



Catchment	Swale Invert (mAHD)	Swale TWL (mAHD)	1yr 1hr inundated area (m2)	Basin invert (mAHD)	Basin obvert (mAHD)	100yr basin volume (m3)	100yr basin inundation area (m2)	Peak discharge (m3/s)
1	5.9	6.2	461					0.148
2	5.9	6.2	296					0.05
3	7	7.3	304					retained
3a	7	7.3	170					retained
4	7	7.3	855	6	7	2585	3217	retained
5	6.1	6.4	946	5.1	6.1	2013	2574	1.368
6	6	6.3	386					combined with C5
7	7.6	7.9	1708			491	1175	0.02
8	6.6	6.9	254	6.1	6.6	1218	1658	0.113
9	6.7	7	492	5.5	6.5	556	860	retained
10	7	7.3	208	6	7	351	867	0
11	7.6	7.9	162	7.1	7.6	155	420	0.094
12	7.4	7.7	109					0
12a	6.5	6.8	165	6.65	7.4			0.028
14	7.6	7.9	314	6.6	7.35	316	617	0.08

Source: EMERGE (EP11-008(01)--F10a)

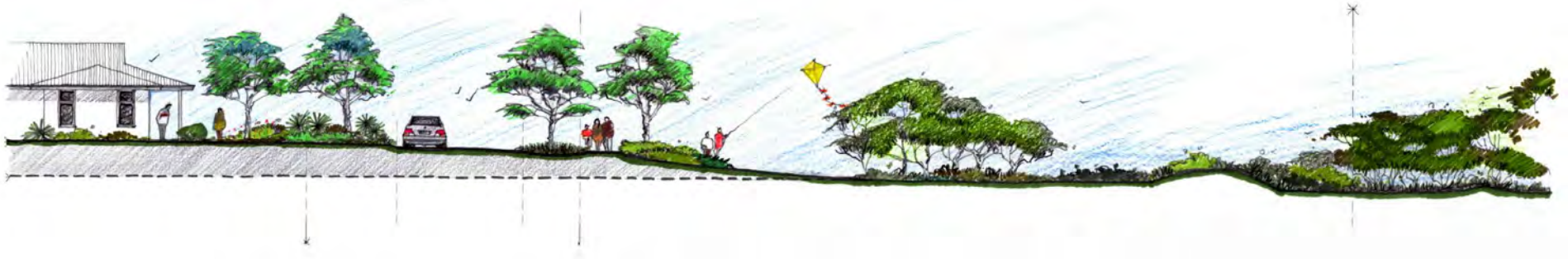
2263-92A-01 (30.04.2012), nts

INDICATIVE DRAINAGE PLAN

Wellard Residential : Figure 18

- Runoff from within the development will be conveyed by either direct sheet flow and flush kerbs to roadside swales, or via a concrete piped network. The concrete pipe network will either discharge to roadside swales or a bio-retention area. Once the capacity of roadside swales has been reached these will convey runoff to the next downstream swale/basin. When roadside swales and bio-retention areas reach capacity, excess runoff will be directed to an infiltration basin or discharge structure. These will be designed so that the post-development peak flows will mimic the pre-development peak flows.
- Runoff from the wider area is currently conveyed through the site and discharged to Bollard Bulrush Swamp. This flow regime will be continued, and provision has been made within the LSP to ensure that the upstream flows will continue to be conveyed to the Bollard Bulrush Swamp via a shallow open swale located within POS. The conveyance of the upstream flows will be kept separate from any roadside swales/treatment areas provided within the site.
- The quality of groundwater will be maintained by directing all runoff from minor events to either soakwells, roadside swales or bio-retention areas. Runoff will be treated by a number of processes that occur within the soil profile which assist in removing nutrients. Further treatment will occur within roadside swales and bio-retention areas as these will be vegetated and underlain by soils with a high capacity to remove nutrients.
- Water conservation requirements will be met by providing:
  - A broad range of lot sizes, which do not encourage large garden areas
  - Waterwise landscape packages will be offered with sale of lots
  - Water efficient fittings will be mandated within all dwellings through the building licence process
  - Promotion of water efficient appliances and rainwater tanks

Figure 18 shows the indicative size and location of the drainage within POS and roadside swales, as well as identifying the areas of open space that will be inundated in both the 1 year 1 hour, and 100 year events.



Source: Urban Landscaping

2263-89-01 (06.09.2011), nts

WETLAND INTERFACE CROSS SECTION 1

Wellard Residential : Figure 19

3.7 Infrastructure Coordination, Servicing & Staging

Civil engineering consultants JDSi have prepared a detailed servicing strategy demonstrating the availability of service infrastructure to the LSP area. The strategy is summarised below, and is provided in full as Appendix 6.

Further detailed infrastructure planning and design will occur as the planning and development of the land progresses.

3.7.1 Wastewater

The Water Corporation has confirmed that the subject land is included in current scheme planning for wastewater infrastructure in this area, and allowances have been made in the capacity planning for the development of the subject land.

The preliminary planning allows for wastewater from the site to be managed and distributed via a combination of existing and proposed pump stations.

3.7.2 Water Supply

The Water Corporation has advised that the development is located within the Thompson's Lake Gravity Scheme and can be serviced by an extension of the DN300 main, which currently terminates at the entrance road to the Emerald Park development (Gemstone Parade). The DN300 will ultimately require extension along Johnson Road to service eastern portions of the subject land.

3.7.3 Power Supply

The existing Western Power distribution infrastructure in the vicinity of the site comprises high voltage underground and overhead feeder lines along Wellard Road. There are opportunities to connect to these feeder lines to provide electricity to the subject land, and thus there is no constraint to urban development. The internal electrical network, including location of substations and transformers, can be determined at subdivision stage as part of the detailed design process.

3.7.4 Gas Supply

Alinta Gas has an existing pressure main located in close proximity to the subject land that can be extended to service the property.

SECTION B-B - RESIDENTIAL TO WETLANDS INTERFACE
Scale 1:200

Source: Urban Landscaping
2263-90-01 (06.09.2011), nts

WETLAND INTERFACE CROSS SECTION 2
Wellard Residential : Figure 20

3.7.5 Telecommunications

Telstra has existing telecommunications infrastructure surrounding the site, and has confirmed that connection to the development will be possible.

3.7.6 Infrastructure Funding

The service infrastructure described above is typically funded via standard agreements between developers and the service agencies as part of the ongoing subdivision and development works. Given that the land is largely in single ownership, and that there are standard infrastructure funding agreements available, servicing of the land is not considered a constraint to the urbanisation and development of the land.

3.7.7 Earthworks and Staging

The preliminary earthworks modelling recognises the existing topography and landform of the LSP area. The LSP remains consistent with the overall landform by ensuring that the gentle slope towards the wetland is maintained, providing a natural battered interface to the wetland area, and avoiding the use of retaining walls or steep batter.

The site currently grades from south adjoining the Bush Forever down to the north adjoining the Bollard Bulrush Wetland. In the central and southern sections earthworks will be minimal, with ground levels remaining as existing in the central section and some cut in the northern section. The northern portion adjoining the wetland will require fill, to achieve finished ground levels that are elevated above the 1 in 100 year flood, with a gentle slope toward the wetland. The relationship between the existing ground level and the proposed fill level is demonstrated in the cross sections provided at Figures 19 and 20, and shows how the proposed earthworks respect the existing landform.

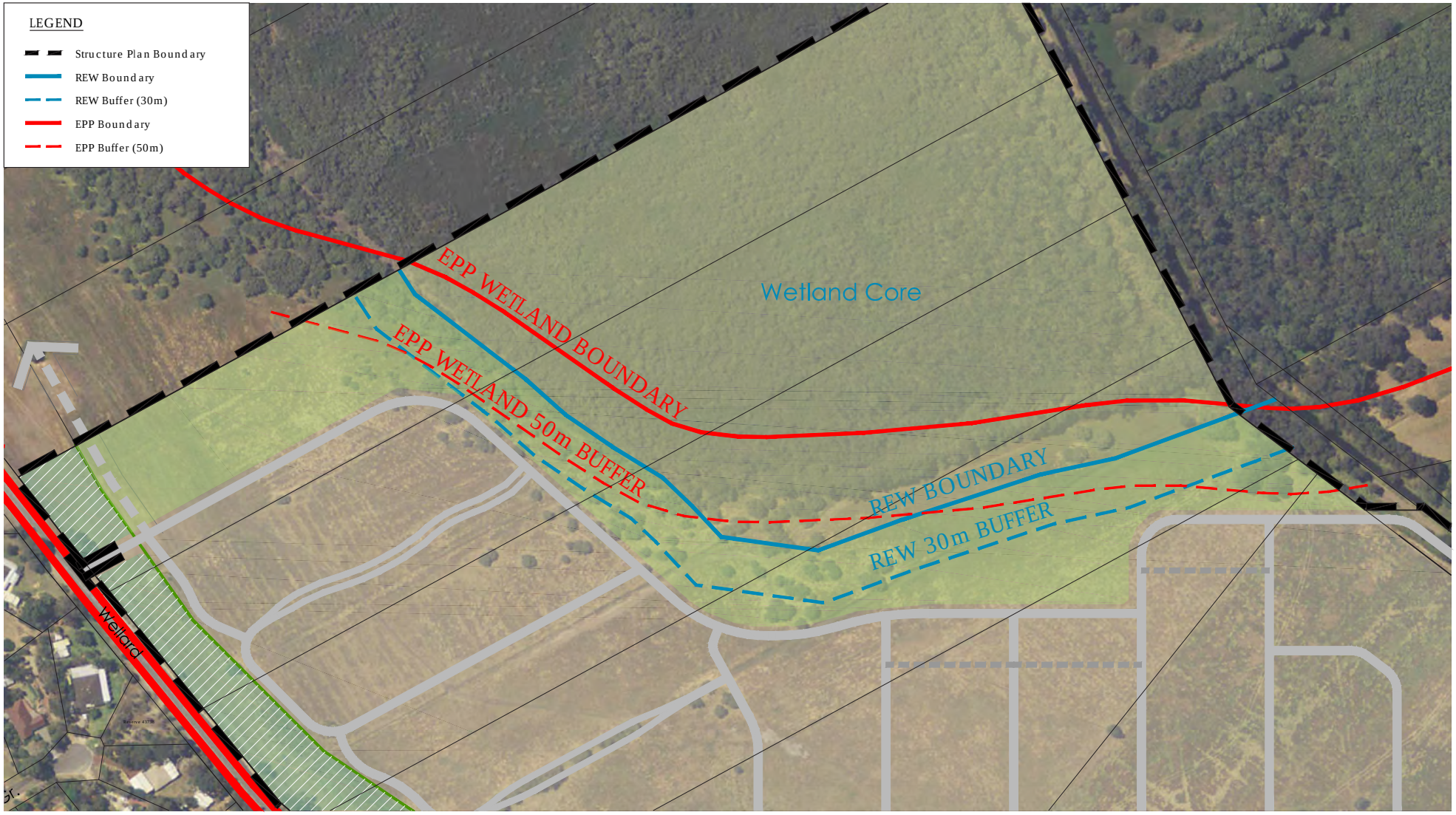
It is anticipated that subdivision works will commence within the LSP area by 2012-2013, with the first stage of development likely to commence on the eastern side of the LSP area, adjacent to Johnson Road and the Peel Main Drain. Subsequent development will progress to the south and west, with final stages estimated to be completed by 2020.

3.8 Environmental Response

The following provides a summary of the Wetland, Vegetation, and Fauna management strategies provided in Appendix 1.

3.8.1 Wetland Management

The LSP recognises the value and significance of the Bollard Bulrush Wetland, and provides buffers that exceed the minimum requirements set by the EPA and DEC. A minimum 50m buffer is provided to the EPP Lake, in accordance with EPA's advice on MRS



Source: Wetland Boundaries - PGV Environmental

2263-94-01 (07.09.2011), nts

WETLAND BOUNDARIES

Wellard Residential : Figure 21

Amdt 1189/57. A 30m buffer has been provided to the Resource Enhancement Wetland, in accordance with DEC requirements. Figure 21 shows the location of the wetland core and buffer boundaries in relation to the development area, demonstrating compliance with the EPA's advice on MRS Amdt 1189/57.

Passive open space, revegetation, and gentle battering of the land provides a seamless transition between the development area and the wetland, respecting and enhancing the existing environment.

Appendix 1 includes a broad level Wetland Management Strategy for the portion Bollard Bulrush Wetland within Wellard Residential's ownership. The Wetland Management Strategy provides the framework for a future Wetland Management Plan (WMP) to be prepared as a condition of subdivision approval. The preparation of a WMP as a condition of subdivision approval is a standard and typical mechanism used to manage such issues, and occurred as part of the Bertram stage 1 subdivision. In addition it is also commonly acceptable for a WMP to be prepared over part of a wetland area, where a wetland is over multiple land ownerships and Local Structure Plans, and development intentions for adjoining land are uncertain.

As a condition of subdivision approval, the WMP will be required to address:

- Retention of existing vegetation within the buffer
- Management of potential fire hazards
- Fencing requirements
- Pedestrian access and educational signage
- Weed management
- Management responsibilities and timing

3.8.2 Trees, Vegetation, Flora Management

The LSP recognises the value of the existing vegetation in both the Wetland (rural zone) to the north, and a 1.33ha area of vegetation in the south western corner adjacent to the Bush Forever reserve, and retains these areas in public open space where practicable.

The LSP does not propose the removal or modification of the vegetation within the wetland core or buffer.

The vegetation to be retained in the south west will provide a useable passive space, whilst retaining the best quality vegetation. The environmental and social value of the 1.33ha of vegetation to be retained is enhanced by the fact that it directly adjoins the Bush Forever site.

The LSP provides a hard edged road interface to these areas, ensuring an adequate separation between the vegetated areas and future development to manage weeds, public access and surveillance of these spaces.

Lots 75, 83, 92, 167-170 & 1278 Wellard Road Proposed Subdivision

Noise Control Option 2 - Architectural Treatments & Wall

Source: Lloyd George Acoustics 25.07.2011 (fig 5.2)

2263-87-01 (06.09.2011), nts

QUIET HOUSE DESIGN

Wellard Residential : Figure 22

3.8.3 Fauna Management

The fauna assessments have confirmed that the LSP area does not include any fauna species of conservation significance. The LSP remains sympathetic to any potential existence of fauna within the LSP area by:

- Retaining vegetation, where possible, in areas of open space;
- Avoiding clearing of vegetation in spring to avoid disturbance to nesting birds;
- Introducing of a fauna relocation program (if deemed necessary at construction stage) prior to clearing of vegetation.

3.9 Acoustic Attenuation

The LSP considers and responds to any potential noise impact from the Kwinana Freeway through the following measures:

- Possible inclusion of an open space buffer and noise wall around the edge of the buffer in the south eastern portion of the LSP area, adjacent to the existing Johnson Road reserve; to be determined at subdivision stage;
- Provision of 'Quiet House Design' (package A) for the majority of properties on the eastern side of the Peel Main Drain, and some of the first row of dwellings on the western side of the Drain. Figure 22 identifies those future lots which will require Quiet House Design;
- Implementation of the Quiet House Design requirements through appropriate notifications on title following subdivision approval.

3.10 Bush Fire Prevention

The LSP provides adequate measures to reduce potential risk in the unlikely event of a bush fire in the adjoining Bush Forever site 249. These measures include:

- Inclusion of a wider road reserve of approximately 23 metres adjoining the Bush Forever site, providing a combined fire separation distance of 29 metres including the front setback area;
- Requirements through future subdivision conditions / DAPs to satisfy the BAL12.5 requirements of AS3959 (2010) for the first row of dwellings fronting the Bush Forever reserve, as agreed with the City of Kwinana;
- Inclusion of suitable notifications on title at subdivision stage advising of the BAL requirements.

The Fire Management Plan at Appendix 3 provides further detail on bush fire prevention, including a summary of the roles and responsibilities of the developer and the local authority to ensure that the LSP area is adequately protected from the unlikely event of a bush fire in the area.

Notes:

1. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.
2. A hard edged road interface shall be provided to the wetland areas and Bush Forever reserves with road reserve widths to be confirmed at subdivision.
3. Northern access to Wellard Road is a full movement "T" intersection with priority to Wellard Road. This intersection may be downgraded to left in/left out when Wellard Road is constructed as a dual carriageway.
4. Southern access to Wellard Road is either a roundabout or a full movement "T" intersection, to be confirmed at subdivision stage.
5. The wetland core comprises of both the EPP lake and Resource Enhancement wetland boundaries.
6. The wetland buffer is 50m to the EPP lake and 30m to the Resource Enhancement wetland as agreed with Environmental Protection Authority.

2263-52K-01 05.12.2023 NTS

LOCAL STRUCTURE PLAN
Johnston Road, Wellard

4.0 STATUTORY IMPLEMENTATION

4.1 Status of Local Structure Plan

The statutory Local Structure Plan is Figure 23. This report and technical appendices provide an explanation of the LSP and its implementation.

The LSP applies to Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and Lots 2, 10, and 1 Johnson Road, Wellard, and consists of all land contained within the inner edge of the line denoting the Structure Plan boundary on the Structure Plan Map at Figure 23.

Pursuant to Clause 6.17.7.2 of Town Planning Scheme 2, the LSP, Figure 23, shall have effect as if it were part of the Scheme and designates zonings, reserves, densities, classifications and land use permissibility.

4.2 Detailed Area Plans

Pursuant to clause 6.17.6 of Town Planning Scheme 2, Detailed Area Plans shall be prepared for the following lots as a condition of subdivision approval:

- Residential R50 density sites
- Lots with rear or side lane access
- Lots directly abutting public open space
- Lots subject to quiet house design requirements, as identified in Figure 22. Additional noise modelling will be required for any two storey development.
- Lots subject to BAL construction standards
- R20 coded lots

4.3 General Subdivision and Development Requirements

The following describes the general subdivision and development requirements:

- A hard edged road interface is to be provided to Bush Forever site 349, and to the Wetland buffer area, with the width of the road reserve to be determined at subdivision.
- Northern access to Wellard Road is a full movement "T" intersection with priority to Wellard Road. This intersection may be downgraded to left in/left out when Wellard Road is constructed as a dual carriageway.
- Southern access to Wellard Road is either a roundabout or a full movement "T" intersection, to be determined at subdivision stage.
- The wetland core comprises of both the EPP lake and Resource Enhancement wetland boundaries.

- The wetland buffer is 50m to the EPP lake and 30m to the Resource Enhancement wetland as agreed with relevant authorities. The EPP Lake and 50m buffer are located outside of the LSP area.
- Implementation of the recommendation of the Noise Impact Assessment to the satisfaction of the City of Kwinana
- Inclusion of notifications on title for those lots deemed to be affected by noise, and subject to Quiet House Design construction standards.
- Inclusion of notifications on title for those lots identified in the Fire Management Plan, acknowledging the requirement to meet specific construction standards in order to minimise risk in the event of a bush fire.
- The proponent acknowledges and understands referral responsibilities in accordance with the Environmental Protection and Biodiversity Conservation Act 1999 as a seperate process to the planning approvals process pursuant to the Planning and Development Act 2005.
- An appropriate interface treatment for the Peel Main Drain is to be identified, to the satisfaction of the City of Kwinana, including but not limited to appropriate fencing, surveillance, landscaping of reserves/wider road reserves to allow for landscaping, with details to be determined at the subdivision stage.
- Inclusion of Notifications on Title to advise of potential impacts of mosquito and midge nuisances in accordance with an approved Mosquito and Midge Management Plan.
- Implementation of an approved Fauna Management Plan to the specification of the City of Kwinana at the subdivision stage, which is to include identification of any potential fauna habitat trees retained in public reserves, strategies for relocation of fauna prior to clearing, salvaging of any suitable hollow logs from cleared trees for installation within Public Open Space and/or the adjacent Bush Forever Area 349, outlining clearing protocol for trees possibly containing Brushtail Possums, strategies for feral pest management, installation of educational signage in the Public Open Space and Bollard Bulrush Swamp, and reporting on the number and variety of species trapped, recorded or relocated both prior to and during subdivision works.
- The ceding of the Bollard Bulrush Wetland core and the Tramway Reserve free of cost to the Crown at the subdivision stage.

4.4 Management Plans

The following management plans are to be prepared where applicable as conditions of subdivision approval.

4.4.1 Wetland Management Plan

A Wetland Management Plan is to be prepared as a condition of subdivision approval to the satisfaction of the Department of Environment and Conservation on advice from the City of Kwinana, and is to address the provisions of the Wetland Management Strategy included in Appendix 1.

4.4.2 Urban Water Management Plan

An Urban Water Management Plan is to be prepared as a condition of subdivision approval. The Urban Water Management Plan is to be prepared in accordance with the approved Local Water Management Strategy at Appendix 7, and the WAPC's Better Urban Water Management Guidelines (October 2008).

4.4.3 Landscape Management Plan

A Landscape Management Plan is to be prepared as a condition of subdivision approval, and shall detail the following:

- Entry statements and verge treatments
- Development and maintenance of public open space
- Remnant vegetation management, requiring on-site tree surveys to be carried out with regards to earthworks and drainage requirements prior to subdivision. This is to determine those trees within the development area to be retained within public reserves and should consider the size and species of trees and potential fauna roosting and nesting hollows.
- Early tree planting and landscaping program for the Tramway Reserve
- Weed control

4.4.4 Mosquito and Midge Management Plan

A Mosquito and Midge Management Plan (including monitoring programs) is to be prepared as a condition of subdivision approval. The Mosquito and Midge Management Plan is to be to the satisfaction of the City of Kwinana, and in accordance with Environmental Protection Authority Guidance Statement 40: Guidance Statement for Management of Mosquitos by Land Developers (EPA 2000).

4.4.5 Fauna Management Plan

A Fauna Management Plan is to be prepared as a condition of subdivision approval. The Fauna Management Plan is to be to the specification of the City of Kwinana, and is to include:

- Identification of potential fauna habitat trees retained in public reserves;
- Strategies for relocation of fauna prior to clearing;
- Salvaging of any suitable hollow logs for installation in POS or Bush Forever Area;
- Outlining clearing protocol for trees possibly containing Brushtail Possums;
- Strategies for feral pest management;
- Installation of educational signage in POS; and
- Reporting on the number and variety of species trapped, recorded or relocated prior to and during subdivision works.

Amendment 1 - Addendum Report

WELLARD RESIDENTIAL LOCAL STRUCTURE PLAN

November 2024

CLE Town Planning + Design

CLE Town Planning + Design

Title:	Wellard Residential Local Structure Plan Addendum 1 - Amendment Report
Prepared for:	Wellard Residential Pty Ltd
CLE Reference:	2263Rep190C
Date:	14 November 2024
Status:	Final
Prepared by:	CLE Town Planning + Design
Project Team:	Town Planning + Design - CLE Town Planning + Design Environment, Water, Bushfire & Landscape - Emerge Associates Transport - PJA Engineering Services - JDSi

This report is for the exclusive use of the Client, pursuant to Agreement between the Client and CLE Town Planning + Design. CLE accepts no liability or responsibility whatsoever in respect of any use of or reliance upon any information contained within this report by anyone who is not party to the Agreement and/or has come into possession of the Report through parties other than the Client or CLE.

CLE is not accountable for any information which may be contained within the Report which has been supplied by others and reproduced by CLE in this report.

Copyright and any other Intellectual Property arising from this report and the provision of the services in accordance with the Agreement belongs exclusively to CLE unless otherwise agreed and may not be reproduced or disclosed to any other person other than the Client without the express written authority of CLE.

Any reproduction by the Client is to reference CLE as the original author.

Plans and figures contained in this report have been prepared for general information purposes only and may inadvertently use uncontrolled data from external sources. CLE does not guarantee the accuracy of the plans and they should not be used for any detailed site design. The content of this report including all plans remains the property of CLE.

© CLE 2024

CONTENTS

PART ONE - IMPLEMENTATION

1. Structure Plan Area & Operation
    - 1.1 Application Area & Approval
    - 1.2 Relationship with Statutory Planning Framework
    - 1.3 Structure Plan Content
2. Purpose
3. Subdivision & Development Requirements
    - 3.1 Land Use Zones & Reserves
        - 3.1.1 Structure Plans Zones
        - 3.1.2 Road Reserves
        - 3.1.3 Public Open Space
    - 3.2 Density & Development
        - 3.2.1 Density & R-Codes
        - 3.2.2 Local Development Plans
    - 3.3 Other Requirements
        - 3.3.1 Bushfire Management
        - 3.3.2 Developer Contributions
        - 3.3.3 Water Resource Management
4. Additional Details
    - 4.1 Studies to be required under condition of subdivision approval

PART TWO - EXPLANATORY

1.0 Purpose of Amendment

2.0 Background

- 2.1 Area & Land Use
- 2.2 Ownership & Title Details
- 2.3 Location & Surrounding Context

3.0 Planning Framework

4.0 Proposal

- 4.1 Zoning & Land Use
- 4.2 Residential & Built Form
- 4.3 Movement Network
- 4.4 Environmental
  - 4.4.1 Topography, Landform & Soils
  - 4.4.2 Flora & Vegetation
  - 4.4.3 Fauna
  - 4.4.4 Wetlands
- 4.5 Water Management
  - 4.5.1 Stormwater Management
  - 4.5.2 Groundwater Management
- 4.6 Public Open Space
- 4.7 Bushfire Hazard Management
- 4.8 Servicing

5.0 Conclusion

ATTACHMENTS

Attachment 1: Amended Wellard Residential Local Structure Plan

Attachment 2: Local Water Management Strategy [Emerge Associates]

Attachment 3: Engineering Services Report [JDSi]

Attachment 4: Bushfire Management Plan [Emerge Associates]

Attachment 5: Landscape Masterplan [Emerge Associates]

Attachment 6: Environmental Assessment & Management Strategy [Emerge Associates]

Attachment 7: Transport Impact Assessment [PJA]

PART ONE: IMPLEMENTATION

1. STRUCTURE PLAN AREA & OPERATION

1.1 Application Area & Approval

This Structure Plan Addendum Report (Amendment 1) applies to Lot 506 (362) Johnson Road, Wellard, being the land subject to Amendment 1 of the Structure Plan. The Structure Plan is identified as the Wellard Residential Local Structure Plan area.

The Structure Plan comes into effect on the date it is approved by Western Australian Planning Commission.

1.2 Relationship with Statutory Planning Framework

The Structure Plan has been prepared as required by Clause 5.14.3 of the City's Local Planning Scheme No. 2 (LPS2) and the *Planning and Development (Local Planning Schemes) Regulations 2015* Schedule 2 - Deemed provisions for local planning schemes (Deemed Provisions). The Structure Plan is in accordance with the objectives of Liveable Neighbourhoods and supporting state and local planning policies to outline future zones, reserves, public open space and supporting infrastructure.

Pursuant to the Deemed Provisions, a decision maker of an application for development or subdivision approval is to have due regard to the provisions of this Structure Plan, including the Structure Plan Map, Implementation Report, Explanatory Report and Technical Appendices.

1.3 Structure Plan Content

The Structure Plan comprises:

- Part One – Implementation Report
- Part Two – Explanatory Report
- Appendices – Technical Reports

Part One – Implementation of this Addendum Report comprises the Structure Plan map and supporting planning provisions and is applicable only to land contained within the land subject to Amendment 1 (Lot 506 Johnson Road, Wellard). Part Two of the Structure Plan is the explanatory report component, which can be used to interpret and implement the requirements of Part One.

2. PURPOSE

The purpose of this Structure Plan amendment is to coordinate zoning, subdivision and development over Lot 506 Johnson Road, Wellard, consistent with its 'Development' zoning under the City of Kwinana Local Planning Scheme No.2 (LPS2).

3. SUBDIVISION & DEVELOPMENT REQUIREMENTS

3.1 Land Use Zones & Reserves

3.1.1 Structure Plans Zones

Plan A is the Structure Plan Map, which designates the proposed zones and reserves applicable to land within the Structure Plan. Subdivision and development of land is to be generally in accordance with the Structure Plan Map.

Refinements to the zones and reserves is permitted at subdivision stage subject to submission of an appropriate level of supporting technical justification.

The Structure Plan proposes a 'Residential' zoning, which accords with the City's LPS 2. Land use permissibility for land within the Structure Plan area shall be in accordance with the corresponding zone.

3.1.2 Road Reserves

The Structure Plan is subject to the following key movement network considerations:

- Road connections to the surrounding local area shall be generally in accordance with **Plan A** and shall connect seamlessly into existing and planned roads in the neighbouring community.
- Road reserves and the supporting cross sections should be developed in accordance with the objectives of *Liveable Neighbourhoods* pursuant to conditions of subdivision approval, in consultation with the City of Kwinana.

3.1.3 Public Open Space

Public open space is to be provided generally in accordance with the Structure Plan Map and **Table 1** of this Structure Plan (as below).

The Structure Plan makes provision for approximately 14.6% of the entire Structure Plan area (including the amendment area) to be set aside as creditable public open space, as set out below and in accordance with **Plan A**.

Notes:
1. In accordance with Liveable Neighbourhoods: the area subject to inundation more frequently than a one year average recurrance interval rainfall event is not included as restricted or unrestricted open space and is a deduction from the net site area (LN R33); areas for the detention of stormwater for a greater than one year average recurrance interval up to the five year recurrance interval is restricted open space up to 20%, the area greater than 20% is a deduction (LN R26 & Table 11); areas for the dentention of stormwater for a greater than five year average recurrance interval is within unrestricted open space (LN R25).

2. Gross Area is the total area of Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and Lots 1, 2, 10 and 502 Johnson Road.

3: The EPP Wetland Core and EPP Wetland Buffer are outside of the LSP boundary and are treated as deductions from the Gross Site Area. There is a portion of the REW Core within the LSP area, which is also a deduction from the Gross Site Area.

4. The REW Buffer is Restricted Use Open Space in accordance with Liveable Neighbourhoods R33.

5. Restricted Use Open space exceeding 2% of the minimum POS requirement is treated as a deduction. This area includes a portion of the REW Buffer area

6. Parks and Recreation (Tramway Reserve) treated as unrestricted open space in accordance with Liveable Neighbourhoods (LN R7).

7. 'Main Drain Interface' and 'Western Entry South' are treated as restricted open space with the exception of the area subject to inundation more frequently than a one year average recurrance interval rainfall event, which is a deduction from the gross site area.

Public Open Space Schedule (all areas are in hectares)		
Site Area		**81.62**
Existing Deductions		
EPP Wetland and Buffer (MRS Rural Zone)	9.70	
REW Core within Urban Zone	0.31	
Total Existing Deductions	9.70	
Gross Urban Area		**71.9**
Structure Plan Deductions		
1:1 Drainage within POS	0.70	
Restricted Use POS Surplus (>2% of total) (2.49-1.40)	1.09	
Total Structure Plan deductions	1.79	
Gross Subdivisible Area		**70.13**
POS @ 10%		7.01
Public Open Space Requirement		
May Comprise:		
Min 8% unrestricted POS	5.61	
Max 2% restricted POS	1.40	
TOTAL POS REQUIRED		**7.01**
Public Open Space Provided	Unrestricted POS Area	Restricted POS Area
1. Wetland Core	0.00	0.00
2. Wetland Buffer	0.00	1.48
3. Wetland Interface	0.53	0.03
4. North Western Open Space	1.10	0.01
5. Tramway	2.29	0.02
6. Western Linear Park	0.97	0.07
7. Western Entry South	0.01	0.09
8. Main POS	0.97	0.19
9. Woodland Park	1.32	0.01
10. Eastern Neighbourhood Park	0.28	0.17
11. Eastern Entry	0.36	0.06
12. Main Drain Interface	0.20	0.12
13. Millar Park	0.22	0.04
14. Main Drain Park	0.40	0.23
15. Johnson Road Interface	0.00	0.15
TOTAL (ha)	**8.66**	**2.66**
Additional Deductions		
Restricted Use POS Surplus (>2% of total; accounted above)		1.09
Public Open Space Contribution		
Min 8% unrestricted POS provided	8.66	12.3%
Max 2% restricted POS provided	1.57	2.2%
Total Creditable POS Provided	**10.23**	**14.6%**

Table 1 - Public Open Space Schedule

3.2 Density & Development

Plan A designates the applicable R-Code to subdivision and development of the Structure Plan. Subdivision and development shall exceed a dwelling target of 22 dwellings per site hectare across the entire Structure Plan area in accordance with *Liveable Neighbourhoods*.

3.2.1 Density & R-Codes

The Structure Plan adopts a residential density code of R30 for the Amendment 1 area.

3.2.2 Local Development Plans

The preparation of a Local Development Plan may be required by the WAPC as a condition of subdivision approval where deemed necessary for land comprising, but not limited to:

(i) Lots abutting areas of public open space to address:

- Built form orientation and passive surveillance; and
- Uniform visually permeable fencing.

3.3 Other Requirements

3.3.1 Bushfire Management

The Structure Plan is supported by a Bushfire Management Plan (**Attachment 4**). Regardless of whether the land has been formally designated as bushfire prone, any building to be erected on land identified within 100 metres of a bushfire hazard is designated as bushfire-prone and shall comply with the requirements of Australian Standard 3959 under the National Construction Code.

Subdivision within the Structure Plan area is required to demonstrate the ability to achieve a maximum post development Bushfire Attack Level (BAL) rating of BAL-29 for all proposed lots and a minimum of two vehicle access and egress points in two different directions, in accordance with the WAPC's *Guidelines for Planning in Bushfire Prone Areas*.

3.3.2 Developer Contributions

The Structure Plan is subject to the requirements of Development Contribution Plan No's 1, 7 and 12 as detailed in Schedule 5 of the City of Kwinana Local Planning Scheme No.2. The Structure Plan is subject to infrastructure cost contributions in accordance with the relevant Development Contribution Plan (DCP) and Cost Apportionment Schedule.

3.3.3 Water Resource Management

Development and subdivision within the Structure Plan area will be required to meet the relevant requirements of the *Better Urban Water Management Guidelines* (WAPC, October 2008) or its successor in the context of the Local Water Management Plan prepared by Emerge Associates as part of this Structure Plan.

4. ADDITIONAL DETAILS

4.1 Studies to be required under condition of subdivision approval

The following technical reports / strategies are to be prepared and submitted as a condition of subdivision approval (where applicable).

Additional Information / Purpose	Approval Stage	Responsible Agency (Consultation Required)
Urban Water Management Plan	Subdivision	City of Kwinana
Mosquito and Midge Management Strategy	Subdivision	City of Kwinana
Wildlife Protection Management Plan	Subdivision	City of Kwinana
Landscape Feature and Tree Retention Management Plan	Subdivision	City of Kwinana
Bushfire Management Plan	Subdivision	City of Kwinana
Landscape Plan	Subdivision	City of Kwinana
Local Development Plan	Subdivision	City of Kwinana

Table 2 - Condition of Subdivision Approval

LEGEND

Structure Plan Boundary (Development Zone Area)

Zones

- Residential R20
- Residential R30
- Residential R50
- MRS Rural Zone

Reserves

- Public Open Space
- MRS Parks and Recreation Reserve

Road Network

- District Distributor
- Local Distributor
- Key Local Access Street
- Bus Routes
- Full Movement "T" Intersection

Notes:

1. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.
2. A hard edged road interface shall be provided to the wetland areas and Bush Forever reserves with road reserve widths to be confirmed at subdivision.
3. Northern access to Wellard Road is a full movement "T" intersection with priority to Wellard Road. This intersection may be downgraded to left in/left out when Wellard Road is constructed as a dual carriageway.
4. Southern access to Wellard Road is either a roundabout or a full movement "T" intersection, to be confirmed at subdivision stage.
5. The wetland core comprises of both the EPP lake and Resource Enhancement wetland boundaries.
6. The wetland buffer is 50m to the EPP lake and 30m to the Resource Enhancement wetland as agreed with Environmental Protection Authority.

Town Planning + Design

PLAN A: LOCAL STRUCTURE PLAN

Johnston Road, Wellard

plan no: **2263-52K-01**
date: 20 November 2023
scale: 1:5,000 @A3, 1:2,500 @A1

PART TWO: EXPLANATORY

1.0 PURPOSE OF AMENDMENT

The primary purpose of this amendment (Amendment 1) is to facilitate subdivision and development over Lot 506 Johnson Road, consistent with its 'Development' zoning under the City of Kwinana Local Planning Scheme No.2 (LPS2), by introducing the subject site into the existing Wellard Residential Local Structure Plan area.

Specifically, this amendment proposes the following updates:

- Extend the Structure Plan map boundary to include Lot 506.
- Allocate a 'Residential' zone to cover Lot 506, with a density coding of R30.
- Append this Addendum Report to the existing LSP to provide an explanatory report for the amendment.

The Wellard Residential Local Structure Plan map, inclusive of the proposed modifications is shown as **Attachment 1** of this Addendum. The updated LSP map supersedes the existing map contained within the existing Wellard Residential Local Structure Plan.

The changes proposed by this amendment shall prevail over the existing Wellard Residential Local Structure Plan to the extent of any inconsistencies.

2.0 BACKGROUND

2.1 Area & Land Use

The amendment area covers the entirety of Lot 506 Johnson Road, which spans a total area of approximately 7.8ha.

Lot 506 is an undeveloped (vacant) land parcel that has been historically cleared and use for agriculture purposes. The site is not currently used for any specific purpose, and the past agricultural uses have had a considerable impact on the natural environment of the site resulting in it being largely cleared of any native vegetation which have any ecological value.

The site has been utilised for various agricultural land uses, since having been cleared in the 1950s, which more recently has included a horse agistment facility. Various shelters and single row windbreak non-native tree plantings that separate cleared paddocks are present across the site.

2.2 Ownership & Title Details

Lot 506 is owned by Wellard Residential Pty Ltd who are the sole landowner of the existing Providence estate. The amendment does not affect any lot currently held in private (third party) ownership.

Figure 1 - Site Plan
Source: Nearmap

2.3 Location & Surrounding Context

The amendment area is located in Wellard within the City of Kwinana, approximately 32km south of the Perth CBD, and 2km southeast of the Kwinana town centre. The Wellard locality is largely defined by Bertram Road to the north, Wellard Road to the west, the Kwinana Freeway to the east, and Millar Road to the south.

The inclusion of Lot 506 into the structure plan area represents a logical extension to the existing Providence estate to the west of the Peel Main Drain. The following provides a brief summary of the local context:

- The site is separated from the balance of the Providence estate via the Peel Main Drain (zoned Rural under the MRS), which currently forms the western boundary of the site.
- The existing Providence estate which is located to the west on the other side of the Peel Main Drain has yet to be fully developed out, with a number of stages yet to be constructed.
- To the north, the site is bound by the Oakebella residential estate which has yet to be developed within the portion fronting the site. Development in the Oakebella estate has been largely isolated to sections further north towards Bertram Road, however the intent is for the site to connect into Oakebella once development progresses southward.
- Johnson Road and Irasburg Parade run along the eastern and southern boundaries of the site and will act as the primary access point to the site. Further afield, the site is in close proximity to existing infrastructure including the Wellard Primary School located on the opposite side of Johnson Road as well as established residential development further east.

3.0 PLANNING FRAMEWORK

The Wellard Residential Local Structure Plan was approved by the Western Australian Planning Commission (WAPC) on 28 September 2012 and subsequently endorsed by the City of Kwinana on 17 October 2012. It covers the land now being developed as the Providence estate. Pursuant to Clause 5.16 of the City of Kwinana's Local Planning Scheme No.2 (LPS2), the Wellard Residential Local Structure Plan is an operational structure plan.

Lot 506 is zoned 'Development' under the LPS2 as shown in **Figure 2** below.

In accordance with LPS2, the purpose of the 'Development' zone is:

a. designate land for future development;

b. provide a planning mechanism for the identification and protection of areas of conservation value whilst facilitating the growth of the Town;

c. provide for the orderly planning of large areas of land for residential, commercial, industrial and associated purposes through a comprehensive structure planning process;

d. enable planning to be flexible and responsive to changing circumstances throughout the developmental stages of the area; and

e. provide sufficient certainty for demand forecasting by service providers.

As outlined in Clause 5.14.3 of LPS2, the subject site requires an approved Structure Plan to guide subdivision and development.

As the site abuts the Wellard Residential Local Structure Plan, which is the overarching planning document for the existing Providence estate, this amendment represents an excellent opportunity to consolidate urban development in the locality and ensure that subdivision and development progresses in a well integrated and coordinated manner across the estate.

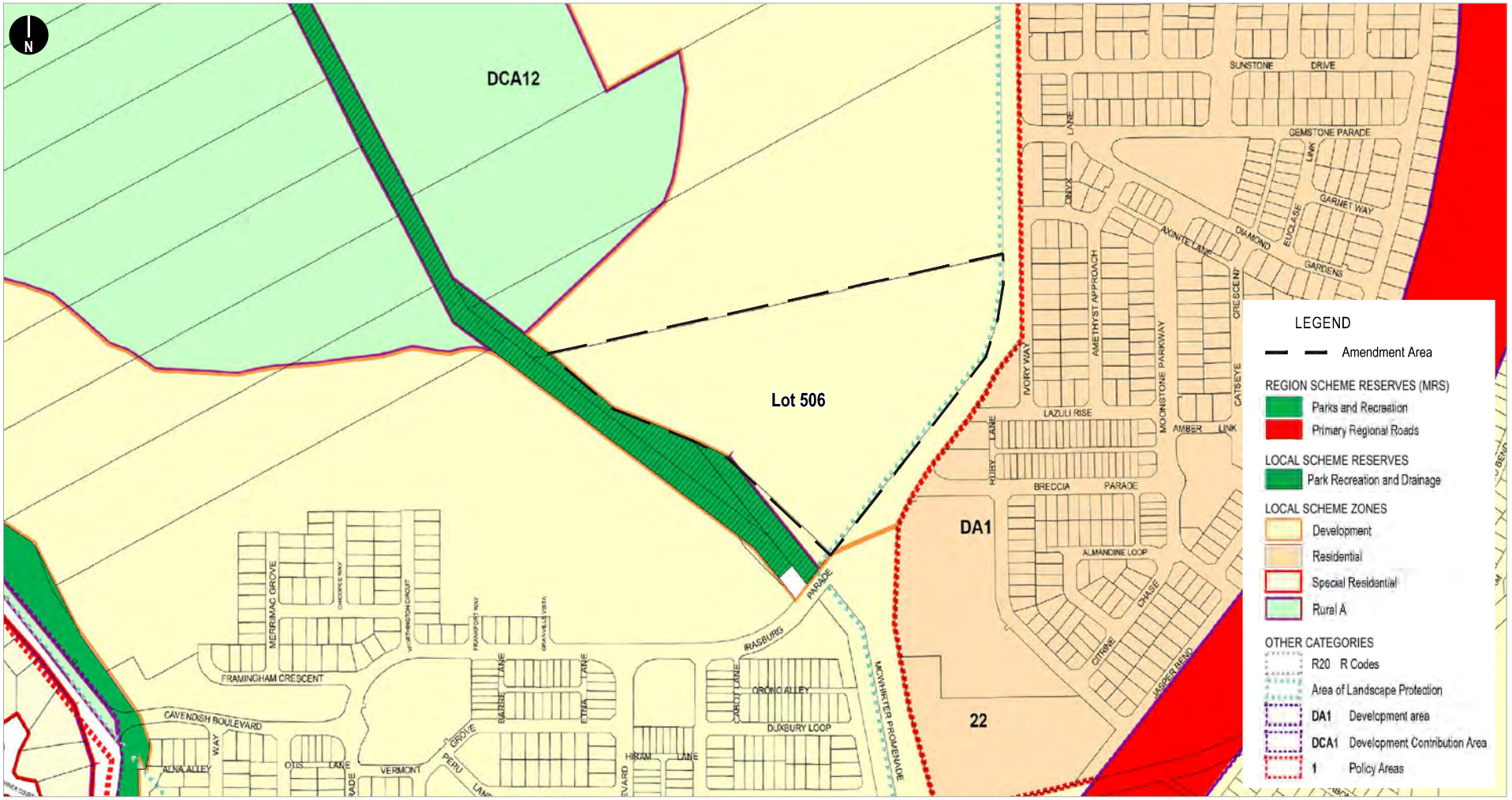


Figure 2 - City of Kwinana Local Planning Scheme No.2 (LSP2)
Source: DPLH

4.0 PROPOSAL

A Subdivision Concept Plan has been prepared in support of the amendment, demonstrating how lot 506 can be developed in accordance with the Structure Plan (as amended).

The Subdivision Concept Plan reflects the existing density codes established in the Wellard Residential Local Structure Plan, through the provision of an R30 density code for the site.

A suite of technical work has been undertaken to support this amendment, demonstrating that there are no impediments to subdivision and development occurring over lot 506, and ultimately the amendment progressing.

The following sections provide analysis and justification for the amendment relating to the key planning considerations.

4.1 Zoning & Land Use

The primary purpose of the amendment is to extend the LSP area to cover the subject site, to facilitate subdivision and development consistent with the density codes established in the Wellard locality.

The amendment proposes to extend the 'Residential' designation over the site, with a density code of R30 applied across the balance of the site, which will provide opportunities to deliver a range of traditional lots typically ranging in size from 260m² to 500m² consistent with the existing LSP.

The *Perth and Peel @3.5 million* planning framework sets an overall residential density target of 15 dwellings per gross hectare of urban-zoned land. This target was carried over from the previous planning framework, Directions 2031 and Beyond and is reflected in *Liveable Neighbourhoods* (LN). *Perth and Peel @3.5 million* also contains a yield target of 26 dwellings per hectare of net developable area ('NDA', being the land area available to the developer for sale for residential purposes).

Based on the subdivision concept (shown within **Figure 3**), it is envisaged the site will provide an additional 100-130 residential dwellings within the Providence estate, achieving an overall density of 16 dwellings per gross hectare and a residential site density of 26 dwellings per residential hectare, consistent with the density targets set out in *Perth and Peel @3.5 million* and LN.

4.2 Residential & Built Form

The addition of lot 506 to the LSP will further opportunities to provide a range of densities, housing types and tenures to facilitate residential yields commensurate with the strategic planning framework, as well as the site's location within the broader district context.

As mentioned above, the site will be covered by a base density code of R30, providing opportunities to deliver traditional front loaded lots. The R30 density code has been allocated in recognition of the sites interface to the Peel Main Drain and nearby Wetland, which will provide a suitable transition to future residential development to the north as part of the Oakebella estate, allowing for both traditional and cottage lots.

Figure 3 - Subdivision Concept
Source: DPLH

To ensure that high quality-built form outcomes are delivered in a manner that is consistent with the existing Providence estate, it is expected that the provisions of the existing estate wide LDP will be carried over to the site. The Bollard Bulrush (South) Local Development Plan ('the LDP') which was approved by Council on 12 November 2013, currently applies to the entirety of the existing Providence estate. The LDP currently provides specific built form controls relating to:

- Setbacks
- Boundary Walls
- Privacy
- Surveillance
- Streetscape Interface
- Private Open Space
- Utilities and Facilities

As the LDP only remains valid until October 2025, consistent with Clause 67 of the Deemed Provisions, the LDP will need to be amended to include lot 506 and to extend the approval period to ensure consistent development outcomes for the remaining sections of the estate. This can be managed at the subdivision stage via standard conditions of approval and will ensure built form outcomes are delivered in a coordinated and consistent manner with the existing estate.

4.3 Movement Network

In accordance with the WAPC's Transport Impact Assessment Guidelines, the project traffic engineers, PJA, have undertaken a Transport Impact Assessment based on the Development Concept Plan.

The TIA demonstrates that the proposed amendment, and inclusion of the subject site, does not compromise the function of the existing movement network, and simply extends the established road network in the Wellard locality.

The following provides a summary of the key elements of the Transport Impact Assessment including details of the existing and proposed road networks, the road hierarchy and traffic generation. Further consideration is also given to public transport, cyclist and pedestrian network provision.

Existing Road Network

The characteristics of the road network surrounding the site are as follows:

- Johnson Road is an undivided single carriage way 'Local Distributor' road, which is located along the eastern boundary of the site. Access will be taken off Johnson Road via the existing Johnson Road / Irasburg Parade / Breccia Parade roundabout intersection along the south-east boundary of the site.
- Irasburg Parade is a divided single carriage way 'Access Road', which is located along the southern boundary of the site. Irasburg Parade runs in east-west alignment and provides connectivity from the existing Providence estate to the west, over the Peel Main Drain.

There is also a planned network of Access Streets emerging in the Oakebella estate to the north, to which connections will be made at appropriate locations to create a permeable and legible network of local roads.

Proposed Road Network

The proposed road network follows a logical and orderly hierarchy which provides legible and useable networks for all modes of transport for travel, to, from and within the area. The network has been defined by predicted traffic volumes, road function and design characteristics. As lot 506 is bound to the west by the Peel Main Drain, the proposed network is general focused in a north and south manner towards Johnson Road and the Oakebella estate respectively.

The proposed LSP road network has been designed with regard to the adjoining structure plans in the area which are currently under construction, particularly that of the Oakebella Estate to the north.

The site comprises a network of 'Access Streets' which will provide connectivity to and from the proposed access points onto Lattuge Drive and Johnson Road to the north and south respectively. Road reserves and street cross sections are provided in accordance with the standards set out in LN as follows:

- Access Street C: 16m
- Access Street D: 13m – 15m

Traffic generated by lot 506 area and other existing and planned road networks have been considered as part of the TIA and it is expected the external traffic generation can be adequately accommodated on the future planned external road network. The traffic modelling undertaken as part of the TIA demonstrates that all traffic movements fall within the acceptable limits outlined by LN for the respective road categories proposed by this amendment.

Intersection Analysis

A total of two access points will be provided for to connect the site into the existing and future road network surrounding the site. Initially, access into lot 506 will be from the Johnson Road / Irasburg Parade / Breccia Parade roundabout intersection at the south-east corner of the site. The TIA demonstrates that there is adequate capacity in this intersection and there are no constraints with accommodating access into lot 506 during both peak periods.

The northern access point into the Oakebella estate will be extended and integrated with lot 506 via an extension of Lattuge Drive to the north as development progresses.

Cycling and Pedestrian Movement

The Structure Plan facilitates a safe and convenient pedestrian and cycle movement network through the provision of indirect vehicle routes and landscaped environments, that expand upon existing connections found in adjoining areas.

A planned shared path through the Oakebella estate to the north will provide north-south connectivity for cyclists travelling to and from the area. Additionally, the existing footpath network on the eastern side of Johnson Road is planned to be upgraded to a shared path standard and will provide further opportunity to utilise active modes of transport.

Footpaths will be provided on at least one side of all Access Streets at the subdivision stage, with the precise location and alignment of all paths to be determined in consultation with the City of Kwinana as part of detailed civil design following subdivision approval.

A copy of PJA's Transport Impact Assessment is included as **Attachment 7**.

4.4 Environmental

The site has been cleared for a number of years for agricultural purposes which has resulted in most of the natural environment being removed, highly disturbed and/or degraded.

The following section summarises the key findings of the Environmental Assessment and Management Strategy (EAMS) prepared by Emerge Associates. The EAMS details the site conditions and constraints within the site and demonstrates that the relevant environmental factors, can all be adequately addressed through the planning approval process via the application of appropriate land use responses and management practices.

As noted previously, the site has been historically cleared of any native vegetation and only comprises pasture grasses and planted trees which have little ecological value.

4.4.1 Topography, Landform & Soils

The site is relatively flat and ranges in height from approximately 4m Australian Height Datum (AHD) to 10m AHD, with the high point being located along the eastern boundary of the site at Johnson Road.

The site is located within the Bassendean soil and landform system and regional geology mapping indicates that the site ranges from Bassendean and Vasse sands. The southern and eastern portions of the site are predominately sandy soils, which are ideal for urban development. Further information on soil types and drainage is provided in the Environmental Assessment and Management Strategy and Local Water Management Strategy (refer **Attachment 6 and 2** respectively).

The Department of Water and Environment Regulation (DWER) acid sulphate soil (ASS) risk mapping shows the majority of the site as 'high to moderate risk' of ASS occurring within 3m of the natural soils surface. The eastern portion of the site is mapped as having a 'moderate to low risk'.

An ASS assessment will be prepared in the usual manner prior to earthworks, as part of the subdivision. Given the limited amount of cut required for the site, potential ASS impacts and associated management response are expected to be limited to areas connected to sewer construction.

4.4.2 Flora & Vegetation

The site does not contain any Threatened Ecological Communities (TECs), Priority Ecological Communities (PECs), Declared Rare or Priority flora or Bush Forever sites.

As noted above, the site is predominantly cleared of native vegetation and is generally comprises planted non-native trees (wind break and shelter plantings) and some scattered native trees remaining amongst extensive areas of paddock grasses and weeds.

The vegetation condition within the site has been assessed as being 'Completely Degraded', reflective of the sites previous agricultural use which involved extensive grazing. As a result, the site has largely remained free of vegetation until around 2000 when rows of windbreak trees were planted dividing empty paddocks.

Some remnant scattered *Eucalyptus rudis* (flooded gum) are located in the central portions of the site and the proposed POS area in the western portion of the site interfacing with the Peel Main Drain. As required by the City's *Local Planning Policy No.1 – Landscape Feature and Tree Retention* (LPP1), trees within the western portion of the site will be retained within the POS which has been strategically located within this section of the site to maximise retention. Despite this, it is noted that the none of the trees were considered to have a diameter at breast height greater than 0.5m, and as such are not considered to be defined as "significant trees" in LPP1.

The location of trees proposed to be retained are shown in **Figure 4** and will be retained where possible subject to detail design and subsequent discussions with the City as part of the earthworks design for the site.

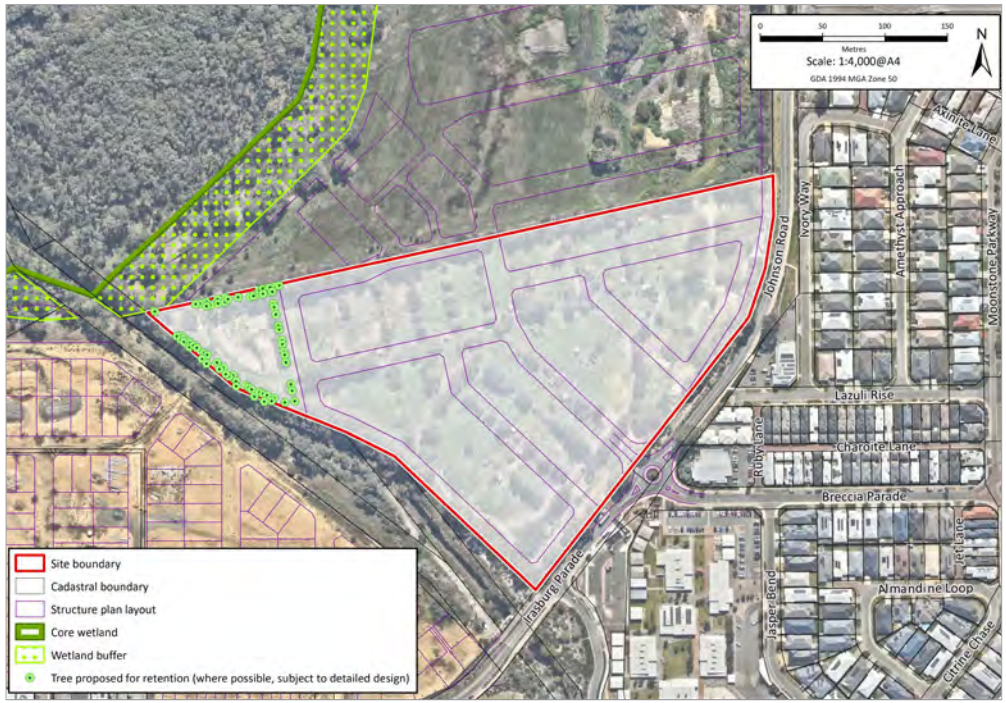


Figure 4 - Tree Retention Plan
Source: Emerge Associates

4.4.3 Fauna

As the site has historically been cleared of native vegetation and largely comprises of recently planted windbreak trees, it offers very limited and poor-quality fauna habitat, particularly in the context of the broader area (with the Bollard Bulrush Swamp to the north).

The EAMS notes that whilst the site is partly mapped within a buffer for a known roosting site for Carnaby's Black Cockatoo, the degraded nature of native vegetation on site is unlikely to provide important habitat particularly given the large patches of suitable habitat found within the nearby Bollard Bulrush Swamp.

4.4.4 Wetlands

The Department of Biodiversity, Conservation and Attractions (DBCA) geomorphic wetlands database shows that the site is covered by a Multiple Use Wetland UFI 13327 associated with the Bollard Bulrush Swamp. Multiple Use Wetlands are the lowest of the 3 wetland categories used in DBCA's classification system and apply to wetlands that have little to no ecological value but retain hydrological functions requiring particular attention in respect of water management planning.

Importantly, the conservation wetland (CCW) and resource enhancement wetland buffer (REW) associated with the Bollard Bulrush Swamp does not extend into the site which is located outside the boundary of the amendment area.

Ultimately, the assessment demonstrates that the vacant site is free of any environmental features of conservation significant that would restrict residential development on site.

4.5 Water Management

A Local Water Management Strategy (LWMS) has been prepared by Emerge Associates to support the inclusion of lot 506 into the existing Providence LSP. The LWMS demonstrates how the site addresses urban water management via an integrated water cycle approach, supported by implementation of Water Sensitive Urban Design (WSUD) initiatives, consistent with the WAPC's Better Urban Water Management guidelines, relevant approved State Planning Policies and local policies, and the draft version of *State Planning Policy 2.9: Planning for Water Guidelines.*

The LWMS (**Attachment 2**) confirms that water can be managed appropriately to enable implementation of water sensitive urban design principles, in line with state and local government objectives and policies and that there are no issues that would preclude the site from being developed for urban uses.

Refining the key principles for the management of stormwater runoff and groundwater quality, implementation of the LWMS will be through the development of a subsequent Urban Water Management Plans (UWMP) which will be prepared at the time of subdivision.

4.5.1 Stormwater Management

The LWMS sets out the proposed drainage system for the site in a manner that is appropriate for local conditions that incorporates best practice water sensitive urban design measures. The key features include:

- Residential lots will retain the first 15mm of runoff with a combination of soakwells, and further infiltration will also be provided in adjacent pervious garden areas to ensure runoff from the small rain event is treated as close to source as possible.

- Runoff not retained on lots or within the road reserve will be conveyed to the downstream bio-retention area within the western POS, abutting the Peel Main Drain to cater runoff above the first 15mm of rainfall (small event) up to and including the 20% AEP event.
- Stormwater runoff above the 20% AEP (minor event) up to and including the 1% AEP event (major event) will be conveyed within the downstream flood management area at the catchment low points and be retained and infiltrated within the western POS.

Despite the current site levels being (in some parts) lower than the 1% AEP flood level in the Peel Main Drain and the existing informal channel connection to the Peel Main Drain, no surface runoff will be discharged into the adjoining Peel Main Drain, with all runoff proposed to be fully retained on site.

4.5.2 Groundwater Management

Adequate separation between finished surface levels and groundwater will be achieved through the use of clean, free draining fill (where required).

An earthworks strategy has been prepared by JDSi Engineers (refer **Attachment 3**) for the site which shows adequate separation with minimum clearance of 1.2m from maximum groundwater levels across the site.

The control of groundwater by subsoil drainage is not required as a result of proposed lot levels which will provide the adequate clearance (at least 500mm) above the 1% AEP flood levels in the Peel Main Drain.

4.6 Public Open Space

The Amendment will provide two additional areas of public open space to support the established areas located within the Providence estate.

A 6,727m² area of public open space (denoted as 'Main Drain Park') is proposed in the western portion of the amendment area, abutting the Peel Main Drain and will act as an extension to the planned POS abutting the site to the north located within Oakebella estate. It performs a combined recreational and drainage function and has been credited as 'Unrestricted' POS for the purpose of the POS calculation.

An additional 1,500m² portion of open space (denoted as 'Johnson Road Interface') is provided along the Johnson Road frontage to ensure a high amenity interface. This area is approximately 9m wide and logically extends from the existing POS interface along Johnson Road to the north, within the Oakebella estate. This has been credited as 'Restricted' POS for the purpose of the POS calculation.

OPEN SPACE		GROSS AREA (ha)
1.	Wetland Core	10.01
2.	Wetland Buffer	1.48
3.	Wetland Interface	0.71
4.	North Western Open Space	1.20
5.	Tramway	2.40
6.	Western Linear Park	1.06
7.	Western Entry South	0.13
8.	Main POS	1.21
9.	Woodland Park	1.39
10.	Eastern Neighbourhood Park	0.50
11.	Eastern Entry	0.44
12.	Main Drain Interface	0.39
13.	Millar Park	0.29
14.	Main Drain Park	0.67
15.	Johnson Road Interface	0.15
Total POS		**22.03**

** Local Open Space size and location is indicative only and is subject to change and refinement at subdivision stage.*

Figure 5 - Public Open Space Overview

An updated POS Schedule has been provided for the entire Structure Plan area to include lot 506, and to reflect revised drainage storage areas and gross POS areas that have been delivered and implemented as part of subsequent subdivision and UWMP's for the existing Structure Plan area.

The updated POS Schedule demonstrates that a revised total POS of approximately 10.23ha will be provided, and once LN credits are applied, the open space provision is 14.6%, meeting the minimum credited public open space requirements, as shown in **Table 3** (Public Open Space Schedule). **Table 3** supersedes the previous POS Schedule (Appendix 10) which currently supports the existing structure plan.

Notes:

1. In accordance with Liveable Neighbourhoods: the area subject to inundation more frequently than a one year average recurrance interval rainfall event is not included as restricted or unrestricted open space and is a deduction from the net site area (LN R33); areas for the detention of stormwater for a greater than one year average recurrance interval up to the five year recurrance interval is restricted open space up to 20%, the area greater than 20% is a deduction (LN R26 & Table 11); areas for the dentention of stormwater for a greater than five year average recurrance interval is within unrestricted open space (LN R25).

2. Gross Area is the total area of Lots 167-170, 83, 85, 92 & 1278 Wellard Road, and Lots 1, 2, 10 and 502 Johnson Road.

3: The EPP Wetland Core and EPP Wetland Buffer are outside of the LSP boundary and are treated as deductions from the Gross Site Area. There is a portion of the REW Core within the LSP area, which is also a deduction from the Gross Site Area.

4. The REW Buffer is Restricted Use Open Space in accordance with Liveable Neighbourhoods R33.

5. Restricted Use Open space exceeding 2% of the minimum POS requirement is treated as a deduction. This area includes a portion of the REW Buffer area

6. Parks and Recreation (Tramway Reserve) treated as unrestricted open space in accordance with Liveable Neighbourhoods (LN R7).

7. 'Main Drain Interface' and 'Western Entry South' are treated as restricted open space with the exception of the area subject to inundation more frequently than a one year average recurrance interval rainfall event, which is a deduction from the gross site area.

Public Open Space Schedule (all areas are in hectares)		
Site Area		**81.62**
Existing Deductions		
EPP Wetland and Buffer (MRS Rural Zone)	9.70	
REW Core within Urban Zone	0.31	
Total Existing Deductions	9.70	
Gross Urban Area		**71.9**
Structure Plan Deductions		
1:1 Drainage within POS	0.70	
Restricted Use POS Surplus (>2% of total) (2.49-1.40)	1.09	
Total Structure Plan deductions	1.79	
Gross Subdivisible Area		**70.13**
POS @ 10%		7.01
Public Open Space Requirement		
May Comprise:		
Min 8% unrestricted POS	5.61	
Max 2% restricted POS	1.40	
TOTAL POS REQUIRED		**7.01**
Public Open Space Provided	Unrestricted POS Area	Restricted POS Area
1. Wetland Core	0.00	0.00
2. Wetland Buffer	0.00	1.48
3. Wetland Interface	0.53	0.03
4. North Western Open Space	1.10	0.01
5. Tramway	2.29	0.02
6. Western Linear Park	0.97	0.07
7. Western Entry South	0.01	0.09
8. Main POS	0.97	0.19
9. Woodland Park	1.32	0.01
10. Eastern Neighbourhood Park	0.28	0.17
11. Eastern Entry	0.36	0.06
12. Main Drain Interface	0.20	0.12
13. Millar Park	0.22	0.04
14. Main Drain Park	0.40	0.23
15. Johnson Road Interface	0.00	0.15
TOTAL (ha)	**8.66**	**2.66**
Additional Deductions		
Restricted Use POS Surplus (>2% of total; accounted above)		1.09
Public Open Space Contribution		
Min 8% unrestricted POS provided	8.66	12.3%
Max 2% restricted POS provided	1.57	2.2%
Total Creditable POS Provided	**10.23**	**14.6%**

Table 3 - Public Open Space Schedule

A Landscape Concept has been prepared by Emerge Associates showing the planned landscaping for this additional area of POS within lot 506. The Concept provides for a grassed area, creating an area of active open space with drainage conveyed to a landscaped bio-retention area to the south for onsite infiltration as shown **Figure 6 & 7**. This retention area will be landscaped with native vegetation and will provide an attractive and accessible interface to the Peel Main Drain.

The Landscape Concept is shown as **Attachment 5** (Emerge Associates).

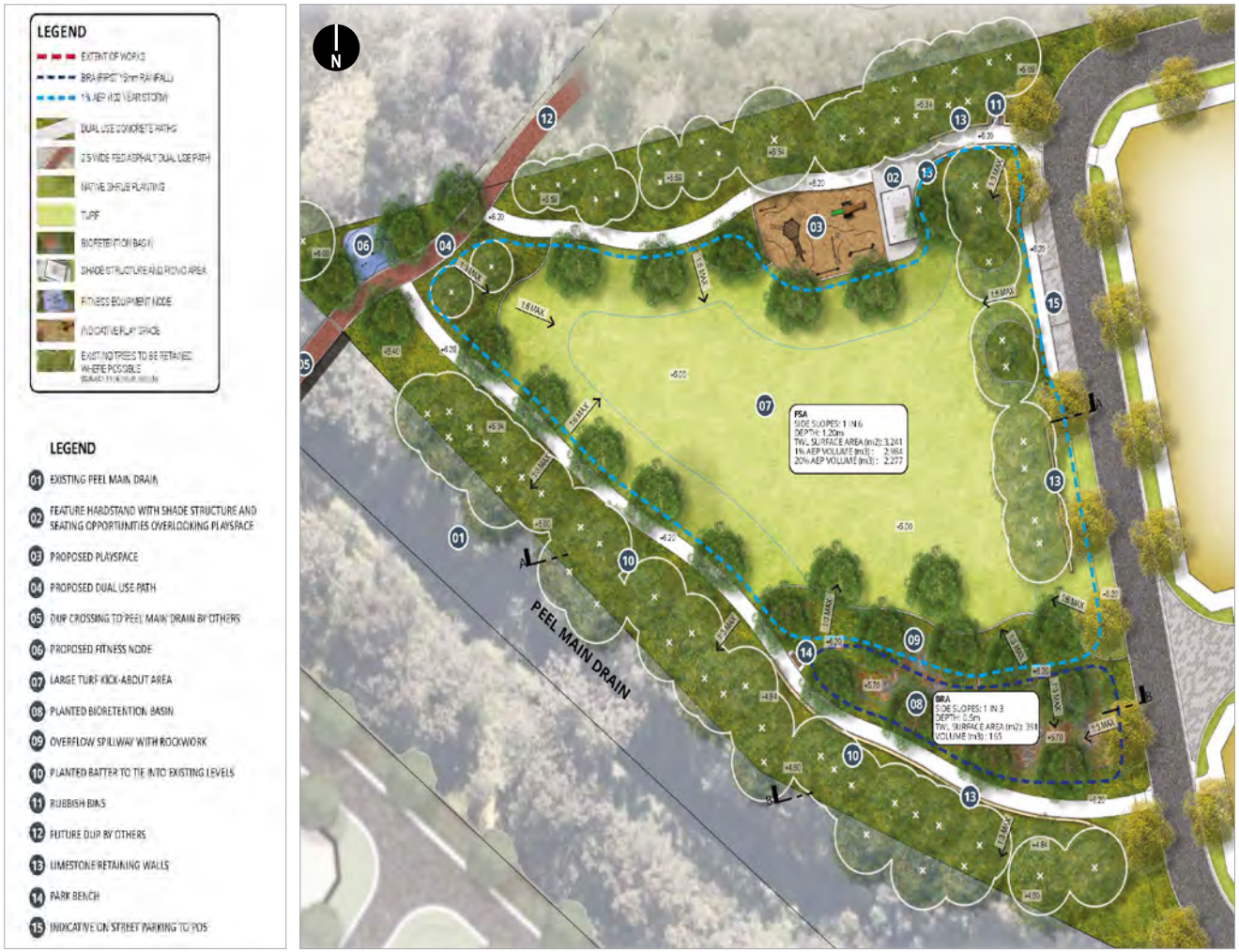


Figure 6 - Landscape Concept
Source: Emerge Associates

POS Detailed Design Considerations

The following are to be considered during the detailed design stage of the POS areas:

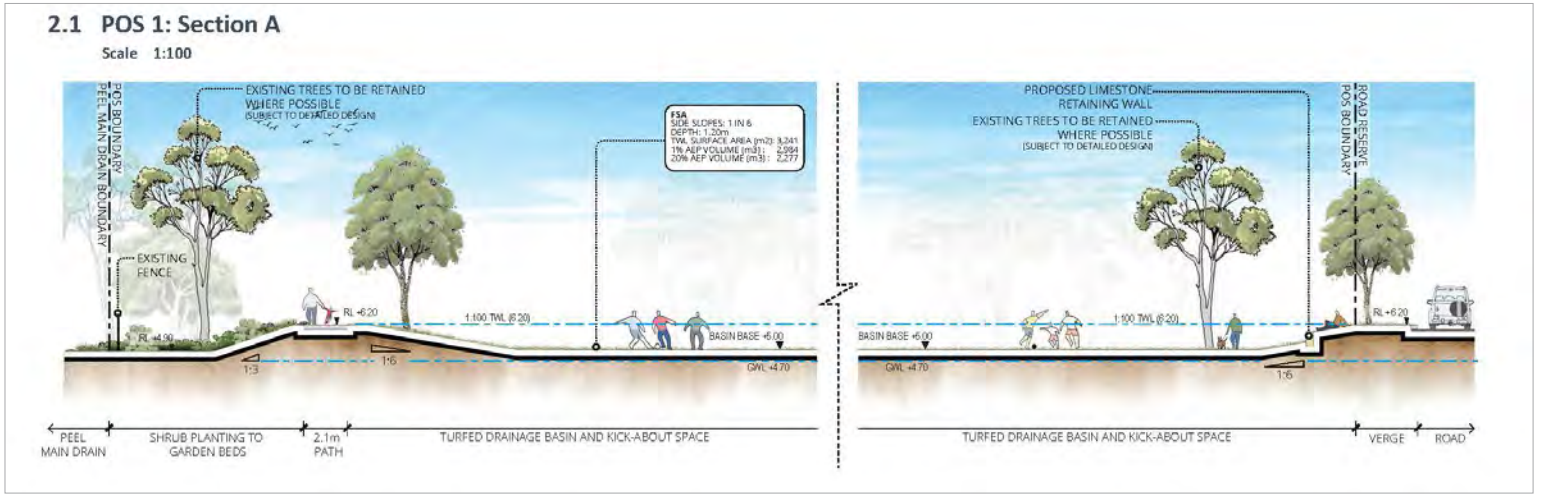
Main Park Drain POS:

- Play spaces will need accessible elements;
- Planted areas are to have a maximum gradient of 1 in 4. Basin areas can have a 1 in 3 gradient for planting;
- Perimeter footpath;
- Non-irrigated planted batters / native shrubland planting;
- Wetland buffer fencing and firebreak access;
- A hard edge (pathway) between the POS and the wetland buffer to minimise the spread of weeds; and
- Integration with the neighbouring / adjoining POS to the north.

Johnson Road POS:

- Landscaping continuity with the neighbouring Oakabella Estate.

Above: Public Open Space at The Wellard Estate



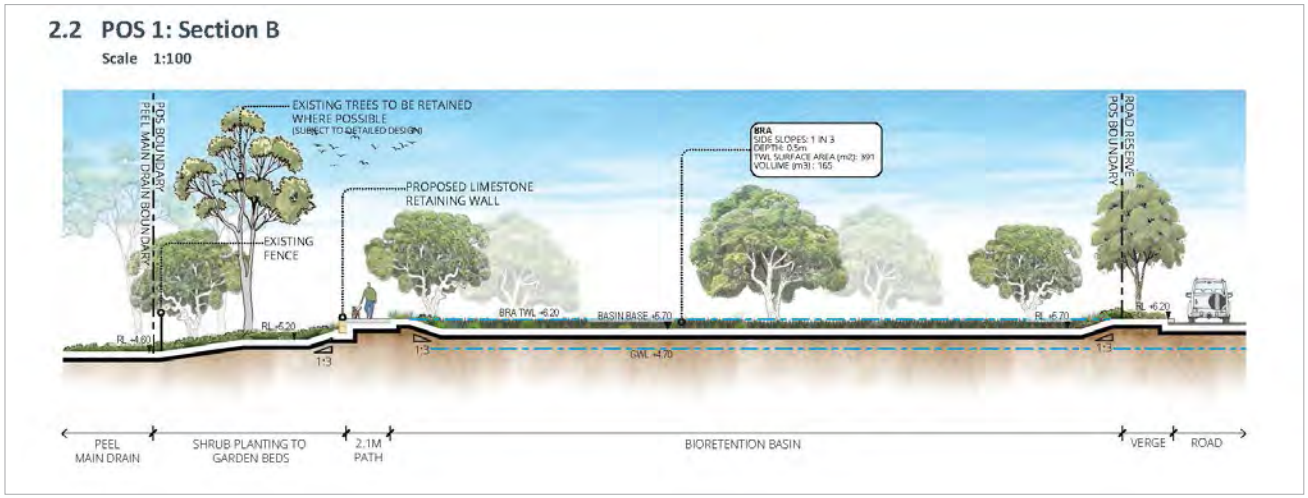


Figure 7 - Typical Site Sections
Source: Emerge Associates

4.7 Bushfire Hazard Management

The north-west portion of the application area is identified as bushfire prone under the Department of Fire and Emergency Services State Bushfire Mapping, which triggers the bushfire planning requirements under *State Planning Policy 3.7 Planning in Bushfire Prone Areas.*

A Bushfire Management Plan (BMP) has been prepared by Emerge Associates as part of this amendment and confirms that the bushfire risk will not be an impediment to development and that any hazard affecting the amendment area can be managed through a combination of asset protection zones (APZ), mandatory dwelling setbacks and appropriate construction standards (of dwellings).

The BMP identifies the primary bushfire hazards affecting the amendment area as the Bollard Bulrush Wetland and Peel Main Drain both of which are located along the northern and western boundaries of the site. The land to the north has been identified as a temporary bushfire risk given the vegetation within the undeveloped portions of Oakebella estate which interfaces with the site, however this will ultimately be removed as development progresses.

To respond to these risks the POS has been strategically located within the western portion of the site and has been designed to be suitable for maintenance in a low-threat state, to provide separation from habitable development to the east. This interface has been further managed via the use of perimeter roads within the western and northern portions of the site, which connect into the proposed access streets to ensure two-way access to the site via Johnson Road to the south and Lattuge Drive to the north.

Lots impacted by the bushfire risk associated with the Oakebella estate and the Peel Main Drain will be managed via minor front or rear lot setbacks which will ensure that habitable building envelopes can be accommodated in areas which are subject to less than BAL-29.

Staged construction at the subdivision stage will also consider the BAL impacts from the Oakebella estate until the hazard has been removed to ensure lots are not impacted by bushfire risk.

Together these measures will ensure the majority of lots are only subject to a Bushfire Attack Level (BAL) rating of BAL-LOW or BAL-12.5, with no lot proposed to be greater than BAL-29.

A copy of the Bushfire Management Plan is enclosed (**Attachment 4)**.

4.8 Servicing

Lot 506 can be connected to all essential services, which typically involve extending the infrastructure network from the existing Providence estate and the surrounding area.

Sewer

Waste water will connect into the site via an extension to the existing network from the Oakebella estate to the north, and will flow northward to the Tikva Way pump station located a further 250m to the north, which has capacity to accommodate the predicated inflows.

Water Supply

Water supply service planning carried out by the Water Corporation has already assumed the development of lot 506. Potable water will be provided through the extension of the network from the Johnson Road and Irasburg Parade, which in turn will be supplied via a DN200 water main that will be constructed to service the site and provide connection northward to the Oakebella estate.

Power Supply

Power supply will be extended into lot 506 from the existing high voltage underground network located on the opposite side of Johnson Road/Irasburg Parade which connects from the Medina Zone Substation.

Telecommunications

Existing telecommunications infrastructure is located within the Johnson Road/Irasburg Parade verge and will be extended into lot 506 as development proceeds northward.

The developer will be responsible for installing pit and pipe infrastructure that can accommodate the fibre, of with which NBN will provide.The design of road reserves, pavement and verge provisions will ensure adequate allowance for services including broadband, which will be accommodate at detailed subdivision stage.

An Engineering Serving report prepared by JDSi engineers can be found as **Attachment 3**.

5.0 CONCLUSION

This amendment to the Wellard Residential Local Structure Plan will facilitate the logical extension of urban development into the subject site. The introduction of density codes into the subject site, consistent with the existing densities established under the structure plan, will ensure residential subdivision and development is able to progress as envisaged for the subject site.

CLE Town Planning + Design

Addendum Report (Amendment 1)

WELLARD RESIDENTIAL LOCAL STRUCTURE PLAN

Attachments

CLE Town Planning + Design

November 2024

ATTACHMENTS

Attachment 1: Amended Wellard Residential Local Structure Plan

Attachment 2: Local Water Management Strategy [Emerge Associates]

Attachment 3: Engineering Services Report [JDSi]

Attachment 4: Bushfire Management Plan [Emerge Associates]

Attachment 5: Landscape Masterplan [Emerge Associates]

Attachment 6: Environmental Assessment & Management Strategy [Emerge Associates]

Attachment 7: Transport Impact Assessment [PJA]

ATTACHMENT 1

Amended Wellard Residential Local Structure Plan

LEGEND

Structure Plan Boundary (Development Zone Area)

Zones

- Residential R20
- Residential R30
- Residential R50
- MRS Rural Zone

Reserves

- Public Open Space
- MRS Parks and Recreation Reserve

Road Network

- District Distributor
- Local Distributor
- Key Local Access Street
- Bus Routes
- Full Movement "T" Intersection

Notes:

1. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.
2. A hard edged road interface shall be provided to the wetland areas and Bush Forever reserves with road reserve widths to be confirmed at subdivision.
3. Northern access to Wellard Road is a full movement "T" intersection with priority to Wellard Road. This intersection may be downgraded to left in/left out when Wellard Road is constructed as a dual carriageway.
4. Southern access to Wellard Road is either a roundabout or a full movement "T" intersection, to be confirmed at subdivision stage.
5. The wetland core comprises of both the EPP lake and Resource Enhancement wetland boundaries.
6. The wetland buffer is 50m to the EPP lake and 30m to the Resource Enhancement wetland as agreed with Environmental Protection Authority.

CLE Town Planning + Design

LOCAL STRUCTURE PLAN

Johnston Road, Wellard

plan no: **2263-52K-01**
date: 20 November 2023
scale: 1:5,000 @A3, 1:2,500 @A1

N

ATTACHMENT 2

Local Water Management Strategy [Emerge Associates]

Local Water Management Strategy

Lot 506 Johnson Road, Wellard

Project No: EP22-062(03)

Prepared for Wellard Residential Pty Ltd
November 2024

Document Control

Doc name:	Local Water Management Strategy Lot 506 Johnson Road, Wellard				
Doc no.:	EP22-062(03)--013 JM				
Version	**Date**	**Author**		**Reviewer**	
1	December 2023	Joyti Mabruk	JM	David Coremans	DPC
		Fabio Hernandez	FMH		
	Issued for project team review				
A	December 2023	Joyti Mabruk	JM	David Coremans	DPC
		Fabio Hernandez	FMH		
	Issued for agency submission				
B	November 2024	Fabio Hernandez	FMH	David Coremans	DPC
	Final to address agency comments				

© 2024 Emerge Associates All Rights Reserved. Copyright in the whole and every part of this document belongs to Emerge Associates and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Emerge Associates.

Executive Summary

Wellard Residential Pty Ltd (the 'proponent') propose to develop Lot 506 Johnson Road, Wellard East (referred to herein as the 'site') for residential purposes. The site is located approximately 38 km south of the Perth central business district (CBD), within the suburb of Wellard. The site is approximately 7.85 hectares (ha) in size, is within the City of Kwinana (CoK) and bounded by Johnson Road and Irasburg Parade along the southeast, future developments to the north and the Peel Main Drain (PMD) to the west. The location of the site is shown in **Figure 1**.

The site is currently zoned as 'Urban' under the Metropolitan Region Scheme (MRS) (WAPC 2023) and 'Development' under the City of Kwinana Town Planning Scheme No.2 (CoK 2024b). This document has been prepared to accompany an amendment to the existing Providence Structure Plan.

This local water management strategy (LWMS) details the water management approach to support the development in accordance with *Better Urban Water Management* (WAPC 2008), expectations of the Department of Water and Environmental Regulation (DWER) and the CoK. The LWMS also aids in achieving the goals and objectives outlined in the *Kep Katitjin – Gabi Kaadadjan - Waterwise Perth Action Plan 2* (DWER 2023).

It is important that stormwater runoff is managed in a manner which avoids flooding and protects the environment. This approach should be clearly documented early in the planning process and should provide a framework for actions and measures to achieve the desired outcomes at subdivision and development stages.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. In summary, the environmental investigations conducted to date indicate that:

- The site has previously been used for grazing/horse agistment.
- Mean maximum temperatures on site range from 18.1 °C to 28.3 °C and mean minimum temperatures range from 11.2 °C to 19.4 °C.
- The site receives 605.10 mm of average annual rainfall with the majority of rainfall received in June and July.
- The site slopes from an elevation of 10 m Australian height datum (mAHD) along the eastern boundary to an elevation of 4.5 mAHD to the western part of the site. A localised low point/sump has an elevation of 3.47 mAHD, and there is an informal channel from this point, providing an existing connection to the PMD.
- The site predominantly consists of Sandy Silt (Ms5) and Sand (S8), which are measured to have moderate (1 m/day) to high (5 m/day) permeability.
- Acid Sulfate soils (ASS) risk mapping classifies the majority of the site as having a 'high to moderate' risk of ASS occurring within 3 m of the natural surface, while a minor portion of the site (near the eastern and southern boundary) is classified as having a 'moderate to low' risk of ASS occurring within 3 m of the natural surface.
- The Geomorphic Wetlands of the Swan Coastal Plain dataset indicates that there is a wetland (referred to as the Bollard Bulrush Swamp) within the study area and classified as:
  - Multiple Use category wetland area (UFI 13327).

- Surface water is present seasonally within the Bollard Bulrush Swamp and the PMD. The PMD flows seasonally and flows in a southerly direction along the western boundary of the structure planning area. The PMD is a Water Corporation asset, and in proximity to the site is a 2 m deep and 8 m wide trapezoidal drain.
- The Jandakot DWMP (Department of Water 2009) has identified the invert and maximum 1% AEP flood levels within the Bollard Bulrush Swamp. These levels are 3.5 mAHD and 5.6 mAHD respectively. Given that the western part of the site is at around 4.5 mAHD, the site has a direct connection to the PMD in a major storm event.
- The results of the surface water quality analysis indicate that water quality exceeds the default trigger values provided in the *National Water Quality Management Strategy* (ANZECC and ARMCANZ 2000), with total phosphorous (TP) concentrations being 5 – 12 times the default trigger values and total nitrogen (TN) concentrations being slightly above the default trigger value.
- The long-term targets for nutrients in the PMD that have been proposed in the Jandakot DWMP (Department of Water 2009) are 0.1 mg/L for TP and 1.0 mg/L for TN.
- Groundwater flow direction is westerly, towards the PMD.
- The maximum recorded groundwater level within the site is 6.12 mAHD at MB05, measured during 2022. Depth to the maximum groundwater level (MGL) varies from approximately 4.4 m separation at the eastern end of the site near Johnson Road to being at the surface at the western portion of the site.

The overall objective for integrate water cycle management for the development is to mimic the existing hydrology regime and to provide a sustainable approach to water use within the site. The design objectives seek to deliver best practices outcomes using a water sensitive urban design (WSUD) approach, including management approaches for:

- Water supply and conservation
- Wastewater servicing
- Surface water quality
- Flood mitigation
- Groundwater management.

<u>Water supply and conservation</u>

Water conservation is achieved by implementing both lots scale and estate scale water use efficiency measures, consistent with a contemporary approach utilised in the region. This includes retention of vegetation within POS where possible and use of waterwise gardening approaches in landscaping of both lots and POS.

<u>Stormwater management</u>

The approach to managing stormwater at the site is to mimic the existing hydrology, and to encourage infiltration at source. Water quality and flood retention will be managed at a lot scale by the use of soakwells and pervious garden areas, whilst at an estate scale will be managed by the use of raingardens and flood storage areas (FSA). It is noted that whilst there is an existing connection to the PMD, a conservative retention at source approach has been taken and therefore there will not be any formal connection required into the PMD.

Groundwater management

Management of groundwater will be achieved by the use of imported fill to achieve minimum clearance levels above the calibrated MGL. Use of the calibrated MGL is a conservative approach however is achievable given site levels. Whilst is not intended to control groundwater by the use of subsoil drainage, this will be adopted under the POS to ensure that the flood retention basin can fully dry between storm events.

This LWMS demonstrates that the concepts previously described can be achieved by the spatial layout of the structure plan for Lot 506 Johnson Rd. By following the recommendations detailed in this report it is demonstrated that the site is capable of being developed for residential purposes.

The water management design criteria for the site and the manner in which they are proposed to be achieved are presented in **Table E1**. This table provides a readily auditable summary of the required outcomes which can be used in the future detailed design stage to demonstrate that the agreed objectives for water management at the site have actually been achieved.

Table E1 Water management criteria and compliance summary

Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Water Conservation	WC1	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water.	Provide advice to residents on water conservation measures	Proponent	Point of sale
			Rainwater tanks (RTWs) utilised for non-potable uses within lots	Lot owner	Post-house construction
			Promotion and use of waterwise gardening principles (WWG) to lot owners	Proponent/Lot owner	Point of sale/Post-house construction
			Promotion and use of water efficient appliances	Proponent/Lot owner	Point of sale/Post-house construction
			Mandate water efficient fittings	CoK	Building approval
	WC2	Ensure the efficient use of all water resources in newly developing urban form.	Use of waterwise landscaping principles in POS	Proponent	Landscape design
			POS designed to use no more than allocated groundwater		
			Minimise water requirements for POS maintenance		
			Use of water efficient appliances	Lot owner	Post-house construction
			Use of WWG principles in lots		

Table E1 Water management criteria and compliance summary (continued.)

Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Stormwater Management	SW1	Retain and treat the first 15 mm of rainfall as close to source as possible	Residential lots to retain the first 15 mm rainfall events on lot via a combination of soakwells and pervious garden areas.	Lot owner/developer	Building construction
			Small rainfall event runoff from road reserves and POS areas will be managed by a treatment train approach using raingardens along side boundaries of dual frontage lots and a BRA located within the POS.	Proponent	Construction
			Small rainfall event (i.e. first 15 mm) runoff will infiltrate through the underlying soil profile with nutrients taken up by vegetation or adsorbed to sand particles prior to reaching groundwater.	Proponent	During detailed drainage design
	SW2	All runoff up to the 1% AEP event is to be retained on site.	Residential lots to retain up to the major rainfall event by the use of soakwells and pervious garden areas. This is consistent with the stormwater and runoff policy from the CoK to retain/confine runoff within the property boundaries.	Proponent	During detailed drainage design
			Major rainfall event (1% AEP) surface runoff from road reserves will be managed via a combination of raingardens along the dual side boundaries of lots, and a BRA and FSA located within the POS.	Lot owner/developer	Building construction
	SW3	Finished floor levels must have a minimum 500 mm clearance above the 1% AEP flood level in the PMD	The 1% AEP flood level in the PMD is 5.60 mAHD. The preliminary bulk earthworks concept provided in **Appendix B** shows that 1.06 m of clearance will be provided by the lowest proposed earthwork lot set at 6.66 m AHD.	Proponent	During detailed drainage design
	SW4	Finished floor levels must have a minimum 300 mm clearance above the 1% AEP TWL in the FSA	All lots will be provided with a minimum of 460 mm clearance to the 1% AEP TWL (6.2 mAHD) in the FSA (see **Appendix B**).	Proponent	During detailed drainage design
	SW5	Ensure minor roads remain passable in a 20% AEP event	The pipe network will be designed to convey the 20% AEP rainfall event.	Proponent	During detailed drainage design

Table E1 Water management criteria and compliance summary (continued.)

Management Aspect	Criteria Number	Criteria Description	Manner in which compliance will be achieved	Responsibility for implementation	Timing of implementation
Stormwater Management (continued.)	SW6	Reduce nutrient loads by applying appropriate non-structural measures	• Minimise use of fertilisers within POS and road verges. • Street sweeping at regular intervals. • Use of drought tolerant turf species.	Landscape/Maintenance contractor/	Landscape implementation
			Education of residents regarding fertiliser use	Proponent	Point of sale
	SW7	Design infiltration areas to avoid creating mosquito habitat	Stormwater infrastructure will be designed to ensure all runoff is infiltrated within 96 hours	Proponent	Detailed drainage design
Groundwater Management	GW1	Use water sensitive design approaches to recharge the superficial aquifer	Retain and infiltrate all runoff up to the 1% AEP rainfall event on site within lot soakwells and permeable lot areas, raingardens within the road reserve, and a BRA and FSA within POS.	Proponent	During detailed drainage design
	GW2	Lots should have clearance to the MGL of at least 1.2 m.	Lots will be set at least 1.2 m above the MGL (see preliminary drawings provided in **Appendix B**).	Proponent	During detailed drainage design
	GW3	Surface based infiltration should have 300 mm clearance above MGL.	Basin inverts will be set at 300 mm above the MGL	Proponent	During detailed drainage design

Table of Contents

1 Introduction 13

1.1 Background 13
1.2 Planning context 13
1.3 Purpose 13
1.4 Policy framework 13
1.5 Previous studies 14
1.5.1 Jandakot Drainage and Water Management Plan (DWMP) 14
1.5.2 Bollard Bulrush West District Water Management Strategy (DWMS) 15
1.5.3 Wellard Urban Precinct East DWMS 16
1.5.4 Wellard Residential Local Water Management Strategy 16
1.5.5 Providence Urban Water Management Plans 17
1.6 LWMS objectives 18

2 Proposed Development 19

3 Existing Environment 20

3.1 Sources of information 20
3.2 Existing and historical land use 20
3.3 Climate 20
3.4 Geotechnical conditions 21
3.4.1 Topography 21
3.4.2 Regional geology 21
3.4.3 Geotechnical investigation 21
3.4.4 Acid sulfate soils 22
3.5 Wetlands 22
3.6 Hydrology 22
3.6.1 Surface water 22
3.6.2 Surface water quality 23
3.6.3 Groundwater 23
3.6.3.1 Groundwater Levels 23
3.6.3.2 Groundwater Quality 24
3.7 Summary of Existing Environment 25

4 Design Criteria and Objectives 27

4.1 Integrated water cycle management 27
4.2 Water conservation 27
4.3 Stormwater management 28
4.4 Groundwater management 28

5 Water Conservation Strategy 29

5.1 Fit for purpose water use 29
5.1.1 Scheme water supply 29
5.1.2 Groundwater 29
5.1.3 Rainwater tanks 29
5.2 Lot scale water conservation measures 29
5.2.1 Rainwater tanks 29
5.2.2 Water efficient fixtures and appliances 30
5.2.3 Waterwise gardens 30
5.3 Water use analysis 30
5.3.1 Lot scale water use analysis 30
5.4 Wastewater management 31

5.5 Water conservation management criteria compliance 31

6 Stormwater Management 32

6.1 Lot drainage 32
6.2 Development drainage 32
6.2.1 Raingardens 32
6.2.2 Bio-retention areas 33
6.2.3 Flood storage areas 33
6.2.4 Stormwater management design 34
6.2.4.1 Small rainfall event 34
6.2.4.2 Major rainfall event 35
6.3 Non-structural measures 35
6.4 Stormwater management criteria compliance 36

7 Groundwater Management 37

7.1 Groundwater level management 37
7.2 Groundwater quality management 37
7.3 Groundwater design criteria compliance 38

8 Subdivision and Urban Water Management Plans 39

8.1 Surface runoff modelling 39
8.2 Implementation of water conservation strategies 39
8.3 Imported fill specifications 40
8.4 Non-structural water quality improvement measures 40
8.5 Management and maintenance requirements 40
8.6 Construction period management strategy 40
8.7 Monitoring and evaluation program 41
8.8 Infiltration assumptions 41

9 Monitoring 42

9.1 Pre-development monitoring summary 42
9.2 Post-development monitoring 42
9.2.1 Trigger values 42
9.3 Recommended program for UWMP 42
9.3.1 Condition monitoring 42
9.3.2 Surface and groundwater monitoring 43
9.3.3 Contingency Action Plan 43
9.3.3.1 Trigger Criteria 44
9.3.3.2 Contingency Actions 44
9.4 Reporting 44

10 Implementation 1

10.1 Roles and responsibility 1
10.2 Funding 1
10.3 Review 1

11 References 2

11.1 General references 2
11.2 Online references 5

Plates

Plate 1: Measured groundwater levels 24

List of Tables

Table 1: Infiltration test summary (GGC 2022) 21
Table 2: Groundwater quality monitoring results (2022-2024) 25
Table 3: Water conservation management criteria compliance 31
Table 4: Small event (first 15 mm) treatment requirements 34
Table 5: Stormwater storage requirements - minor (20% AEP), and major (1% AEP) events 35
Table 6: Stormwater management criteria compliance 36
Table 7: Groundwater criteria compliance summary 38
Table 8: Post-development trigger values 42
Table 9: Monitoring Program Summary 43

Figures

Figure 1: Site Location
Figure 2: Topographic Contours
Figure 3: Environmental Geology and Geotechnical Investigations
Figure 4: Acid Sulfate Soil Risk Mapping
Figure 5: Geomorphic Wetlands and Hydrological Features
Figure 6: Groundwater Contours
Figure 7: Stormwater Management Plan
Figure 8: Post-development Monitoring Locations

Appendices

Appendix A

Concept Plan

Appendix B

Earthworks concept

Appendix C

Landscape Concept

Appendix D

Detailed Survey

Appendix E

Geotechnical Report

Appendix F

Modelling Assumption Report

Appendix G

Groundwater Licence

This page has been left blank intentionally.

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
ABS	Australian Bureau of Statistics
ANZECC	Australian and New Zealand Environment and Conservation Council
BOM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DoW	Department of Water
DWER	Department of Water and Environmental Regulation
DoW	Department of Water
DPLH	Department of Planning, Lands and Heritage
EPA	Environmental Protection Authority
WAPC	Western Australian Planning Commission

Table A2: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
ASS	Acid sulfate soil
BMP	Best management practice
BRA	Bio-retention area
CBD	Central business district
CoK	City of Kwinana
DP	Deposit plan
DWMP	District water management plan
FSA	Flood storage area
GWL	Groundwater licence
MGL	Maximum groundwater level
LWMS	Local water management strategy
PMD	Peel main drain
POS	Public open space
PRI	Phosphorus retention index
RWT	Rainwater tank
TN	Total nitrogen

Table A2: Abbreviations – General terms (continued)

General terms	
TP	Total phosphorus
TPS	Town planning scheme
TWL	Top water level
UFI	Unique feature identifier
UWMP	Urban water management plan
WEFA	Water efficient fixtures and appliances
WSUD	Water sensitive urban design
WWG	Waterwise gardening

Table A3: Abbreviations – units of measurement

Units of measurement	
uS/cm	Micro siemens per centimetre
mg/L	Milligrams per litre
ha	Hectare
m	Metre
m^2	Square metre
m AHD	m in relation to the Australian height datum

Table A4: Terminology – design rainfall

Rainfall event	Annual exceedance probability (AEP)	Approximate equivalent average recurrence interval (ARI)
Small/frequent	1 exceedance year (EY) event (frequent)	1 in 1 year ARI event
Minor (residential purposes)	20% AEP event	1 in 5 year ARI event
Major	1% AEP event	1 in 100 year ARI event

1 Introduction

1.1 Background

Wellard Residential Pty Ltd (the 'proponent') propose to develop Lot 506 Johnson Road, Wellard East (referred to herein as the 'site') for residential purposes. The site is located approximately 38 km south of Perth central business district (CBD), within the City of Kwinana (CoK). The site is approximately 7.85 hectares (ha) in size and bounded by Johnson Road and Irasburg Parade along the southeastern boundary, future developments to the north and the Peel Main Drain (PMD) to the west. The site currently consists of open paddocks and some remnant bushland.

The location and extent of the site is shown in **Figure 1** and the "Concept Structure Plan" is provided in **Appendix A**.

1.2 Planning context

The site is currently zoned as 'Urban' under the *Metropolitan Region Scheme* (WAPC 2023) and 'Development' under the CoK Town Planning Scheme No. 2 (TPS) (City of Kwinana 2023; CoK 2024b). This document has been prepared to accompany an amendment to the existing 'Providence Structure Plan' area that includes the site area and supports the future urban development of the site.

1.3 Purpose

It is important that stormwater runoff is managed in a manner which avoids flooding and protects the environment. This approach should be clearly documented early in the planning process and should provide a framework for actions and measures to achieve the desired outcomes at subdivision and development stages.

This local water management strategy (LWMS) details the water management approach as required by *Better Urban Water Management* (WAPC 2008), and is intended to satisfy the expectations of the Department of Water and Environmental Regulation (DWER) and the CoK. The LWMS also aids in achieving the goals and objectives outlined in the *Kep Katitjin – Gabi Kaadadjan - Waterwise Perth Action Plan 2* (DWER 2023).

1.4 Policy framework

There are a number of local and State Government policies of relevance to the development, including:

- *Guidance Statement No. 33: Environmental Guidance for Planning and Development* (EPA 2008a)
- *Gnangara Sustainability Strategy* (Government of WA 2009)
- *Kep Katitjin – Gabi Kaadadjan - Waterwise Perth Action Plan 2* (DWER 2023)

- *Liveable Neighbourhoods Edition 4* (WAPC 2015)
- *Planning Bulletin No. 64: Acid Sulfate Soils* (WAPC 2009)
- *State Planning Policy 2.9 Water Resources* (WAPC 2006)
- *Draft – State Planning Policy 2.9 Planning for Water* (DPLH 2021).

In addition to the above policies, there are a number of published guidelines and standards available that provide direction regarding the water management characteristics that developments should aim to achieve. These are key inputs that relate either directly or indirectly to the development and include:

- *Australian Rainfall and Runoff* (Ball J et al. 2019)
- *Australian Runoff Quality* (Engineers Australia 2006)
- *Better Urban Water Management* (WAPC 2008)
- *Developing a Local Water Management Strategy* (DoW 2008a)
- *Decision Process for Stormwater Management in Western Australia* (DWER 2017b)
- *National Water Quality Management Strategy (NWQMS)* (Australian Government 2018)
- *Stormwater Management Manual for Western Australia* (DWER 2022)
- *Water Quality Improvement Plan for the Rivers and Estuary of the Peel Harvey System* (EPA 2008b)
- *Jandakot Structure Plan (JSP)* (WAPC 2007)

1.5 Previous studies

1.5.1 Jandakot Drainage and Water Management Plan (DWMP)

The Jandakot DWMP (DoW 2009) presented the then Department of Water (DoW) expectations for developers and stakeholders within the JSP area. The Jandakot DWMP provided guidance on protection of environmental assets, stormwater management, groundwater management and implementation within the PMD catchment. The key objectives proposed in the Jandakot DWMP include:

- New developments should achieve a maximum water consumption target of 100 kL/person/year for residential uses.
- Of the lot scale (residential) uses less than 40-60kL/person/year should be from scheme water.
- Protection of wetlands and waterways from the impacts of urban runoff.
- Protection of infrastructure and assets from flooding and inundation.
    - Retain and or detain the first 15 mm rainfall event at source.
    - Maximise infiltration at source via soakwells, swales, basins and other structures.
    - Use detention storages disbursed throughout urban areas to attenuate peak runoff rates.
    - Avoid modification of existing channels unless it is to ensure continuation of flows.
    - Use revegetation and strategic channel stabilisation.
    - Provide protection from 1% annual exceedance probability (AEP) levels by achieving 500 mm clearance for lot levels.
    - Major arterial roads should remain passable in a 1% AEP event.

- Minimise changes to hydrology to prevent impacts on receiving environments.
  - Maintain post development peak discharges to pre-development levels for the small event.
  - Manage catchment runoff such that the critical 10% AEP and 1% AEP event peak flows are consistent with the pre-development peak flows.
  - Promote WSUD and BMPs which promote onsite retention of events up to the first 15 mm rainfall event at source or as close to source as possible.

The detention storage requirements for each sub-catchment within the Jandakot DWMS area were modelled by Water Corporation using an Infoworks CS model. The outputs of the model were broad scale detention requirements for each sub-catchment, allowable peak water levels within each of the wetlands intersected by the PMD and peak flow rates from each sub-catchment and within the PMD. These were provided within the Jandakot DWMP, and have been used to guide the modelling methodology adopted in this LWMS, and to calibrate the results of the LWMS modelling to ensure consistency with the *Jandakot DWMP* (DoW 2008b) and *Wellard Residential LWMS* (Emerge Associates 2012) Modelling.

1.5.2 Bollard Bulrush West District Water Management Strategy (DWMS)

The Bollard Bulrush West DWMS was prepared by ENV (2011) to support the lifting of the MRS 'Urban Deferment' status over the land immediately surrounding the Bollard Bulrush Swamp. The DWMS utilised surface runoff methodology consistent with the Infoworks model adopted by DWER (then the Department of Water (DoW)) and the Water Corporation (WC) for the Jandakot DWMP. The main outcomes of the modelling were to demonstrate that the water level within the Bollard Bulrush Swamp would increase if no onsite detention was provided in the surrounding developments, however if adequate detention for the major rainfall event would be provided from the development areas, then there will be no change to the top water level (TWL) in the Bollard Bullrush Swamp.

The objectives for water management that were proposed in the Bollard Bulrush West DWMS include:

- Water Conservation
  - Consumption target for potable water of 100 kL/person/year, including not more than 40-60kL/person/year scheme water.
- Ecological Protection
  - Maintain post development peak discharges to pre-development levels for the 1 year critical duration ARI event (now referred as to the 1EY).
  - Where there are identified impacts on significant ecosystems, maintain or restore desirable environmental flows and/or hydrological cycles.
- Flood Management
  - Manage the catchment runoff for up to the 1 in 100 year ARI event (now referred as to the 1% AEP) to predevelopment peak flows, unless otherwise indicated in an approved strategy.
- Water Quality
  - Manage contaminated sites in accordance with the Contaminated Sites Act 2003.

- Achieve water quality improvements if pollutant outputs exceed ambient conditions or arrange water quality improvement offsets. This should be achieved by use of structural and non-structural measures.

- Disease Vector and Nuisance Insect Management
  - Avoid creating mosquito habitat be ensuring that detention areas fully infiltrate within 96 hours, and by avoiding creation of permanent water bodies.

1.5.3 Wellard Urban Precinct East DWMS

The Wellard Urban Precinct East DWMS was prepared by Emerge Associates (2014a) to support the lifting of the "Urban Deferred" zoning across the eastern half of the Bollard Bullrush Swamp wetland. The DWMS showed the development of Lot 506 Johnson Road and surrounding land, and the indicative location of flood storage to avoid impact the Bollard Bullrush Swamp TWL. Since then, the DWMS was approved by DWER (then the DoW) and the CoK in 2015 and has allowed the development of all land north of the site. The key water management objectives proposed for the site included:

- Water Conservation
  - Utilise fit for purpose water sources throughout the development
  - Water consumption target of no more than 100 kL/person/year, including not more than 40-60 kL/person/year of scheme water.
- Groundwater Management
  - Maintain adequate clearance between habitable floor levels and beneath MGL
  - Achieve adequate clearance between the retention basins and MGL
  - Groundwater quality leaving the site should be consistent or of higher quality than that entering the site.
- Stormwater Management
  - Maintain predevelopment event peak flows leaving the site.
  - Achieve at least 500 mm of clearance the major TWL within the PMD and onsite detention areas
  - Minor roads to remain passable in the minor rainfall event.
- Stormwater quality
  - Retain and treat the 1 year 1 hour ARI event (now referred as to the 1EY) as close to the source as practicable.
  - Bioretention areas to be sized at least 2% of the total connected impervious areas
  - Utilise appropriate structural and non-structural measures to reduce nutrient load
  - Surface water quality leaving the site should be the same as the one entering the site.

1.5.4 Wellard Residential Local Water Management Strategy

The Wellard Residential LWMS was prepared by Emerge Associates Emerge Associates (2012) to support the Wellard Residential local structure plan (LSP) area (also referred to as 'Providence') and is herein referred to as the LWMS. Whilst this site has largely been constructed, the site conditions and characteristics are similar and it fronts the same portion of the PMD. On this basis, many of the

design criteria adopted in this document are relevant for the site structure planning area. The Providence LWMS adopted the following objectives:

- Water conservation
  - Ensure the efficient use of all water resources in newly developed urban form.
  - Use scheme water efficiently wherever possible.
  - Consumption target for scheme water of 100 kL/person/year for residential areas.
- Groundwater management
  - Lots should have a clearance to the measured maximum groundwater level (MGL) of at least 1.2 m.
  - The bio-retention system, detention basins and drainage inverts will be set at least 500 mm above the measured MGL.
  - Groundwater quality downstream of the development should be at least the same as or better quality than upstream groundwater quality.
  - Soils underlying the bio-retention areas (BRAs) should have a band of material that is a minimum of 150 mm deep with a phosphorus retention index (PRI) of at least 20. It is acceptable for this to be achieved with a thicker layer of lower PRI soil.
- Stormwater management
  - Retain the first 15 mm rainfall event at source or as close as practicable.
  - The post–development critical 20 % AEP and 1 % AEP cumulative peak flows leaving the development shall be generally consistent with the pre-development environment.
  - The pipe network will be designed to convey the 20 % AEP event (and therefore roads will be passable in the 20 % AEP event).
  - Finished floor levels of lots must have 300 mm clearance from the 1 % AEP flood event flows being conveyed within road reserves.
  - The finished floor levels of lots must have a 300 mm clearance from the 1 % AEP flood levels in the Bollard Bulrush Swamp, the PMD and onsite detention areas.
  - Runoff generated upstream which is currently being conveyed through the site should be maintained.
  - The surface area of BRAs is to be at least 2% of the connected impervious area.
  - BRAs to have 1:3 side slopes and a maximum water depth of no greater than 500 mm.
  - Reduce nutrient loads by applying appropriate structural and non – structural measures.

1.5.5 Providence Urban Water Management Plans

There are a number of UWMPs prepared for Providence which have been endorsed by DWER and CoK. The UWMPs are listed below:

- *Providence Stage 1 UWMP* (Emerge Associates 2013a)
- *Providence Stages 2 and 3 UWMP Addendum* (Emerge Associates 2013b)
- *Providence Stages 4 and 5 UWMP Addendum* (Emerge Associates 2014b)
- *Providence Stages 6 and 7 UWMP Addendum* (Emerge Associates 2015)
- *Providence Stage 9a UWMP Addendum* (Emerge Associates 2016)
- *Providence Stage 10 UWMP Addendum* (Emerge Associates 2019)

- *Providence Stage 11 and 12 UWMP Addendum* (Emerge Associates 2020)
- *Providence Stage 13 UWMP Addendum* (Emerge Associates 2022b)
- *Providence Stage 14 & 15 UWMP Addendum* (Emerge Associates 2022a)
- *Providence Stages 16 to 20 UWMP Addendum (Emerge Associates 2023)*.

1.6 LWMS objectives

This LWMS has been prepared in accordance with the key water management objectives outlined in the endorsed DWMS for the broader Bollard Bullrush Swamp wetland, and these have been adopted and further revised for consistency with contemporary water planning policies and local government requirements. This LWMS is therefore based on the following major objectives:

- Maintain the existing hydrological regime by retaining all stormwater within the site.
- Provide a broad level stormwater management framework to support future urban development.
- Incorporate appropriate best management practices (BMPs) into the drainage systems that address the environmental and stormwater management issues identified.
- Ensure that sufficient land area is set aside to manage urban runoff.
- Minimise development construction costs, which will result in reduced land costs for future home owners.
- Minimise transport of nutrients/pollutants to groundwater.
- Minimise ongoing operation and maintenance costs for the land owners and CoK.
- Develop a water conservation strategy for the site that will accommodate existing groundwater allocation constraints for the area.
- Gain support from DWER and CoK for the proposed method to manage stormwater within the site.

Detailed objectives for water management within the site are further discussed in **Section 4.**

2 Proposed Development

The development consists of a total of 7.85 ha of available land for residential development and proposes land uses including medium density urban residential and public open space (POS) areas. Development of the site will allow the creation of approximately 4.83 ha of residential lots, 0.82 ha of POS and 2.2 ha of road reserve.

In order to maintain the existing hydrology within the site, any additional stormwater generated as a result of greater impervious areas is proposed to be managed as close to the source as practicable and within the site via the following water sensitive urban design (WSUD) approaches:

- In lot soakage (i.e. soakwells and permeable garden areas), that will manage up to the major rainfall event.
- Raingardens located along side boundaries of dual frontage lots to manage localised runoff from road reserves
- BRA integrated into a downstream POS for management of the frequent rainfall event
- FSA integrated into a downstream POS to manage up to the major rainfall event.

These WSUD features are further described in **Section 6** and shown in **Figure 7**.

It is noted that whilst the PMD runs southwards along the western boundary of the site, the development does not propose to discharge any surface runoff towards the PMD and the 1% AEP storm event will fully retain and infiltrated onsite.

The Concept Plan for Lot 506 Johnson Road which will form part of the Structure Plan amendment is provided in **Appendix A**. Civil earthworks concept and landscape concept for the site are provided in **Appendix B** and **Appendix C**, respectively.

3 Existing Environment

3.1 Sources of information

The following sources of information were used to provide a broad regional environmental context to the site:

- *Weather and Climate Statistics* (BoM 2024)
- *LIDAR elevation dataset, Swan Coastal Plain* (DoW 2008c)
- *Geological survey of Western Australia* (Gozzard 1986)
- *Acid sulfate soils risk mapping* (DWER 2017a)
- *Geomorphic wetlands of the Swan Coastal Plain database* (DBCA 2023)
- *Perth groundwater map* (DWER 2024a)
- *Water register* (DWER 2024b)
- *Landgate Aerial Photography* (WALIA 2024)
- *National Water Quality Management Strategy (NWQMS)* (Australian Government 2018).

In addition to the above information, site-specific investigations have been conducted. These have aimed at providing more detail to the existing regional information. These site-specific investigations include:

- Jandakot Drainage and Water Management Plan (DoW 2009)
- Wellard Urban Precinct East District Water Management Plan (Emerge Associates 2014a)
- *Geotechnical Investigation Report – Providence East Estate* (GGC 2022)

The above studies have been reviewed to determine infiltration potential within the site, existing groundwater levels and potential locations for drainage infrastructure around the existing environmental values. This is important, as they can have implications for the stormwater management measures and the extent of earthworks that may be required to facilitate subdivision.

3.2 Existing and historical land use

A review of the *Landgate Aerial Photography* (WALIA 2024) shows predominately vacant land that was historically used for grazing since 1995. A few trees were visible at the northwest corner of the site adjacent to the PMD. The land has been divided into number of paddock areas and paddock sheds are visible from 2003.

3.3 Climate

The site experiences a dry Mediterranean climate of hot dry summers and cool wet winters. Long term climatic averages indicate that mean maximum temperatures range from 18.1 °C to 28.3 °C and mean minimum temperatures range from 11.2 °C to 19.4 °C (BoM 2024).

The site is located in an area of moderate rainfall, receiving 605.10 mm annually on average with the majority of rainfall received in June and July (BoM 2024). The region experiences rainfall for 80.2 days annually (on average).

3.4 Geotechnical conditions

3.4.1 Topography

The site is generally undulating and slopes gently from an elevation of 10 m Australian height datum (mAHD) along the eastern boundary to an elevation of 4.5 mAHD at the western part of the site. There is a minor depression in the western corner adjacent to the PMD, which has an elevation of 3.47 mAHD. A small swale/depression runs from the small depression towards the PMD, suggesting an existing informal connection to the PMD. Topographic contours of the site are shown on **Figure 2** and a detailed survey of the site is provided in **Appendix D**.

3.4.2 Regional geology

Geological mapping (Gozzard 1983) indicates that the site is underlain mostly by Sandy Silt (Ms5) and Sand (S8) to the eastern and southern portion of the site. These soil types are described as:

- **Silty Sand (Ms5)** – dark brownish grey silt, with disseminated fine – grained quartz sand, firm, variable clay content, of lacustrine origin.
- **Sand (S8)** – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over Clay (C2), Silt (M4) and Clayey Silt (Mc2).

Regional Geological mapping of the site is shown on **Figure 3**.

3.4.3 Geotechnical investigation

A geotechnical investigation across the site was carried out by Geotechnical and Geological Consultants (GGC 2022) and included a total of 25 cone penetrometer tests (CPT), 12 test pits, 11 sand penetrometer tests and six infiltration tests. Infiltration rates encountered during the infiltration testing are provided in **Table 1,** with test pitting locations shown in **Figure 3.**

Table 1: Infiltration test summary (GGC 2022)

Test location	Stratigraphy	Minimum unsaturated permeability. K (m/day)
IT1	Sand fill over sand	5
IT2	Organic silt over sand	1
IT3	Organic silt	<1.0
IT4	Organic silt over sand	1
IT5	Organic sand over sand	4
IT6	Organic sand over sand	>5

The subsurface profile encountered during the geotechnical investigation is described as:

- **Uncontrolled Fill** – fine to coarse grained, subangular to subrounded, grey mottled orange, dark grey; trace non-plastic fines. Containing occasional deleterious materials.
- **Topsoil (Organic Sand)** – Organic SAND: fine to coarse grained, subangular to subrounded, dark grey black.
- **Topsoil (Organic Silt)** – low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded.
- **Upper Sand** – fine to coarse grained, subangular to subrounded, pale grey mottled white. Typically, medium dense at top of unit becoming dense to very dense at depth.
- **Upper Clayey Material** – Low to medium plasticity, black mottled dark grey and yellow, brown, grey orange, firm to stiff.
- **Lower Clayey Material** – Firm to stiff, thin layer of sensitive fine-grained material
- **Lower Sand** – Sand. Very Dense.

The geotechnical report is provided in **Appendix E**.

3.4.4 Acid sulfate soils

Acid sulfate soil (ASS) mapping (DWER 2017a) classifies the majority of the site as having a 'high to moderate' risk of ASS occurring within 3 m of the natural surface. A small portion of the site is classified as having a 'moderate to low' risk of ASS occurring within 3 m of the natural surface. ASS risk mapping across the site is shown on **Figure 4**.

3.5 Wetlands

Review of the *Geomorphic Wetlands of the Swan Coastal Plain* dataset indicates that the Bollard Bulrush Swamp is located within and to northwest of the site. The Bollard Bulrush Swamp wetland that is within the site is aMultiple use wetland (MUW - UFI 13327) - Most of the central portion of the site and the northwestern corner is classified as a MUW.

The location of the geomorphic wetlands is shown on **Figure 5**.

3.6 Hydrology

3.6.1 Surface water

The site high point is along the eastern boundary at Johnson Road, with the generally westerly aspect of the site resulting in surface runoff being directed towards the west, to the PMD. Johnson Road has been fully constructed and forms a barrier to upstream flows entering the site. The site is therefore a discrete catchment that does not need to cater for upstream inflows.

Within the site, a dry open channel drain conveys overland water flows to a small depression adjacent the western boundary of the site and to the PMD. The elevation of the depression is 3.75 mAHD and includes a direct but informal trenched connection to the PMD (JDSI 2023).

Surface water is present seasonally within the Bollard Bulrush Swamp. The PMD (Water Corporation asset) is a steep sided trapezoidal drain approximately 2 m deep and 8 m wide which flows seasonally and in a southerly direction along the western boundary of the site. The Jandakot DWMP (DoW 2009) has identified the invert and maximum 1% AEP flood levels within the Bollard Bulrush Swamp. These levels are 3.5 mAHD and 5.6 mAHD respectively. Given that the site levels are approximately 4.5 mAHD in the western part of the site, there is an existing direct connection to the PMD during major rainfall events. The DWMP indicates that the water levels in Bollard Bulrush are strongly influenced by the tailwater conditions in the Serpentine River. During a major storm event, tailwater conditions from the Serpentine River propagate up the PMD and inundate the low-lying area of Bollard Bulrush Swamp (DoW 2009) and this would also be the case for the lower portions of the site.

The hydrological features within and adjacent to the site is shown in **Figure 5**.

3.6.2 Surface water quality

The water quality of the PMD was characterised by Murdoch University in 2003 and 2005 (MAFRL, 2003 & 2005). The findings of this study indicate that total phosphorous (TP) concentrations within the PMD in proximity to the study area were low (<0.065 mg/L), and total nitrogen (TN) concentrations were low (<1.2 mg/L). Surface water quality monitoring has been undertaken nearby the site within the Bollard Bulrush Swamp in 2010 (ENV 2010). The results of the surface water quality analysis indicate that the water quality exceeds the default trigger values provided in the National Water Quality Management Strategy (ANZECC and ARMCANZ 2000), with TP concentrations being 5 – 12 times the default trigger values and TN being slightly above the default trigger value. There are no defined regularly flowing drainage channels within the site, and therefore analysis of surface water quality within the site has not been possible to undertake. The long-term targets for the nutrient concentrations in the PMD that have been proposed in the Jandakot DWMP (DoW 2009) are 0.1 mg/L for TP and 1.0 mg/L for TN.

3.6.3 Groundwater

The *Water Register* (DWER 2024b) indicates that groundwater beneath the site is a multi-layered system comprised of the following:

- Serpentine – Perth Superficial Swan unconfined aquifer
- Serpentine – Perth Leederville confined aquifer
- Serpentine – Perth Yarragadee confined aquifer.

The allocation status of aquifers is further discussed in **Section 5.1.2**.

3.6.3.1 Groundwater Levels

Five groundwater monitoring bores (MB01 – MB05) were installed by Emerge Associates in June 2022 and these have been monitored for a period of 3 years between 2022 to 2024 during the wet seasons. Two monitoring bores (MB-1 and MB-2) are located at the outer edge of the northern boundary. The maximum groundwater levels observed during the three years of monitoring were

recorded in August 2022, with the maximum elevation observed at MB05 (6.12 mAHD). **Plate 1** outlines all the measured groundwater levels across the site during the three years of monitoring.

Analysis of long-term data from bore ID 61410095 located 1.3 km southwest of the site indicates that the 2022 recorded maximum is approximately 680 mm below the regional maximum groundwater level recorded in the previous 40 years. A simplistic addition of 680 mm would indicate that groundwater would be above the surface for part of the site, and this is not representative of site observations nor consistent with historical imagery. It is also noted that the PMD which runs southwards along the western boundary acts as a natural groundwater control for the site. Therefore, the measured maximum groundwater level from 2022 is adopted as the site design datum (MGL). The groundwater monitoring bore locations and MGL contours are shown on **Figure 6** , and this illustrates that groundwater flows westerly towards the PMD.

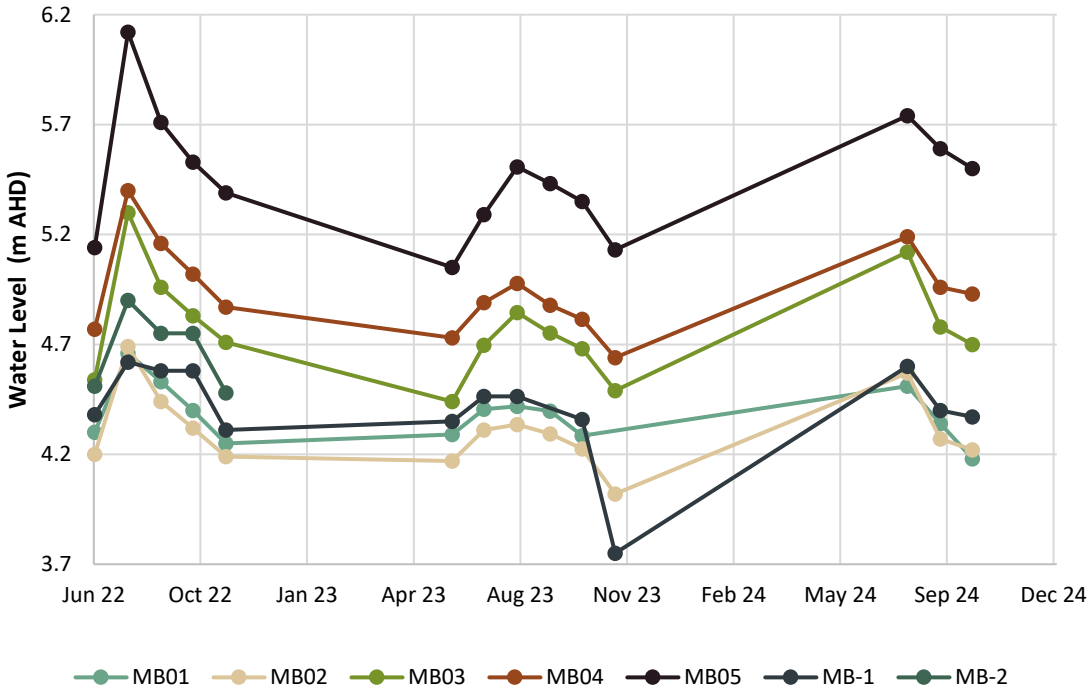


Plate 1: Measured groundwater levels

3.6.3.2 Groundwater Quality

Groundwater quality analyses indicate that the local groundwater is slightly acidic (pH 6.03) to neutral (pH 7.12). Monitoring bores near the PMD have slightly higher electrical conductivity. TN concentrations in groundwater are highly varied across the site, but generally elevated above relevant downstream trigger values. TP concentrations are moderate with the exception of MB05 which displayed high TP concentrations (2.3 mg/L). It is noted that MB05 is located at the upstream end of the development (most eastern corner) indicating that high TP concentrations are related to the upstream inflows and possibly influenced by the drainage basin (BRA) located approximately 100

m northeast of MB05. TP concentration was recorded as declining at the downstream monitoring locations. The groundwater quality monitoring results are summarised in **Table 2.**

Table 2: Groundwater quality monitoring results (2022-2024)

Bore ID	pH	EC (uS/cm)	TKN (mg/L)	TN (mg/L)	TP (mg/L)	NO_3 (mg/L)
MB01	7.17 (0.13)	2,463.00 (429.75)	2.5 (0.1)	2.50 (0.1)	0.14 (0.046)	0.03 (0.0071)
MB02	6.76 (0.26)	4268.33 (1119.88)	8.2 (2.4)	8.23 (2.46)	0.10 (0.01)	0.01 (0.0029)
MB03	6.44 (0.33)	551.67 (117.35)	3.6 (0.3)	3.63 (0.32)	0.17 (0.05)	0.01 (0.00)
MB04	6.09 (0.13)	387.20 (44.58)	1.5 (0.17)	1.50 (0.17)	0.15 (0.06)	0.02 (0.0087)
MB05	6.80 (0.18)	675.33 (238.0)	1.2 (0.65)	1.53 (0.55)	1.89 (0.74)	0.32 (0.10)
*NWQMS**	*6.0-8.0*	*120-300*	-	*2*	*0.1*	-

**National Water Quality Management Strategy Guidelines* (ANZECC and ARMCANZ 2000)

***Values given are average and (standard deviation)*

3.7 Summary of Existing Environment

In summary, the environmental investigations conducted to date indicate that:

- The site has previously been used for grazing/horse agistment.
- Mean maximum temperatures on site range from 18.1 °C to 28.3 °C and mean minimum temperatures range from 11.2 °C to 19.4 °C.
- The site receives 605.10 mm of average annual rainfall with the majority of rainfall received in June and July.
- The site slopes from an elevation of 10 mAHD along the eastern boundary to an elevation of 4.5 mAHD to the western part of the site. A localised low point/sump has an elevation of 3.47 mAHD, and presence of an informal channel indicates an existing connection to the PMD.
- The site predominantly consists of Sandy Silt (Ms5) and Sand (S8), which are measured to have moderate (1 m/day) to high (5 m/day) permeability.
- ASS risk mapping classifies the majority of the site as having a 'high to moderate' risk of ASS occurring within 3 m of the natural surface, while a minor portion of the site (near the eastern and southern boundary) is classified as having a 'moderate to low' risk of ASS occurring within 3 m of the natural surface.
- The Geomorphic Wetlands of the Swan Coastal Plain dataset indicates that the Bollard Bulrush Swamp MUW (UFI -13327) is located within the site and the REW and CCW are located 50m to 200 m northwest.
- Surface water is present seasonally within the Bollard Bulrush Swamp and the PMD. The PMD flows seasonally in a southerly direction along the western boundary of the site area. The PMD

is a Water Corporation asset, and in proximity to the site is a 2 m deep and 8 m wide trapezoidal drain.

- The Jandakot DWMP has identified the invert and maximum 1% AEP flood levels within the Bollard Bulrush with them being 3.5 mAHD and 5.6 mAHD respectively. Given that the western part of the site is at around 4.5 mAHD, it is expected that the site has a direct connection to the PMD in a major storm event.
- The results of the surface water quality analysis indicate that the water quality exceeds the default trigger values provided in the NWQMS (ANZECC and ARMCANZ 2000), with TP concentrations being 5 – 12 times the default trigger values and TN concentrations being slightly above the default trigger value.
- The long-term targets for nutrients in the PMD that have been proposed in the Jandakot DWMP are 0.1 mg/L for TP and 1.0 mg/L for TN.
- Groundwater flow direction beneath the site is westwards, towards the PMD.
- The maximum recorded groundwater level within the site is 6.12 mAHD at MB05, measured during 2022-2023 monitoring program. Depth to the maximum groundwater level (MGL) varies from approximately 4.4 m separation at the eastern end of the site near Johnson Road to being at the surface at the western portion of the site.

4 Design Criteria and Objectives

This section outlines the objectives and design criteria that this LWMS and future management plans must achieve. The water management strategy includes water conservation, groundwater management and stormwater management.

4.1 Integrated water cycle management

Better Urban Water Management (WAPC 2008) endorses the promotion of integrated water cycle management and application of WSUD principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies.

The key principles of integrated water cycle management include:

- Considering all water sources, including wastewater, stormwater and groundwater
- Integrating water and land use planning
- Allocating and using water sustainably and equitably
- Integrating water use with natural water processes
- Adopting a whole catchment integration of natural resource use and management.

Integrated water cycle management addresses not only physical and environmental aspects of water resource use and planning, but also integrates other social and economic concerns. Water management design objectives should therefore seek to deliver better outcomes in terms of:

- Potable water consumption
- Stormwater quality management
- Groundwater management.

The first step in applying integrated water cycle management in urban catchments is to establish agreed environmental values for receiving environments. The existing environmental context of the site has been discussed in **Section 3** of this document. Guidance regarding environmental values and criteria is provided by a number of national and state policies/guidelines and site-specific studies undertaken in and around the site. These were detailed in **Section 1.4** and **Section 1.5** respectively.

4.2 Water conservation

This LWMS proposes the following water conservation criteria:

Criteria WC1 Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water.

Criteria WC2 Ensure the efficient use of all water resources in newly developing urban form.

The manner in which this objective will be achieved is further detailed in **Section 5**.

4.3 Stormwater management

The principle behind stormwater management at the site is to mimic the pre-development hydrological conditions, as described in **Section 3**. This principle and the guidance documents discussed in **Section 1.4** and have guided the stormwater management criteria.

Criteria SW1 Retain and treat the first 15 mm of rainfall as close to source as possible.

Criteria SW2 All runoff up to the 1% AEP event is to be retained on site.

Criteria SW3 Finished floor levels must have a minimum of 500 mm clearance above the 1% AEP flood level in the PMD.

Criteria SW4 Finished floor levels must have a minimum of 300 mm clearance above the 1 % AEP TWL in the FSA.

Criteria SW5 Ensure minor roads remain passable in a 20% AEP event.

Criteria SW6 Reduce nutrient loads by applying appropriate non-structural measures.

Criteria SW7 Design infiltration areas to avoid creating mosquito habitat.

The manner in which these objectives will be achieved is further detailed in **Section 6**.

4.4 Groundwater management

The principle behind the groundwater management strategy is to maintain the existing groundwater hydrology. The groundwater management criteria for the site include:

Criteria GW1 Use WSUD approaches to recharge the superficial aquifer.

Criteria GW2 Lots should have a clearance to the MGL of at least 1.2 m.

Criteria GW3 Surface based infiltration should have 300 mm clearance above MGL.

Criteria GW4 Groundwater quality at the downstream end of the development should be at least the same or better than upstream groundwater quality.

Criteria GW5 Soils underlying bio-retention areas should have a band material that is minimum of 300 mm deep with high PRI<10.

The manner in which the groundwater management objectives will be achieved is further detailed in **Section 7**.

5 Water Conservation Strategy

5.1 Fit for purpose water use

Conservation of water through fit-for-purpose use and best management practices is encouraged so that scheme water is not wasted. Fit-for-purpose describes the use of water that is of a quality suitable for the required use of the water. Fit-for-purpose principles have been utilised in the water conservation strategy for the site and will achieve **Criteria WC1**.

5.1.1 Scheme water supply

The site is located within the Water Corporation water infrastructure and can be serviced by an existing DN300 water main located in the Johnson Road/ Irasburg Parade verge (JDSI 2023).

Scheme water is proposed to be used for all in-house potable uses and, where non-potable uses cannot be serviced by other supplies or approaches, it would also satisfy non-potable requirements.

5.1.2 Groundwater

As discussed in **Section 3.6.3**, the site is located beneath a multi-layered system comprising of the Superficial Swan, Leederville and Yarragadee aquifers.

The proponent currently holds a groundwater license (GWL 96942) from the Superficial Swan aquifer with a total yearly allocation of 43,500 kL. Based on the total proposed POS area of 8,189 m^2, if an irrigation rate of 7,500 kL/ha/year was adopted then the current groundwater license would be sufficient for irrigation of all POS areas. The groundwater licence is provided in **Appendix G**. A landscape concept of the site has been prepared to provide an indication of the vision that is being developed for the POS areas. This is contained in **Appendix C**.

5.1.3 Rainwater tanks

Rainwater tanks (RWTs) can be used within private lots to harvest roof runoff. This water is considered non-potable, but can be used to supplement non-potable water uses both inside and outside the home.

5.2 Lot scale water conservation measures

This LWMS proposes that the water conservation measures to be adopted would include RWTs, waterwise principles for lot scale gardens and within estate landscaping (WWG) and water efficient fixtures and appliances (WEFA) to ensure that the development minimises the use of water. These are summarised in the following sections.

5.2.1 Rainwater tanks

The use of RWTs will not be mandated, and the stormwater quantity management strategy does not rely on their use. They are therefore only considered to be a water conservation measure. Given that

rainwater tanks will not be mandated or supplied by the proponent, it has been assumed that these would be implemented by 7.5% of households. The assumed uptake rate has been based on data obtained from the Australian Bureau of Statistics (ABS 2013). It is assumed (for the purposes of the water balance analysis) that all rainwater tanks have a capacity of 3 kL.

5.2.2 Water efficient fixtures and appliances

Water conservation strategy for the site proposes the use of WEFA. Water efficient fittings will be mandated through the building licence, while uptake of water efficient appliances can be encouraged by State and Local Government rebates in addition to education from the proponent at point of sale. It is assumed that water efficient appliances will be implemented by 40% of households, which has been based on data obtained from the Australian Bureau of Statistics (ABS 2013, 2014).

5.2.3 Waterwise gardens

Landscape packages will be provided as a part of the land sale contract. Reductions in water used for irrigation will therefore be achieved by promoting Waterwise gardening principles (WWG) (WC 2003) at the time of sale. It is assumed that 75% of households will implement WWG principles within lot gardens (ABS 2013). WWG principles include:

- Soil to be improved with soil conditioner certified to Australian Standard (AS) 4454 to a minimum depth of 150 mm where turf is to be planted and a minimum depth of 300 mm for garden beds.
- The irrigation system shall be designed and installed according to best water efficient practices:
  - The controller must be ‘hydrozoned’.
  - Emitters must disperse coarse droplets or be subterranean.
- Garden beds to be mulched to 75mm with a product certified to AS4454.
- Increasing community awareness of water conservation by promoting Waterwise practices, fixtures and fittings at the point of sale.
- Minimise water requirements for POS maintenance. This will be achieved by implementing an appropriate management and maintenance program for POS areas in accordance with CoK specifications. This is further detailed in **Section 8**.

The above measures will assist in achieving **Criteria WC1** and **WC2**.

5.3 Water use analysis

5.3.1 Lot scale water use analysis

A water use analysis has been undertaken to estimate the expected individual residential lot water use to demonstrate the effectiveness of the water conservation strategy. The water use analysis has been based on the rates and calculation methodology presented in the Water Corporation (2011)

spreadsheet *AltWaterSupply_Water_Use_Model.xls*. This spreadsheet has been adapted to model the effects of using the water conservation measures proposed.

A number of key assumptions were made including:

- Total lot area has been based on the subdivision layout (see **Appendix A**).
- Average residency of 2.6 people per single lot dwelling. This value has been calculated from data provided by ABS for new housing developments in Perth (ABS 2022).
- Assumed up-take rates include:
  - 100% uptake of water efficient fittings
  - 40% uptake of water efficient appliances
  - 7.5% uptake of RWTs
  - 55% uptake of WWG principles.

The results of the water balance indicate that if households adopt the proposed water conservation measures (e.g. efficient fittings, RWT, WWG principals) at typical uptake rates they will use an average of 45.1 kL/year/person. This achieves the water target of no more than 60 kL/year/person of scheme water and satisfies **Criteria WC1**.

5.4 Wastewater management

The wastewater generated from the site will be managed by connecting the development to the Water Corporation deep sewer network.

5.5 Water conservation management criteria compliance

A summary of the proposed water conservation management criteria and how these are addressed is provided within **Table 3.**

Table 3: Water conservation management criteria compliance

Criteria number	Criteria description	Manner in which compliance will be achieved
WC1	Consumption target for water of 100 kL/person/year, including not more than 40-60 kL/person/year scheme water.	Provide advice to residents on water conservation measures
		RWTs can be utilised for non-potable uses
		Promotion and use of WWG in lots
		Promotion and use of water efficient appliances
		Mandate water efficient fittings
WC2	Ensure the efficient use of all water resources in newly developing urban form.	Use of waterwise landscaping principles in POS
		POS designed to use no more than allocated groundwater
		Minimise water requirements for POS and verge maintenance
		Use of water efficient appliances
		Use of WWG principles in lots

6 Stormwater Management

The principle behind the stormwater management strategy for the site is to maintain the existing hydrology by retaining and treating runoff from the small rainfall event (i.e. first 15 mm) as close to source as possible and retaining up to the major event (1% AEP) on site. Due to the existing environmental conditions (See **Section 3.4**), the site is well suited for structural controls utilising infiltration of stormwater, on the basis that sufficient clearance to MGL can be provided. It is noted that all surface runoff will be retained on site and there will be no discharge or connection required into the PMD.

WSUD measures utilised in the stormwater management strategy include:

- In lot soakwells
- Raingardens on side boundary of dual frontage lots
- BRA at the downstream POS
- FSA at the downstream POS.

The WSUD measures that will be implemented as a part of the development are described in the following sections. Surface runoff modelling undertaken using XPSWMM has been used to inform the design of stormwater infrastructure as detailed in the following sections. Assumptions used to represent the post-development environment are provided in the modelling assumptions report in **Appendix F**.

6.1 Lot drainage

Residential lot stormwater infrastructure will be design to retain the up to the major rainfall event (i.e. 1% AEP) from roof and pervious areas within soakwells and impervious gardens areas. This assumption is consistent with the CoK stormwater and runoff policy (CoK 2024a) which requires private lots to retain/confine all runoff within the property boundaries. Where adopted, runoff from roof areas may be directed to a RWT with excess runoff to soakwells, or entirely to soakwells which will infiltrate into the sandy soil and ultimately the groundwater. Lot storage is the responsibility of the lot owner and will be assessed as part of the building approval process prior to construction.

The use of soakwells will assist in achieving **Criteria SW1.**

6.2 Development drainage

6.2.1 Raingardens

Raingardens can potentially be provided along side boundaries of dual frontage lots and will assist capturing localised surface runoff from road reserves in the frequent storm event. The design of raingardens will be generally consistent with similar infrastructure within the CoK. Raingardens should be planted with native vegetation to encourage biological nutrient uptake of nitrogen species (Monash University 2014). An appropriate soil medium should be used to line the raingarden to

increase phosphorous removal from runoff during infiltration if parent soils do not exhibit sufficient PRI (PRI>10).

The location and number of raingardens will be confirmed and detailed in future UWMPs as part of detailed design, however potential locations have been identified and are shown in **Figure 7**. It is noted that overall retention requirements for the site do not account for storage within rain gardens at this time as its adoption will be highly influenced by the detail designs and other constraints e.g. pedestrian access. The provision of raingardens will increase the volume of runoff treated and infiltrated higher in the catchment and may result in a decrease in the volume required to be retained within downstream BRAs.

The use of raingardens will assist in achieving **Criteria SW1**, **SW2**, **SW6** and **SW7**.

6.2.2 Bio-retention areas

Runoff from the frequent event (i.e. first 15 mm) from road reserves when maximum capacity of the raingardens is exceeded will be intercepted by the pit and pipe network and conveyed to the downstream vegetated BRA where it will be retained, treated and infiltrated. The BRA is assumed to have a depth maximum water depth of 500 mm in response to the frequent rainfall event (i.e. first 15 mm) and to have 1:3 side slopes. It is noted that this approach is consistent with previously supported infrastructure within the CoK. Treatment of surface runoff will be provided through interaction with vegetation and adsorption to sand particles through infiltration prior to reaching groundwater. The BRA will be underlain with a band of 300 mm of high PRI amended soils (PRI>10). Suitability of the parental soils will be confirmed prior to the detailed design stage and where not deem appropriate imported soils will be utilised. The proposed location and drainage requirements of the BRA is illustrated in **Figure 7**.

The BRA will be designed to dry out within 96 hours following rainfall events, and therefore there will be no risk of creating mosquito breading habitat. The BRA is immediately next to the PMD and set above the MGL. The PMD will provide an immediately adjacent groundwater control that will assist in the BRA drying out between storm events.

The use of a BRA will assist in achieving **Criteria SW1, SW6** and **SW7**.

6.2.3 Flood storage areas

An FSA will be utilised to retain and infiltrate runoff above the first 15 mm and up to the 1% AEP rainfall event. To achieve this, the invert of the FSA will be provided with at least 300 mm of clearance to the MGL. The FSA will be designed to have a maximum water depth of 1.2 m in response to the major rainfall event and to have 1:6 side slopes. In addition, it will be designed around the existing topography in order to maximise tree retention. It is noted that all surface runoff from road reserve areas that is not intercepted by the upstream drainage infrastructure will be fully retained and infiltrated on site, and therefore there will be no discharge to the PMD in a 1% AEP rainfall event.

The design of the FSA will be such that adjacent lots will achieve at least 300 mm clearance above the 1% AEP top water levels (TWL) to ensure protection from flooding during extreme rainfall events. The concept earthworks strategy is provided in **Appendix B**.

Extensive infiltration testing across the POS area and future location of the drainage infrastructure has been undertaken by Douglas Partners (2024). Based on the recorded permeability, an infiltration rate of 0.5 m/day has been adopted to inform the surface runoff modelling for the sizing of the FSA.

Consistent with the BRA, the FSA will be designed to dry out within 96 hours following rainfall events**.** The base of the FSA will be provided with subsoil drains that will be installed in a band of free draining amended soil. This will assist emptying between rainfall event and ensure that subsoils work as intendent. Given that the PMD act as a natural groundwater control and it will be adjacently to the FSA, the proponent may seek permission from Water Corporation for a subsoil drain outlet to the PMD. The overall configuration of the basin and underlying subsoil will be detailed in subsequent UWMPs to support subdivision, and it will be consistent with CoK and WC design policies.

The sizes and spatial requirements for the FSA are further discussed in **Section 6.2.4.2** and illustrated in **Figure 7**. The use of an FSA will assist in achieving **Criteria SW2, SW4, SW5** and **SW7**.

6.2.4 Stormwater management design

The development drainage system has been designed to achieve the objectives and criteria stated in **Section 4**. Surface runoff modelling undertaken using XPSWMM has been used to inform the design of stormwater infrastructure; modelling assumptions adopted are provided in **Appendix F**.

6.2.4.1 Small rainfall event

Runoff from the small rainfall event (i.e. first 15 mm of rainfall) from residential lots will be retain and infiltrated in lot by the use of soakwells and impervious garden areas. Runoff from the road reserve will be managed by a treatment train approach using raingarden and a downstream BRA. Road reserve runoff in the small event that is not intercepted by the raingardens will be conveyed by the pit and pipe network and ultimately discharge into the BRA where it will be treated by interaction with vegetation know for nutrient uptake and infiltrated.

The retention storage requirements for management of the small rainfall event are provided in **Table 4** with proposed location shown in **Figure 7**. As mentioned in **Section 6.2.1**, raingardens have not been considered to determine the retention requirements of the site as their uptake and capacity are subjected detail designs.

Table 4: Small event (first 15 mm) treatment requirements

Catchment	Storage Area	Small Event Treatment (first 15 mm)		
		Depth (m)	TWL Surface Area (m2)	Volume (m3)
Ct-A	BRA A	0.5	468	203

The invert level (IL) of the BRA will be set 700 mm above the FSA IL equating to a minimum BRA IL level of 5.7 mAHD and a top water level (TWL) of 6.2 mAHD. Note that the ultimate configuration and spatial location of the BRA can be modified at detailed design stage (subject to CoK design requirements) provided that the intent of the design criteria can still be met.

The landscape concept plan provided in **Appendix C** indicates how the stormwater management components are intended to be integrated into the POS. The use of raingardens and BRAs will assist in achieving **Criteria SW1**.

6.2.4.2 Major rainfall event

will be retained onsite (within lots and/or road reserve) to satisfy **Criteria SW1**. Runoff not retained on lots or within the road reserve will be conveyed to downstream POS via the piped drainage network, sized to cater the 20% AEP event as per CoK specifications.

Runoff from the major rainfall event within residential lots will be managed by the use of soakwells and impervious garden areas. Soakwells will be sized to cater the 1% AEP in response to the CoK which requires to retain/confine all runoff within the property boundaries. Surface runoff in the major rainfall event from road reserves and POS areas will be conveyed the pit and pipe network size to cater up to the minor rainfall event (20% AEP) and sheet flow over the road network to the downstream FSA. The FSA has been sized to retain and infiltrate up to the major rainfall event on site. The retention requirements, modelled depths and TWL for the minor (20% AEP) and the major (1% AEP) storm events are summarised in **Table 5**.

Table 5: Stormwater storage requirements - minor (20% AEP), and major (1% AEP) events

Catchment	Storage Area	Minor Event Storage (20% AEP)			Major Event Flood Storage (1% AEP)		
		Depth (m)	TWL Surface Area (m2)	Volume (m3)	Depth (m)	TWL Surface Area (m2)	Volume (m3)
Ct-A	BRA A	0.5	468	203	0.5	468	203
	FSA A	0.45	1,390	534	1.2	2,150	1,860

The invert of the FSA will be set at a minimum of 5.0 m AHD to provide 300 mm above the MGL. On this basis, the TWL of the FSA will be 6.2 m AHD. The adjacent lot levels are set at a minimum of 6.66 mAHD, thereby providing 460 mm of clearance between the TWL and the earthworked lot level. The above measures will therefore help to achieve **Criteria SW2, SW3** and **SW4**.

Whilst the above provides an overall configuration of the FSA, it is noted that the final configuration will be reviewed and documented in subsequent UWMPs at the detailed design stage.

6.3 Non-structural measures

A number of non-structural measures will be implemented to help reduce nutrient loads within stormwater runoff. These measures include:

- Minimising fertiliser use to establish and maintain vegetation within POS and road verges.

- Street sweeping at regular intervals.
- Use of drought tolerant turf species that require minimal water and nutrients.
- Education of residents regarding fertiliser use and nutrient absorbing vegetation species within lots.

The above measures will assist in achieving **Criteria SW6**.

6.4 Stormwater management criteria compliance

A summary of the proposed stormwater design criteria and how these are addressed is provided in **Table 6**.

Table 6: Stormwater management criteria compliance

Criteria number	Criteria description	Manner in which compliance will be achieved
SW1	Retain and treat the first 15 mm of rainfall as close to source as possible	Residential lots to retain the first 15 mm of rainfall on lot in soakwells.
		Runoff from road reserves in small rainfall events will be intercepted higher in the catchment by raingardens (localised runoff). When maximum capacity of raingardens is exceeded runoff will be conveyed by the pit and pipe network to the downstream BRA in POS.
		All small rainfall event (first 15 mm) runoff will infiltrate through the underlying soil profile with nutrients taken up by vegetation or adsorbed to sand particles prior to reaching groundwater.
SW2	All runoff up to the 1% AEP event to be retained on site	Runoff from lots up to the 1% AEP will be managed within soakwells and impervious garden areas.
		Runoff from road reserves up to the major rainfall event will be managed by a combination of raingardens located along inactive side of dual frontage lots, and BRA and FSA located in the downstream POS.
SW3	Finished floor levels must have a minimum 500 mm clearance above the 1% AEP flood level in the PMD	The 1% AEP flood level in the PMD is 5.60 mAHD. The preliminary bulk earthworks concept provided in shows that approximately 1.06 m of clearance will be provided at the closest lots.
SW4	Finished floor levels must have a minimum 300 mm clearance above the 1% AEP TWL in the FSA	All lots will be provided a minimum of 460 mm clearance to the 1% AEP TWL (6.2 mAHD) in the FSA.
SW5	Ensure minor roads remain passable in a 20% AEP event	The pipe network will be designed to convey the 20% AEP rainfall event.
SW6	Reduce nutrient loads by applying appropriate non-structural measures	• Minimise use of fertilisers within POS and road verges. • Street sweeping at regular intervals. • Use of drought tolerant turf species. • Education of residents regarding fertiliser use
SW7	Design infiltration areas to avoid creating mosquito habitat	Stormwater infrastructure will be designed to ensure all runoff is infiltrated within 96 hours.

7 Groundwater Management

Groundwater management within the site will incorporate measures to manage groundwater levels and quality. The adoption of groundwater management strategies and how the detailed designs will achieve the proposed criteria will be provided in the subsequent UWMP document at the subdivision stage. The development drainage system has been designed to achieve the objectives and criteria stated in **Section 4.4.**

7.1 Groundwater level management

Stormwater is proposed to be retained and infiltrated at close to the source as possible to be consistent with the existing hydrological regime. This will be achieved by the use of WSUD features that retain and allow infiltration of surface runoff such as soakwells, permeable portions of lots, raingardens, a BRA and an FSA.

The groundwater level management for the site will achieved by:

- Use of existing site levels plus some imported fill to achieve sufficient clearance.
- Final lot levels designed to be at least 1.2 m above the MGL.
- Inverts of infiltration structures are set at least 300 mm above MGL.

Control of groundwater by subsoil drainage is not required/recommended for the site due to the lot levels that result when providing adequate clearance (at least 500 mm) above the 1% AEP flood levels in the PMD (of 5.6 mAHD (DoW 2009)). Lot levels are also influenced by the need to connect to the deep sewer network.

Subsoil drainage will be utilised under the downstream drainage infrastructure to assist emptying between rainfall events. However, these are not proposed to actively control groundwater levels nor to manage event based surface runoff. It is noted that the use of subsoil drains under the FSA is proposed as a contingency measure to improve the functioning of the drainage infrastructure. The final adoption of subsoil drainage under the FSA will be revised at the detail design stage and will ultimately be subject to future approval from Water Corporation regarding the connection into the PMD.

The preliminary bulk earthworks concept is provided in **Appendix B**, and this indicates that the lowest lot earthwork level is set at 6.66 mAHD, which is approximately 1.8 m above MGL. Further, the FSA invert of 5 m AHD is 300 mm above the MGL (4.7 mAHD) and therefore compliance with **Criteria GW2** and **GW3** will be achieved.

7.2 Groundwater quality management

The main objective for groundwater quality management is to maintain or improve the existing groundwater quality. This can be achieved by reducing the total nutrient load into the groundwater that originates from the development. Groundwater that originates from the development is surface

runoff that has infiltrated into the soil profile. Therefore, improving groundwater quality can be achieved by treatment of the surface runoff prior to infiltrating to groundwater.

The reduction of nutrient load to the groundwater will be achieved by:

- Retention of existing trees within POS wherever possible
- Directing stormwater to a vegetated (with native wetland species) BRA.
- The BRA will be underlain by material with an appropriate PRI (nominally a PRI of 20 at 150 mm or equivalent). It is acceptable for this to be achieved with a thicker layer of lower PRI soil (e.g. 300 mm of PRI 10).
- Minimise fertiliser use to establish and maintain vegetation within POS areas and road verges.
- Drought tolerant turf species that require minimal water and nutrients will be used.
- Roll-on turf will be used within the POS areas and road verges, to prevent the high nutrient input requirement during establishment of the turf.
- Garden beds should not be immediately adjacent to the BRA to reduce nutrient transportation into these infiltration areas.

The above measures will improve the quality of the water prior to it infiltrating into the underlying groundwater and will assist in achieving **Criteria GW1**.

7.3 Groundwater design criteria compliance

A summary of the proposed groundwater quantity design criteria and how these are addressed within the site is provided in **Table 7**.

Table 7: Groundwater criteria compliance summary

Criteria number	Criteria description	Manner in which compliance will be achieved
GW1	Use water sensitive design approaches to recharge the superficial aquifer	Retain and infiltrate all runoff up to the 1% AEP rainfall event on site within lot soakwells, permeable lot areas, raingardens a BRA and an FSA.
GW2	Lots should have clearance to the measured MGL of at least 1.2 m.	Lots will be set at least 1.2 m above the MGL.
GW3	Surface based infiltration should have 300 mm clearance above MGL	Basin inverts will be set at 300 mm above the MGL, and subsoil drainage would be provided under the FSA.
GW4	Groundwater quality at the downstream end of the development should be at least the same or better than upstream groundwater quality.	Surface runoff generated within the site will be treated within vegetated raingardens and BRA prior to infiltration.
GW5	Soils underlying bio-retention areas should have a band material that is minimum of 300 mm deep with high PRI<10.	BRA will be provided with a 300mm band of amended soils with PRI<10.

8 Subdivision and Urban Water Management Plans

The requirement to prepare more detailed water management plans to support subdivision is generally imposed as a condition of subdivision. The development of any future UWMP should follow the guidance provided in *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008d).

While strategies have been provided within this LWMS that address planning for water management within the site, it is a logical progression that future subdivision designs and the supportive UWMP will clarify details not provided within the LWMS. The main areas that will require further clarification within future UWMPs include:

- Surface runoff modelling
- Implementation of water conservation strategies
- Imported fill specifications
- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program
- Infiltration assumptions.

These are further detailed in the following sections. As stated above, ongoing (post-development) monitoring of groundwater will be detailed in the UWMP, however in this LWMS is outlined broadly in **Section 9**.

8.1 Surface runoff modelling

It is acknowledged that the water management strategies documented in this LWMS are based upon broad-scale assumptions and to some extent regional data. These assumptions are considered adequate for development of this LWMS and are of an appropriate level of detail. However, verification of proposed subdivision drainage designs will be undertaken once the specific basin designs and extent of inclusion of finer scale WSUD elements are confirmed.

As identified in **Section 3**, there is some measure of existing connection to the PMD via an existing informal channel and due to the site levels being (in some parts) lower than the 1% AEP flood level in the PMD. Water Corporation have indicated that direct connection to the PMD will not be supported for discharge of any event base surface runoff. On this basis, future UWMPs will demonstrate that the surface runoff will be managed and fully retain on site.

8.2 Implementation of water conservation strategies

A number of potential measures to conserve water have been presented within this LWMS. These water conservation strategies will be incorporated into the design and the ongoing maintenance of the POS areas. Landscape concept design measures that will be incorporated into the water

conservation strategy will be further detailed within the future UWMPs produced for the development. The manner in which the developer intends to promote water conservation measures discussed in this LWMS to future lot owners will also be discussed within the future UWMPs.

8.3 Imported fill specifications

As discussed previously the use of clean fill will be required to ensure the BRA/FSA remain as dry basins and sufficient clearance to groundwater is maintained. Soils beneath the BRA will require a high PRI to provide at-source nutrient retention to ensure the protection of downstream water bodies. The specification for this would typically be a 300 mm band of soil with a PRI>10 beneath the BRA, however this can be modified as long as the soils adopted are comparable to the assumptions in this LWMS.

8.4 Non-structural water quality improvement measures

Guidance for the development and implementation of non-structural water quality improvement measures is provided within the *Stormwater Management Manual for Western Australia* (DWER 2022). Some measures will be more appropriately implemented by CoK, such as street sweeping, however many can be implemented relatively easily within the design and maintenance of the subdivision and the POS areas.

It is expected that the future UWMP will provide an implementation plan/timing/responsibility for measures such as street sweeping, public education (through measures such as signage that may be implemented to raise awareness), etc.

8.5 Management and maintenance requirements

The management measures to be implemented to address surface water quality (such as the use of vegetation within WSUD assets) will require ongoing maintenance. It is therefore expected that the future UWMP will detail management and maintenance procedures that will set out required maintenance actions (e.g. gross pollutant removal), timing (e.g. how often it will occur), locations (e.g. exactly where it will occur) and responsibilities (e.g. who will be responsible for carrying out the actions). Given that approval from the CoK will be sought for the proposed measures, it is anticipated that consultation will be undertaken and referral to guiding policies and documents will be made.

8.6 Construction period management strategy

It is anticipated that the construction stage will require some management of various aspects (e.g. dust, surface runoff, noise, traffic etc.). The management measures undertaken for construction management will be addressed either in the future UWMP or a separate Construction Management Plan (CMP).

8.7 Monitoring and evaluation program

It will be necessary to confirm that the management measures that are implemented are able to fulfil their intended management purpose, and are in a satisfactory condition at a point of management hand-over to the CoK. A post-development monitoring program will be developed to provide this confirmation, and it will include details of objectives of monitoring, relevant issues and information, proposed methodology, monitoring frequency and reporting obligations. These monitoring programs are discussed in **Section 9** of this LWMS and will be further detailed at the UWMP stage.

8.8 Infiltration assumptions

The infiltration rates used within the hydrological modelling have been based on a preliminary geotechnical investigation carried out by GGC (GGC 2022), which measured unsaturated permeability ranging from <1 m/day to >5 m/day. The infiltration rate for the hydrological model was assumed to be 4.32 m/day (minus clogging) which is consistent with the existing shallow sand. Further testing may be warranted at the target location and intended invert; however, it is also noted that currently the FSA invert is at or slightly above the natural surface. Therefore, the permeability of either natural soils and/or imported soils should be confirmed at the detailed design stage.

9 Monitoring

The aim of this section is to assess the effectiveness of the pre-development monitoring that has been undertaken and make recommendations regarding future post-development monitoring.

9.1 Pre-development monitoring summary

The pre-development groundwater monitoring was conducted at five monitoring bores within the site. The data collected includes groundwater levels, sampling of physio-chemical parameters in situ and laboratory analysis of nutrients. Monitoring data has been collected since 2022 over June to November and captured for two winter peak levels. The result of this monitoring provides an appropriate baseline that will assist in verification of future detailed designs at the subdivision stage. Further predevelopment monitoring is therefore not required.

9.2 Post-development monitoring

The post-development monitoring should be generally consistent in approach with the pre-development monitoring (as documented in earlier sections), with the addition that the WSUD measures should also be monitored to ensure their continued effectiveness. It will be necessary to confirm that the structural management measures that are implemented are able to fulfill their intended management purpose and are in a satisfactory condition at a point of management hand-over to the CoK. These monitoring programs will be further detailed at the UWMP stage.

9.2.1 Trigger values

Water quality targets have been derived from the *National Water Quality Management Strategy* (ANZECC and ARMCANZ 2000) and in consideration of the measured levels provided in **Table 2**. The trigger criteria proposed are shown in **Table 8.**

Table 8: Post-development trigger values

Analyte	pH	EC (uS/cm)	TN (mg/L)	TP (mg/L)
Value	6-8	1900	4.0	0.2

9.3 Recommended program for UWMP

9.3.1 Condition monitoring

It is proposed that the overall condition of the development will be monitored on a bi-annual basis. This monitoring will be implemented after the completion of the civil and landscaping works and will continue for a period of two years.

A visual assessment will be undertaken to monitor the overall condition of the development, with the aim to ascertain that the maintenance activities are achieving the overall management objectives for the development. The parameters that will be monitored include:

- Gross pollutants
- Terrestrial weeds
- Irrigation
- Vegetation density
- Paths, benches, walkways and other infrastructure.

The management and maintenance objectives will be detailed within future UWMPs along with details of the corresponding monitoring program.

9.3.2 Surface and groundwater monitoring

Given that there will be no surface water discharge from the site during small rainfall events (the first 15 mm) it will be very difficult to collect a water quality sample for treated surface runoff. Post-development surface water monitoring is therefore not proposed.

Post-development monitoring will focus on groundwater quality as this will be more representative of water that has been treated (i.e. post infiltration).

The locations of existing groundwater bores need not necessarily be maintained post-development. Given the variability in the observed water quality data, it is proposed that post-development monitoring will reference both the derived water quality target, and an upstream/downstream comparison of water quality at key locations. The indicative proposed locations for groundwater monitoring are shown on **Figure 8** and have been selected to provide an indication of the results of POS management.

Groundwater quality monitoring should be conducted on a quarterly basis. A summary of the post-development monitoring program is shown in **Table 9**. The post-development monitoring should be conducted for two years.

Table 9: Monitoring Program Summary

Monitoring Type	Locations	Frequency	Parameters
Groundwater	Bores upstream and downstream of key representative areas	Quarterly (typically Jan, April, July, Oct).	In situ pH, EC, temperature. Sample TSS, TN, TKN, NH_4, NO_X, TP.

9.3.3 Contingency Action Plan

A Contingency Action Plan (CAP) should be detailed and implemented as a part of the UWMP. The CAP is effectively a plan of steps that will be undertaken should certain water quality criteria be exceeded.

9.3.3.1 Trigger Criteria

As indicated, the groundwater trigger values proposed in **Section 9.2.1** have been derived from the *National Water Quality Management Strategy* (ANZECC and ARMCANZ 2000), measured water quality from the site and in consideration of other relevant guidelines.

9.3.3.2 Contingency Actions

If the results from the initial monitoring occasion indicate that nutrient concentrations exceed the nominated trigger values, a number of contingency measures may be employed.

The first action that should be undertaken if groundwater trigger criteria are exceeded is to repeat the monitoring to remove the potential for sampling error. If the repeat monitoring still shows results which breach the trigger value, the next action will be to compare the upstream (incoming) nutrient concentrations with the outgoing (downstream) nutrient concentrations. If the downstream nutrient concentrations are >50% higher than the upstream nutrient concentrations, the following actions should be undertaken:

- Review POS nutrient application practices to identify source if possible.
- Conduct surveillance of subdivision area to determine any other potential and obvious nutrient inputs.
- Remove source if possible (i.e. fertiliser input, etc.).
- Remove sediment–bound nutrients by removing basin sediments.
- Manual removal of plant material from BRAs to facilitate further nutrient uptake.

If the downstream nutrient concentrations are found to be generally consistent with the upstream concentrations the next action will be to conduct a site – specific comparison of long-term background data presented in the DWMP and this LWMS. There is some amount of variability (both spatially and temporally) in nutrient concentrations experienced across the site and the trigger values may need to be modified to accommodate background levels. This information should then be used as a management tool to determine if the trigger values should be revised.

Following the implementation of the above contingency measures the groundwater quality will be re – sampled. If the results of the analysis still show water quality characteristics which breach the trigger values an additional set of upstream/downstream monitoring bores may be installed. The additional bores will be sampled as per the ongoing sampling regime already being undertaken for the first two bores. If the additional locations demonstrate results consistent with the initial monitoring, an assessment will be undertaken as to whether the results are representative of a broader catchment management issue, and whether any additional contingency actions need to be implemented onsite.

9.4 Reporting

A post-development monitoring report will be prepared on conclusion of the two-year monitoring period and will be provided to CoK on request. Interim results (spreadsheet) can be provided to either CoK or DWER on request during the monitoring program.

10 Implementation

10.1 Roles and responsibility

The LWMS provides a framework that the proponent can utilise to assist in establishing stormwater management methods that have been based upon site-specific investigations, are consistent with relevant State and Local Government policies and have been endorsed by DWER and CoK. The responsibility for working within the framework established within the LWMS rests with the proponent, although it is anticipated that a future UWMP will be developed in consideration of other relevant policies and documents.

10.2 Funding

The proponent will fund all subdivision, civil and landscape works within the public realm. Development of individual lots will be the responsibility of the lot owner at the lot-scale development application stage.

10.3 Review

It is not anticipated that this LWMS will be reviewed unless the site undergoes significant change post-lodgement of the LWMS. If the proposed layout of the development is substantially modified, the surface runoff modelling undertaken for this LWMS may need to be reviewed and the criteria revised to ensure that all are still appropriate.

The next stage of water management is UWMP preparation. The UWMP is largely an extension of the LWMS, as it should provide detail to the designs proposed within this LWMS and will demonstrate compliance with the criteria proposed in **Section 4**.

The next stage of development following the UWMP is single lot development. It is recognised that certain elements of the LWMS and the UWMP will not be implemented until this late stage, and that there is little or no statutory control that can be applied to ensure the implementation of any remaining measures. While the remaining measures are unlikely to be enforced at this stage their implementation could be encouraged by the CoK through policy (or modification of these where necessary), building licence or awareness programs (such as the Water Corporation Waterwise program).

11 References

11.1 General references

The references listed below have been considered as part of preparing this document.

Australian Bureau of Statistics (ABS) 2013, *4602.0.55.003 - Environmental Issues: Water use and Conservation, Mar 2013*, Canberra <https://www.abs.gov.au/ausstats/abs@.nsf/mf/4602.0.55.003>.

Australian Bureau of Statistics (ABS) 2014, *4602.0.55.001 - Environmental Issues: Energy Use and Conservation, Mar 2014*.

Australian Bureau of Statistics (ABS) 2022, *Housing Occupancy and Costs 2019-2020*, Canberra, <https://www.abs.gov.au/statistics/people/housing/housing-occupancy-and-costs/latest-release>.

Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand (ANZECC and ARMCANZ) 2000, *National Water Quality Management Strategy - Australian Guidelines for Urban Stormwater Management*.

Australian Government 2018, *Charter: National Water Quality Management Strategy*.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Editors) 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

Bureau of Meterology (BoM) 2024, *Climate Data Online*, <http://www.bom.gov.au/climate/data/>.

City of Kwinana 2023, *City of Kwinana Town Planning Scheme No. 2*, Westernm Australia.

City of Kwinana (CoK) 2024a, *Stormwater and Water Tanks Policy*, WA, <https://www.kwinana.wa.gov.au/property-and-pets/building-and-renovating-(residential)/storm-water-and-water-tanks>.

City of Kwinana (CoK) 2024b, *Town of Kwinana Local Planning Scheme*, Western Australia.

Department of Biodiversity, Conservation and Attractions (DBCA) 2023, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*, Western Australia, <https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain>.

Department of Water 2009, *Jandakot Drainage and Water Management Plan (DWMP)*, Department of Water.

Douglas Partners 2024, *Report on Infiltration Testing Providence Estate Irasburg Parade Wellard*.

Department of Water (DoW) 2008a, *Interim: Developing a local water management strategy*, Department of Water, Government of Western Australia, Perth.

Department of Water (DoW) 2008b, *Jandakot District Water Management Plan*, Perth.

Department of Water (DoW) 2008c, *LiDAR Elevation Dataset, Swan Coastal Plain*, Perth.

Department of Water (DoW) 2008d, *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions*, Perth.

Department of Water (DoW) 2009, *Jandakot Drainage and Water Management Plan Peel main drain catchment*, Perth.

Department of Planning, Lands and Heritage (DPLH) 2021, *Draft State Planning Policy 2.9: Planning for Water*, Perth, WA.

Department of Water and Environmental Regulation (DWER) 2017a, *Acid Sulfate Soil – Swan Coastal Plain Database (DWER-055) (Dataset)*, <https://catalogue.data.wa.gov.au/dataset/acid-sulphate-soil-risk-map-swan-coastal-plain-dwer-055>.

Department of Water and Environmental Regulation (DWER) 2017b, *Decision Process for Stormwater Management in Western Australia*, Government of Western Australia, Perth.

Department of Water and Environmental Regulation (DWER) 2022, *Stormwater Management Manual for Western Australia, updated 2022*, Government of Western Australia, Perth.

Department of Water and Environmental Regulation (DWER) 2023, *Kep Katitjin – Gabi Kaadadjan – Waterwise Perth Action Plan 2*, Government of Western Australia, Western Australia.

Department of Water and Environmental Regulation (DWER) 2024a, *Perth Groundwater Map*, <https://maps.water.wa.gov.au/Groundwater/>.

Department of Water and Environmental Regulation (DWER) 2024b, *Water Register*, Perth, WA, <https://maps.water.wa.gov.au/#/webmap/register>.

Emerge Associates 2012, *Local Water Management Strategy, Wellard Residential*.

Emerge Associates 2013a, *Urban Water Management Plan - Providence Stage 1*.

Emerge Associates 2013b, *Urban Water Management Plan Addendum - Providence Stages 2 & 3*.

Emerge Associates 2014a, *District Water Management Strategy - Wellard Urban Precinct East*

Emerge Associates 2014b, *Urban Water Management Plan Addendum - Providence Stages 4 & 5*.

Emerge Associates 2015, *Urban Water Management Plan Addendum - Providence Stages 6 & 7*.

Emerge Associates 2016, *Providence Stage 9a Urban Water Management Plan Addendum*, EP13-011(08)--026A PML, Rev A.

Emerge Associates 2019, *Urban Water Management Plan Addendum - Providence Stage 10*.

Emerge Associates 2020, *Urban Water Management Plan Addendum - Providence Stages 11 and 12*.

Emerge Assocates (Emerge Associates) 2022a, *Urban Water Management Plan Addendum- Providence Stages 14 and 15*. EP13-011(19)--077 FMH, A.

Emerge Associates 2022b, *Urban Water Management Plan Addendum - Providence Stage 13*, EP13-011(15)--069B FMH, B.

Emerge Associates 2023, *Providence Stages 16-20 UWMP Addendum*, EP13-011(23)--083, D.

Engineers Australia 2006, *Australian Runoff Quality: A guide to Water Sensitive Urban Design*, National Committee for Water Engineering, Engineers Australia, Canberra.

ENV Australia (ENV) 2010, *Wellard Vegetation and Flora Assessment*.

ENV 2011, *Bollard Bulrush West District Water Management Strategy*, 10/219, Version 5.

Environmental Protection Authority (EPA) 2008a, *Guidance Statement No. 33. Environmental Guidance for Planning and Development*, Perth.

Environmental Protection Authority (EPA) 2008b, *Water Quality Improvement Plan for the Rivers and Estuary of the Peel-Harvey System - Phosphorus Management*.

Geotechnical and Geological Consultants (GGC) 2022, *Geotechnical Investigation Report Proposed Subdivision Development Providence East Estate Wellard WA*.

Government of WA 2009, *Gnangara Sustainability Strategy*, Perth.

Gozzard, J. R. 1983, *Rockingham, Sheets 2033 III and 2033 II*, Perth Metropolitan Region 1:50 000 Environmental Geology Series. Geological Survey of Western Australia, Perth.

Gozzard, J. R. 1986, *Perth Metropolitan Region* Geological Survey of Western Australia, Perth.

JDSi Consulting Engineers (JDSI) 2023, *Lot 506 Johnson Road, Servicing Report*.

Monash University 2014, *Vegetation Guidelines for Stormwater Biofilters within South-west of Western Australia* Melbourne.

Western Australian Land Information Authority (WALIA) 2024, *Landgate Map Viewer Plus*, <https://map-viewer-plus.app.landgate.wa.gov.au/index.html>.

Western Australian Planning Commission (WAPC) 2006, *State Planning Policy 2.9: Water Resources*, Gazetted in December 2006, Perth.

Western Australian Planning Commission (WAPC) 2007, *Jandakot Structure Plan*, Perth.

Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management*, Perth.

Western Australian Planning Commission (WAPC) 2009, *Planning Bulletin No. 64 Acid Sulfate Soils*, January 2009, Perth.

Western Australian Planning Commission (WAPC) 2015, *Draft Liveable Neighbourhoods*, Department of Planning, Perth.

Western Australian Planning Commission (WAPC) 2023, *Metropolitan Regional Scheme*, Western Australia.

Water Corporation (WC) 2003, *Domestic Water Use Study in Perth, Western Australia 1998-2001*, Perth.

Water Corporation (WC) 2011, *AltWaterSupply_Water_Use_Model.xls*, Perth.

11.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 11.1**, with access date information provided in **Table R 1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
(ABS 2013)	19/10/2023	Environmental Issues: Water use and Conservation
(ABS 2022)	19/10/2023	Housing Occupancy and Costs 2019-2020, Canberra
(BoM 2024)	19/10/2023	Climate Data
(DWER 2017a)	19/10/2023	Acid Sulfate Soils Risk Maps
(DWER 2024a)	19/10/2023	Perth Groundwater Map
(DWER 2024b)	19/10/2023	Water Register

Figures

Figure 1: Site Location

Figure 2: Topographic Contours

Figure 3: Environmental Geology and Geotechnical Investigations

Figure 4: Acid Sulfate Soil Risk Mapping

Figure 5: Geomorphic Wetlands and Hydrological Features

Figure 6: Groundwater Contours

Figure 7: Stormwater Management Plan

Figure 8: Post-development Monitoring Locations

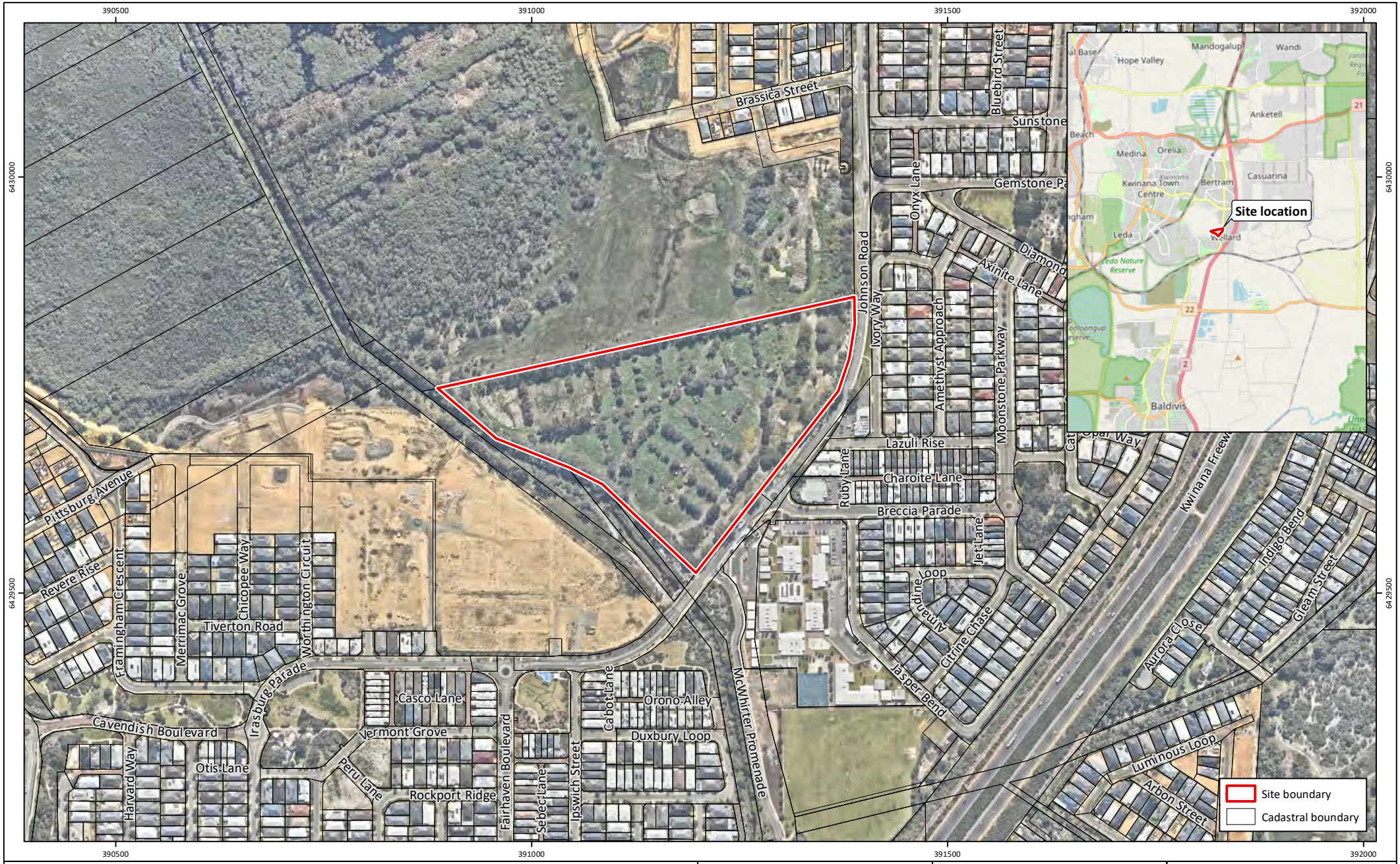


Figure 1: Site Location

Project:	Local Water Management Strategy Lot 506 Johnson Road, Wellard
Client:	Eastcourt Properties

Plan Number:
EP22-062(03)--F01

Drawn:	WJC
Date:	08/11/2023
Checked:	JM
Approved:	DPC
Date:	01/12/2023

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

Figure 2: Topographic Contours

Project:	Local Water Management Strategy Lot 506 Johnson Road, Wellard
Client:	Eastcourt Properties

Plan Number:
EP22-062(03)--F02

Drawn:	WJC
Date:	08/11/2023
Checked:	JM
Approved:	DPC
Date:	01/12/2023

N

0 50 100
Metres

Scale: 1:3,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

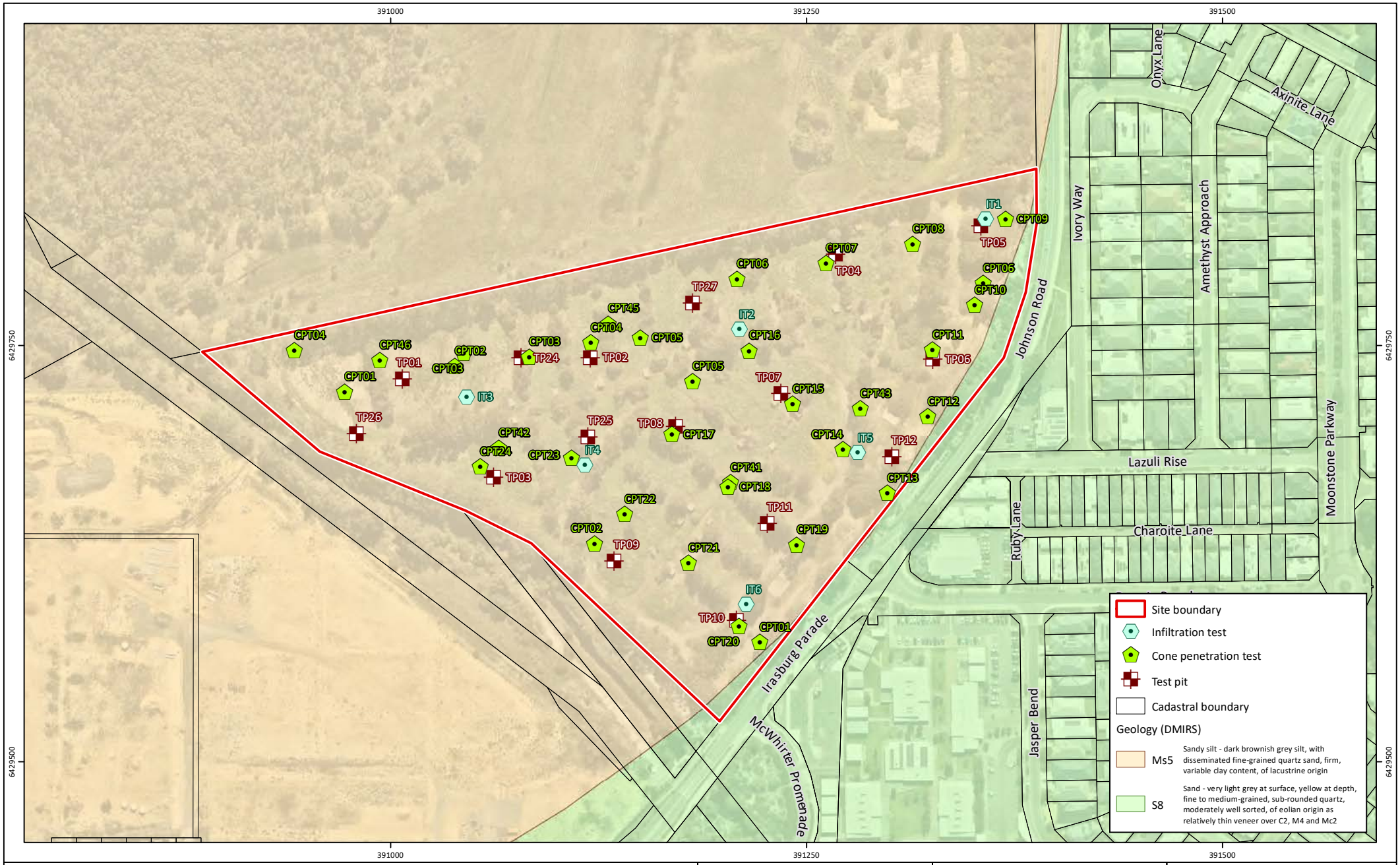


Figure 3: Environmental Geology and Geotechnical Investigations

Project: Local Water Management Strategy
Lot 506 Johnson Road, Wellard

Client: Eastcourt Properties

Plan Number:
EP22-062(03)--F03

Drawn:	WJC
Date:	08/11/2023
Checked:	JM
Approved:	DPC
Date:	01/12/2023

N

0 50 100
Metres

Scale: 1:3,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

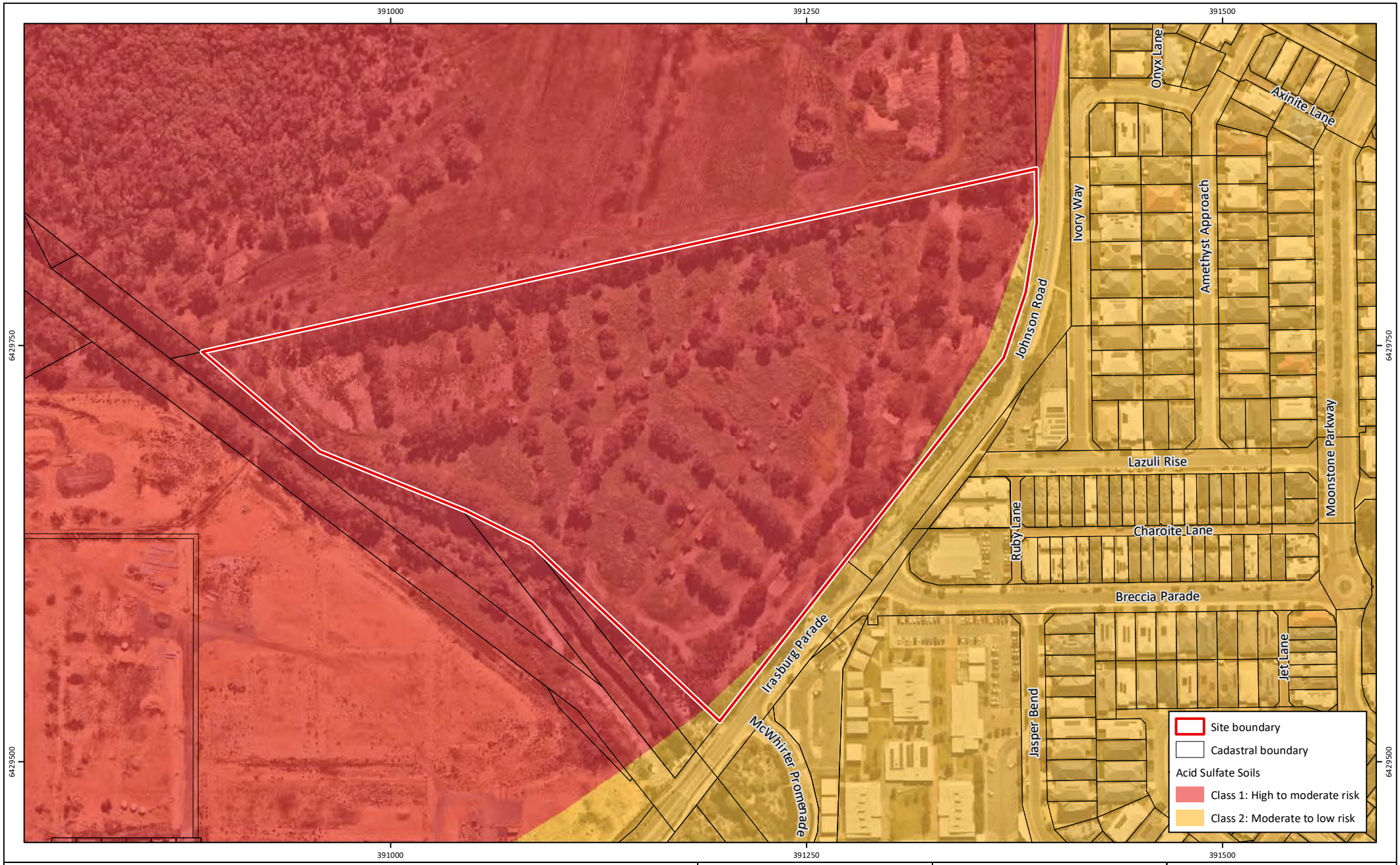


Figure 4: Acid Sulfate Soil Risk

Project: Local Water Management Strategy
Lot 506 Johnson Road, Wellard
Client: Eastcourt Properties

Plan Number:
EP22-062(03)--F04

Drawn:	WJC
Date:	08/11/2023
Checked:	JM
Approved:	DPC
Date:	01/12/2023

N

0 50 100
Metres

Scale: 1:3,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

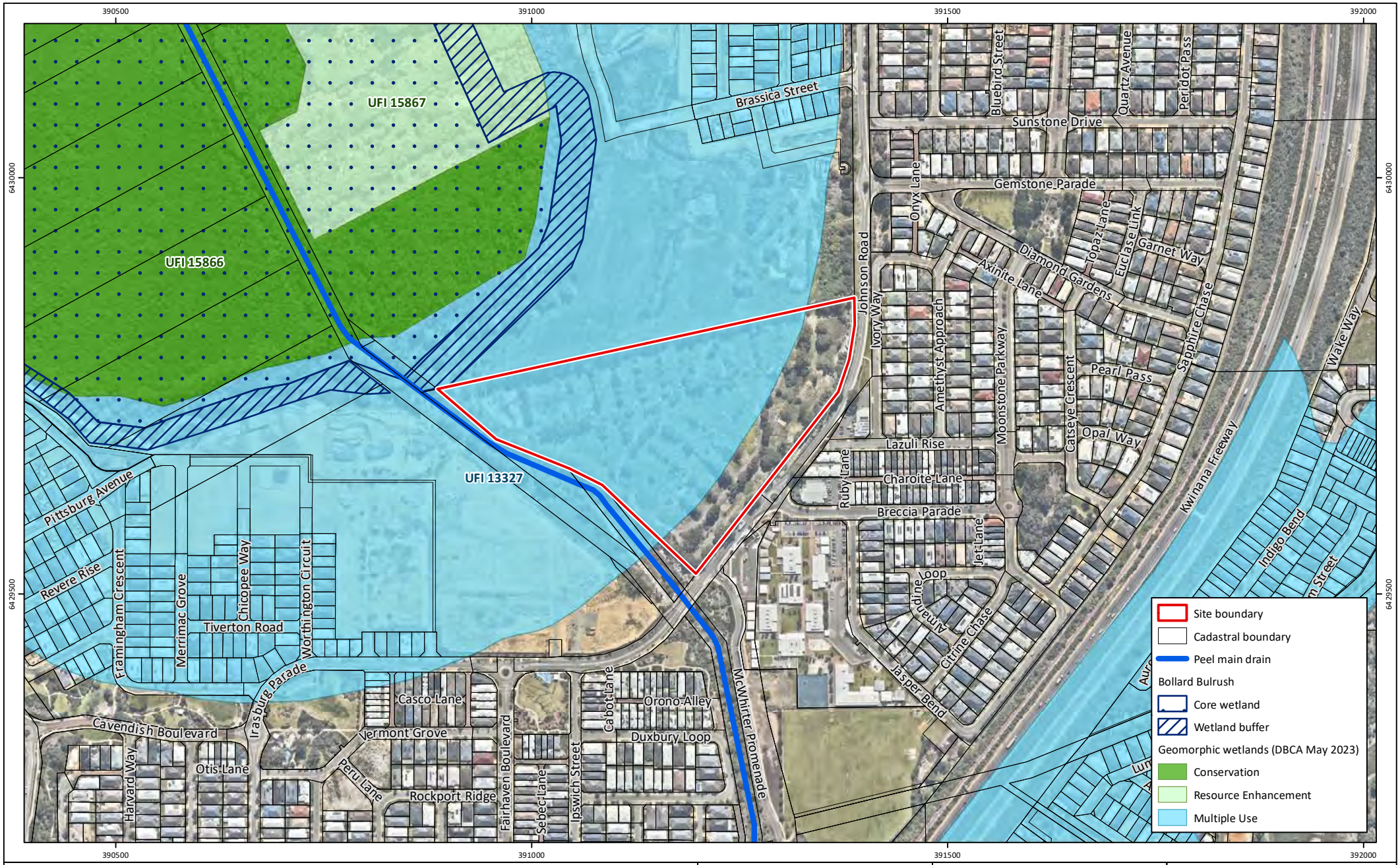


Figure 5: Geomorphic Wetlands and Hydrological Features

Project:	Local Water Management Strategy Lot 506 Johnson Road, Wellard
Client:	Eastcourt Properties

Plan Number:
EP22-062(03)--F05

Drawn:	WJC
Date:	08/11/2023
Checked:	JM
Approved:	DPC
Date:	01/12/2023

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

Figure 6: Groundwater Contours

Project: Local Water Management Strategy
Lot 506 Johnson Road, Wellard
Client: Eastcourt Properties

Plan Number:
EP22-062(03)--F06a

Drawn:	GAR
Date:	31/10/2024
Checked:	FMH
Approved:	DPC
Date:	31/10/2024

N

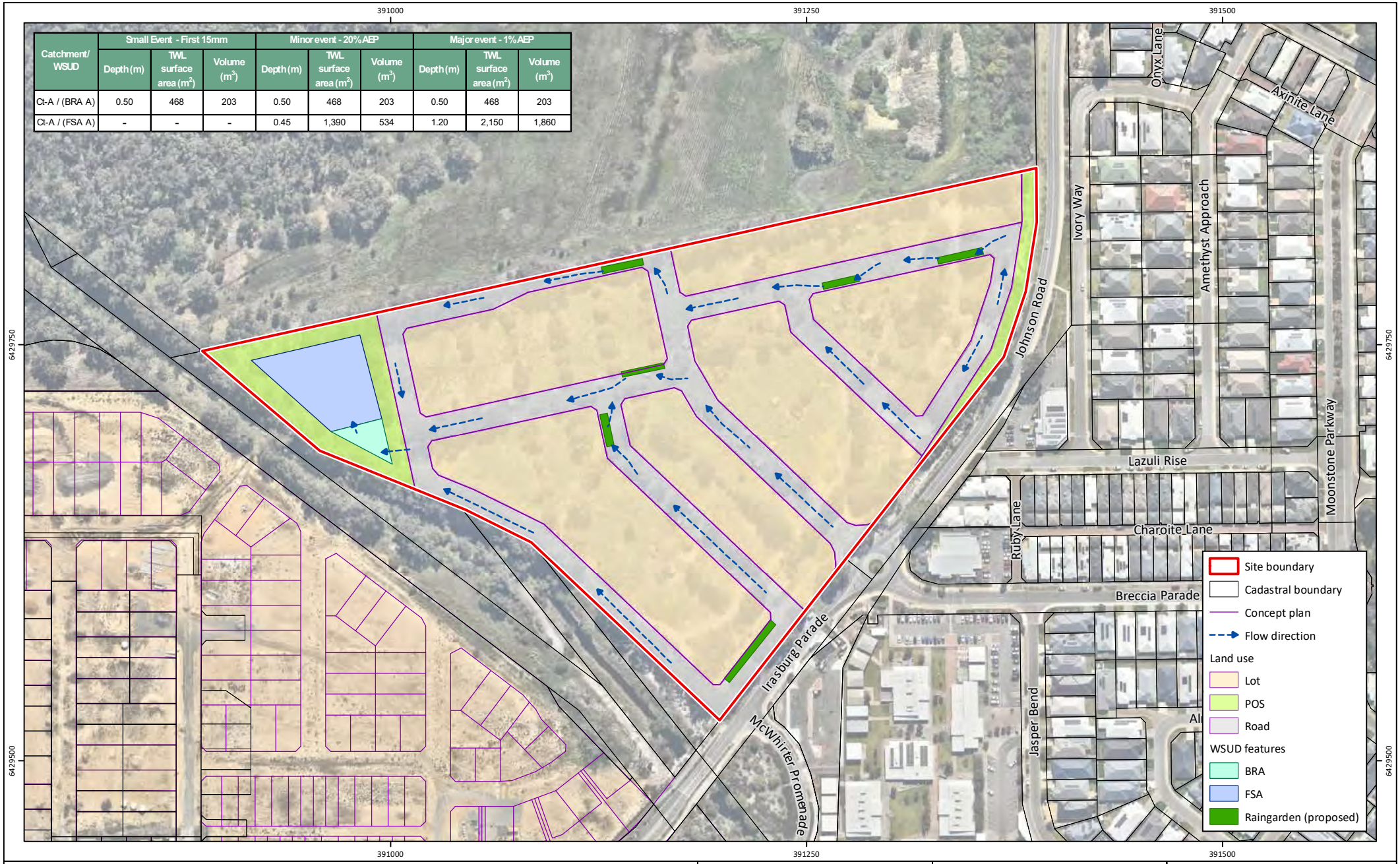
0 50 100
Metres

Scale: 1:3,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023



Catchment/ WSUD	Small Event - First 15mm			Minor event - 20% AEP			Major event - 1% AEP		
	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)	Depth (m)	TWL surface area (m^2)	Volume (m^3)
Ct-A / (BRA A)	0.50	468	203	0.50	468	203	0.50	468	203
Ct-A / (FSA A)	-	-	-	0.45	1,390	534	1.20	2,150	1,860

Figure 7: Stormwater Management Plan

Project: Local Water Management Strategy
Lot 506 Johnson Road, Wellard
Client: Eastcourt Properties

Plan Number:
EP22-062(03)--F08a
Drawn: GAR
Date: 31/10/2024
Checked: FMH
Approved: DPC
Date: 31/10/2024

N

0 50 100
Metres
Scale: 1:3,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

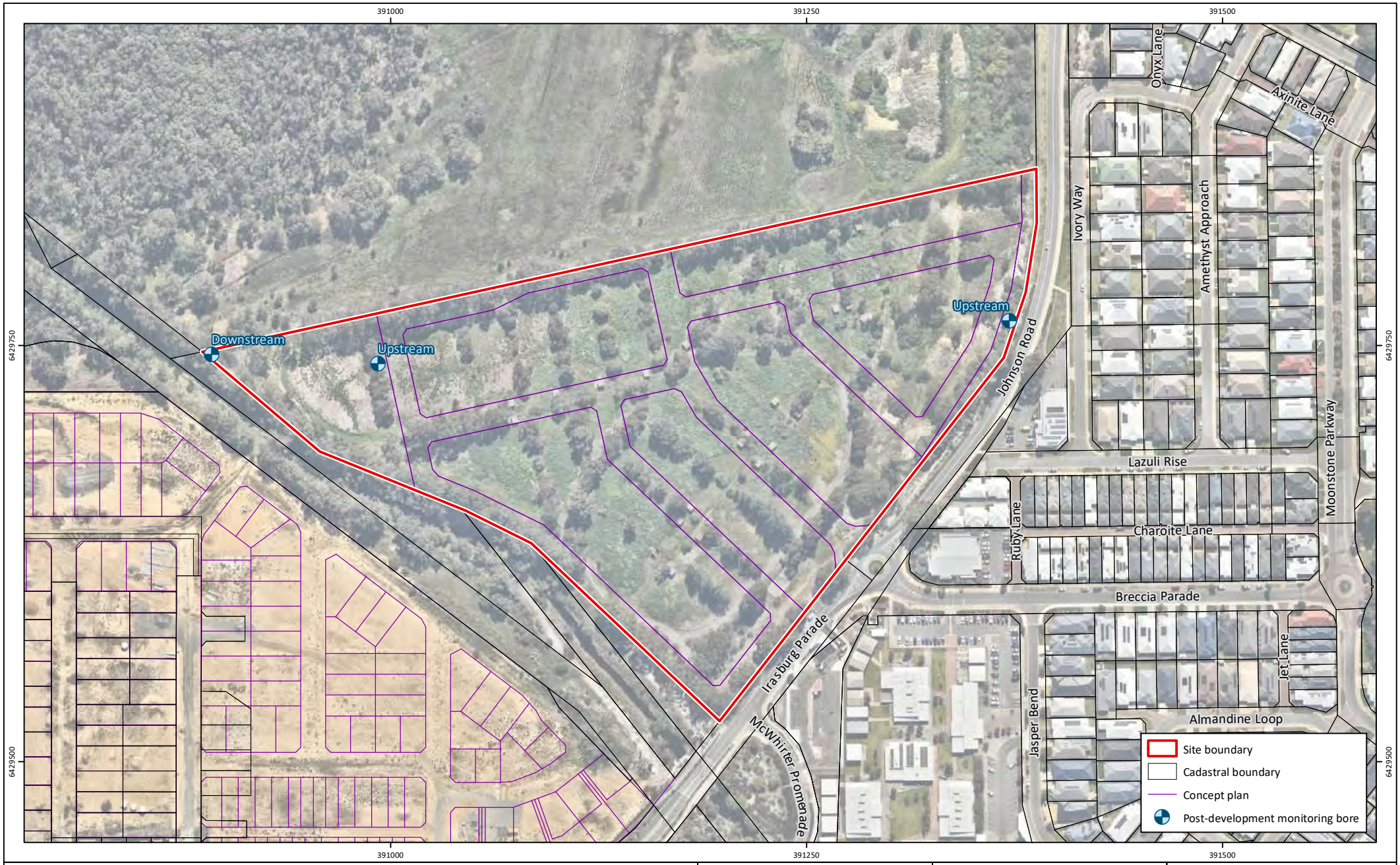


Figure 8: Post-development Monitoring Locations

Project:	Local Water Management Strategy Lot 506 Johnson Road, Wellard
Client:	Eastcourt Properties

Plan Number:
EP22-062(03)--F09a

Drawn:	GAR
Date:	31/10/2024
Checked:	FMH
Approved:	DPC
Date:	31/10/2024

N

0 50 100
Metres

Scale: 1:3,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

Appendix A

Concept Plan

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

LATTUGE DRIVE
CAROTA VIEW
NAVET STREET
POS
6727m²
30
60
54.5
55
40
60
506
53
45
54
13m Reserve
15m Reserve
16m Reserve
1462m²
ROAD
JOHNSON
BRECCIA
PARADE
IRASBURG
PARADE
58
59
353
360
359
358
357
356
805
804
803
801
802
800
886
722
835 834 833 832 831 830 829 828 827 826
721 720 719 718 717 716 715 714 713 71
665
666
667
668
664
663
691
692
69

LEGEND
SUBJECT SITE

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

CONCEPT PLAN
Lot 506 Johnson Road, Wellard

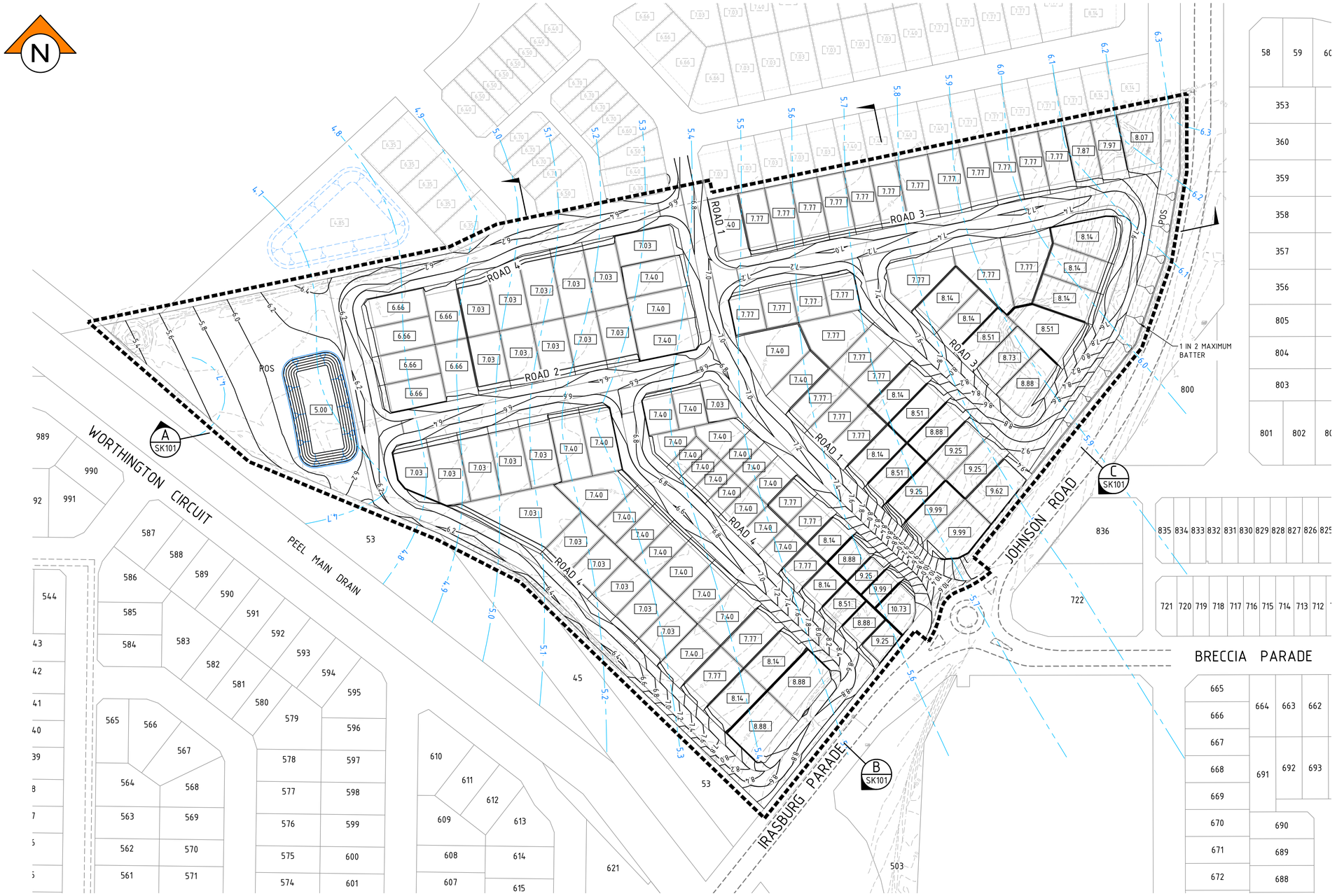
DRAFT

plan no: **2263-186C-02**
date: 12 October 2022
scale: 1:1,500 @A3, 1:750 @A1

N

Appendix B

Earthworks concept



NOTES

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION
2. SETOUT OF ROAD CENTERLINE, FACE OF KERB AND EDGE OF SEAL FOR UN-KERBED ROADS SHALL BE BASED ON SUPPLIED AUTOCAD DATA. ALL OTHER WORKS SHALL BE SETOUT BASED ON INFORMATION CONTAINED ON THE CONTRACT DRAWINGS
3. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE SHOWN
4. SURVEY DATA PROVIDED BY MNG SURVEY
5. ALL LEVELS SHALL BE DETERMINED FROM BENCH MARKS ESTABLISHED BY THE PROJECT SURVEYOR
6. ALL SETBACKS TO BE 4.0m FROM FRONT BOUNDARY UNLESS NOTED OTHERWISE
7. ALL LEVELS ARE FINISHED SURFACE LEVELS. ROADS, FOOTPATHS AND HARDSTANDS TO BE BOXED OUT TO APPROPRIATE DEPTHS
8. FOR RETAINING WALL LEVELS REFER TO DRAWING C110 OF THIS SET
9. GEOTECHNICAL INSPECTIONS AND ASSESSMENTS TO BE CARRIED OUT AS PER SPECIFICATION AND AT RECOMMENDATION FROM THE PRINCIPAL NOMINATED GEOTECHNICAL CONSULTANT
10. EXISTING SERVICES ARE SHOWN FOR INFORMATION ONLY - FOR CONSTRUCTION DETAILS REFER TO RELEVANT SERVICES DRAWINGS

LEGEND

- LIMIT OF WORKS
- 2 — LOT NUMBER
- 8.51 — PROPOSED LOT LEVEL
- 8.51 — FUTURE LOT LEVEL
- 8.51 — EXISTING LOT LEVEL
- PROPOSED CONTOURS (0.20m INTERVAL)
- EXISTING CONTOURS (0.25m INTERVAL)
- MAXIMUM GROUNDWATER CONTOUR
- PROPOSED ROAD
- EXISTING ROAD/TRACK
- PROPOSED BATTER
- EXISTING EMBANKMENT
- PROPOSED SHALLOW SWALE

0 10 20 40 60m
SCALE 1:1000 @ ORIGINAL SHEET SIZE A1

WARNING
BEWARE OF UNDERGROUND SERVICES
BEFORE YOU DIG www.byda.com.au
The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Work Health and Safety (General) Regulations 2022.

REV	DATE	DRAWN	CHECKED	APPROVED	
B	19.12.23	MS	BG	SB	EARTHWORKS LEVELS AMEDNED TO SUIT NEW CADASTRAL LAYOUT
A	14.03.23	MS	BG	SB	ISSUED FOR INFORMATION

COPYRIGHT
This drawing is copyright and the property of JDSi Pty Ltd (JDSi). Use without written permission from JDSi constitutes an infringement of copyright.
This document and the information are solely for the use of the authorised recipient and may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by JDSi.

NOTE
This drawing shall be preliminary only until it is issued for Construction.
Certified Quality System to ISO 9001

JDSi CONSULTING ENGINEERS
Level 1, 432 Murray Street, Perth WA 6000
P: (08) 9227 0595 F: (08) 9227 8617

CLIENT: PROVIDENCE

PROJECT: PROVIDENCE EAST BULK EARTHWORKS

DRAWING TITLE: EARTHWORKS CONCEPT PLAN

DRAWN: M.SABBATINO	WAPC No.
DESIGNED: M.SABBATINO	SCALE @ A1: 1:1000
PROJECT MANAGER: S.BROERE	DATUM: PCG94 / CO-ORDS: AHD
JDSI PROJECT No.: JDS222081.BE01	DRAWING No.: SK100 / REVISION: B

Plotted By: msabbatino Plot Date: 19/12/23 - 15:03 Cad File: I:\JDS222081\JDS222081.BE01\02 CIVIL\Drawings\Sketches\JDS222081.BE01_SK100.dwg

Appendix C

Landscape Concept

Lot 506 Johnson Rd
Wellard WA

PRELIMINARY LANDSCAPE DESIGN REPORT

EASTCOURT

emerge ASSOCIATES

December 2023

Contents

1.0 Landscape Concepts 3

1.1 Overall Masterplan..... 3

1.2 POS 1 Detailed Plan 4

2.0 Typical Site Sections 5

2.1 POS 1: Section A..... 5

2.2 POS 1: Section B 5

2.3 POS 2: Section C..... 6

3.0 Street Tree Masterplan 7

4.0 Planting Palette..... 8

4.1 Indicative Planting Palette..... 8

REVISION	DATE	ISSUE OR AMENDMENT	BY	REVIEWED
A	05.12.23	Issue for Comment	JW	MM
B	07.12.23	Issue for Approval	JW	MM

1.0 Landscape Concepts

1.1 Overall Masterplan

1.2 POS 1 Detailed Plan

LEGEND

- EXTENT OF WORKS
- BRA (FIRST 15mm RAINFALL)
- 1% AEP (100 YEAR STORM)
- DUAL USE CONCRETE PATHS
- 2.5 WIDE RED ASPHALT DUAL USE PATH
- NATIVE SHRUB PLANTING
- TURF
- BIORETENTION BASIN
- SHADE STRUCTURE AND PICNIC AREA
- FITNESS EQUIPMENT NODE
- INDICATIVE PLAY SPACE
- EXISTING TREES TO BE RETAINED WHERE POSSIBLE (SUBJECT TO DETAILED DESIGN)

LEGEND

01 EXISTING PEEL MAIN DRAIN

02 FEATURE HARDSTAND WITH SHADE STRUCTURE AND SEATING OPPORTUNITIES OVERLOOKING PLAYSPACE

03 PROPOSED PLAYSPACE

04 PROPOSED DUAL USE PATH

05 DUP CROSSING TO PEEL MAIN DRAIN BY OTHERS

06 PROPOSED FITNESS NODE

07 LARGE TURF KICK-ABOUT AREA

08 PLANTED BIORETENTION BASIN

09 OVERFLOW SPILLWAY WITH ROCKWORK

10 PLANTED BATTER TO TIE INTO EXISTING LEVELS

11 RUBBISH BINS

12 FUTURE DUP BY OTHERS

13 LIMESTONE RETAINING WALLS

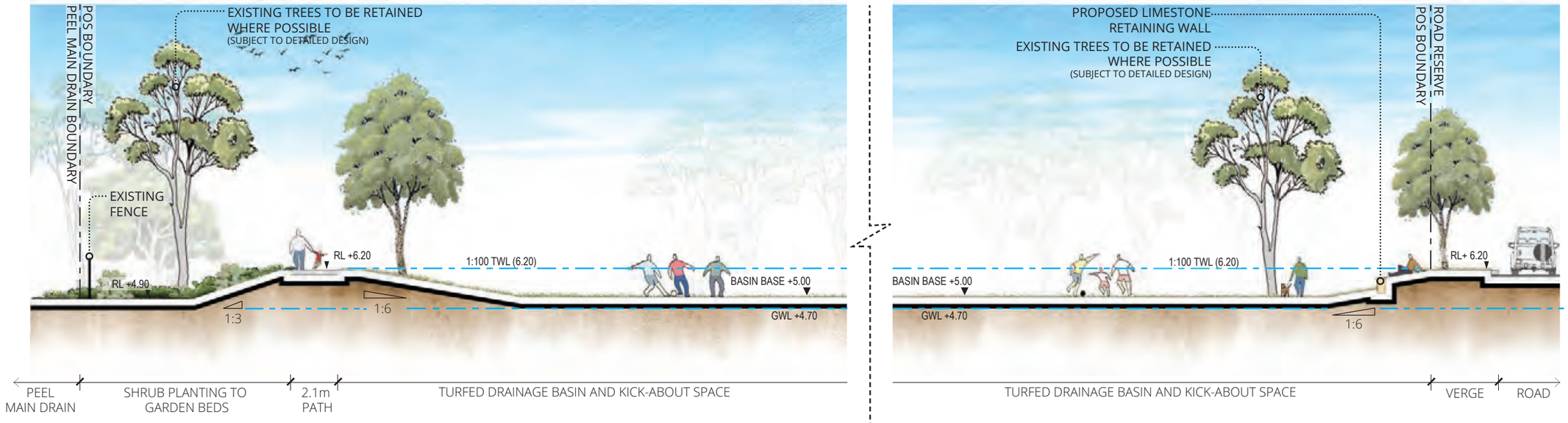
14 PARK BENCH

15 INDICATIVE ON STREET PARKING TO POS

2.0 Typical Site Sections

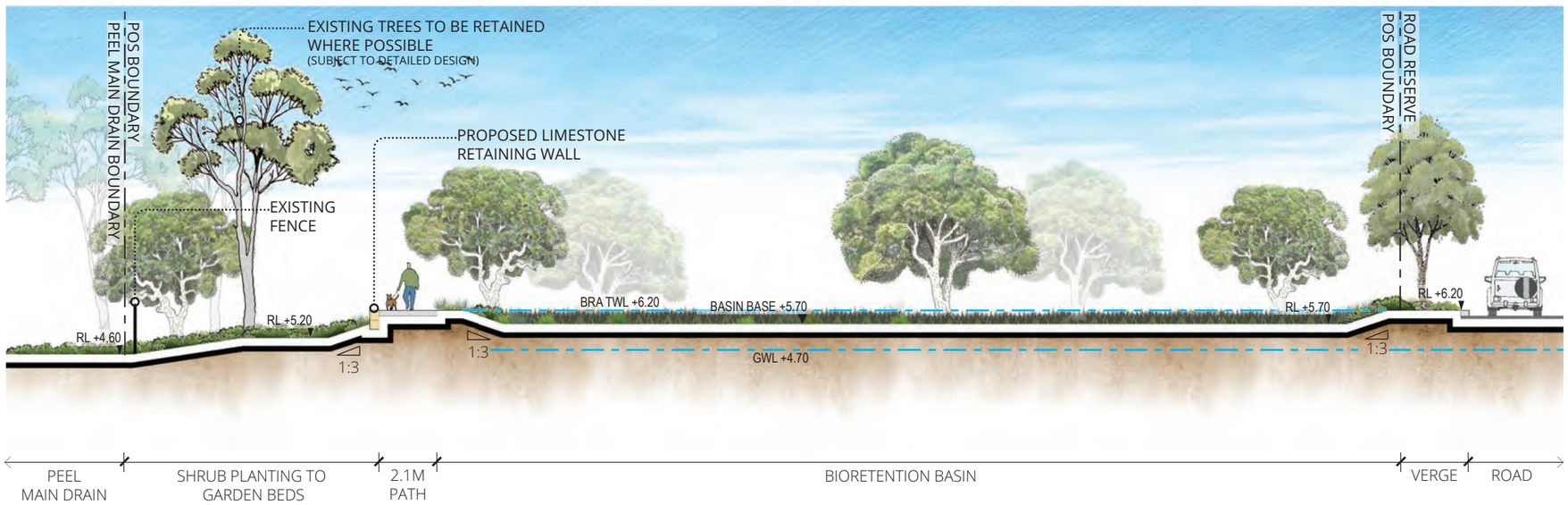
2.1 POS 1: Section A

Scale 1:100



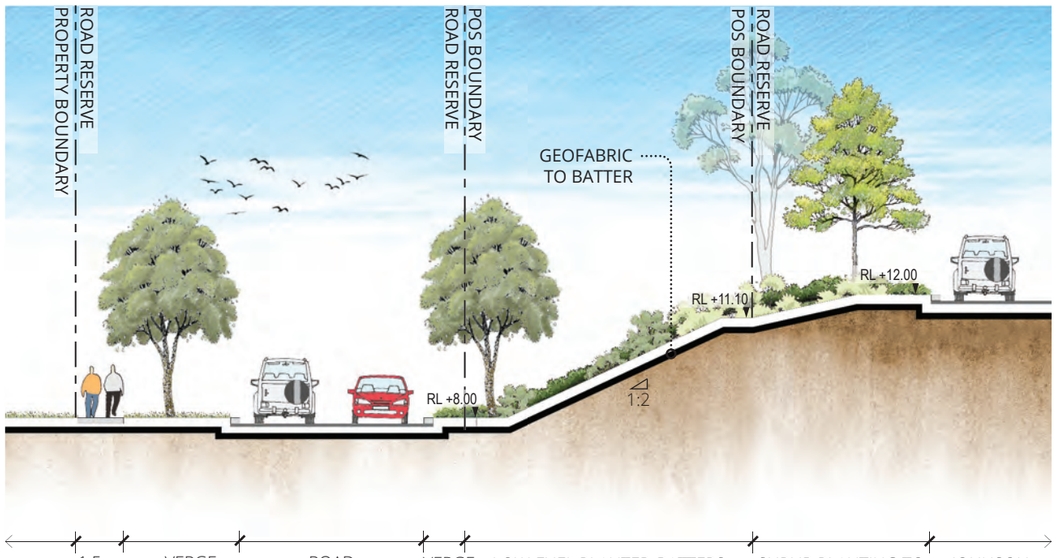
2.2 POS 1: Section B

Scale 1:100



2.3 POS 2: Section C

Scale 1:100



3.0 Street Tree Masterplan

Pyrus ussuriensis
Manchurian Pear

Cupaniopsis anacardioides
Tuckeroo

Melaleuca leucadendra
Weeping Paperbark

4.0 Planting Palette

4.1 Indicative Planting Palette

Trees (>3m)

Agonis flexuosa	WA Peppermint
Banksia littoralis	Swamp Banksia
Eucalyptus gomphocephala	Tuart
Eucalyptus rudis	Flooded Gum
Melaleuca preissiana	Stout Paperbark
Melaleuca rhaphiophylla	Swamp Paperbark
Pyrus calleryana	Ornamental Pear

Large Shrubs (>1.5m)

	Golden Wreath Wattle
Acacia saligna	Wooley Bush
Adenanthos sericeus	One-Sided Bottlebrush
Calothamnus quadrifidus	Yellow-spotted Emu Bush
Eremophila maculata 'Aurea'	Olive Grevillea
Grevillea olivacea	Chenille Honeymyrtle
Melaleuca huegelii	Dwarf Melaleuca
Melaleuca 'Little Nessie'	Coastal Daisy-Bush
Olearia axillaris	

Medium Shrubs (1 - 1.5m)

	Grevillea
Grevillea crithmifolia upright	Elegant beaufortia
Beaufortia elegans	Club Rush
Ficinia nodosa	Boobialla
Myoporum insulare	Pom-Pom Myrtle
Melaleuca conothamnoides	Heart Leaf Flame Pea
Chorizema cordatum	Coastal Rosemary
Westringia fruticosa 'Grey Box'	

Small Shrubs (0.5 - 1m)

	Red & Green Kangaroo Paw
Anigozanthos manglesii	Grey Cottonhead
Conostylis candicans	Stalked Guinea Flower
Hibbertita racemosa	White myrtle
Hypocalymma angustifolium	Cushion Bush
Leucophyta brownii	Lomandra
Lomandra tanika	Wingarra
Lomandra wingarra	Native Iris
Patersonia occidentalis	

Groundcovers (<0.5m)

	Prostrate Golden Wreath Wattle
Acacia saligna prostrate	Honeypot Dryandra
Banksia Nivea	Common Clematis
Clematis pubescens	Creeping Boobialla
Myoporum parvifolium	Eremophila
Eremophila glabra 'Roseworthy'	Grevillea
Grevillea crithmifolia prostrate	

Trees

Agonis flexuosa
WA Peppermint

Melaleuca rhaphiophylla
Swamp Paperbark

Eucalyptus gomphocephala
Tuart

Banksia littoralis
Swamp Banksia

Large Shrubs

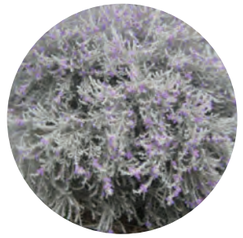
Acacia saligna
Golden Wreath Wattle

Eremophila maculata 'Aurea'
Yellow-spotted Emu Bush

Melaleuca huegelii
Chenille Honeymyrtle

Calothamnus quadrifidus
One-Sided Bottlebrush

Medium Shrubs



Eremophila nivea
Spring Mist

Chroizema cordatum
Heart Leaf Flame Tree

Melaleuca conothamnoides
Pom-Pom Myrtle

Westringia fruticosa 'Grey Box'
Coastal Rosemary

Small Shrubs

Conostylis candicans
Grey Cottonhead

Leucophyta brownii
Cushion Bush

Lomandra wingarra
Wingarra

Patersonia occidentalis
Native Iris

Groundcovers

Acacia saligna prostrate
Prostrate Golden Wreath Wattle

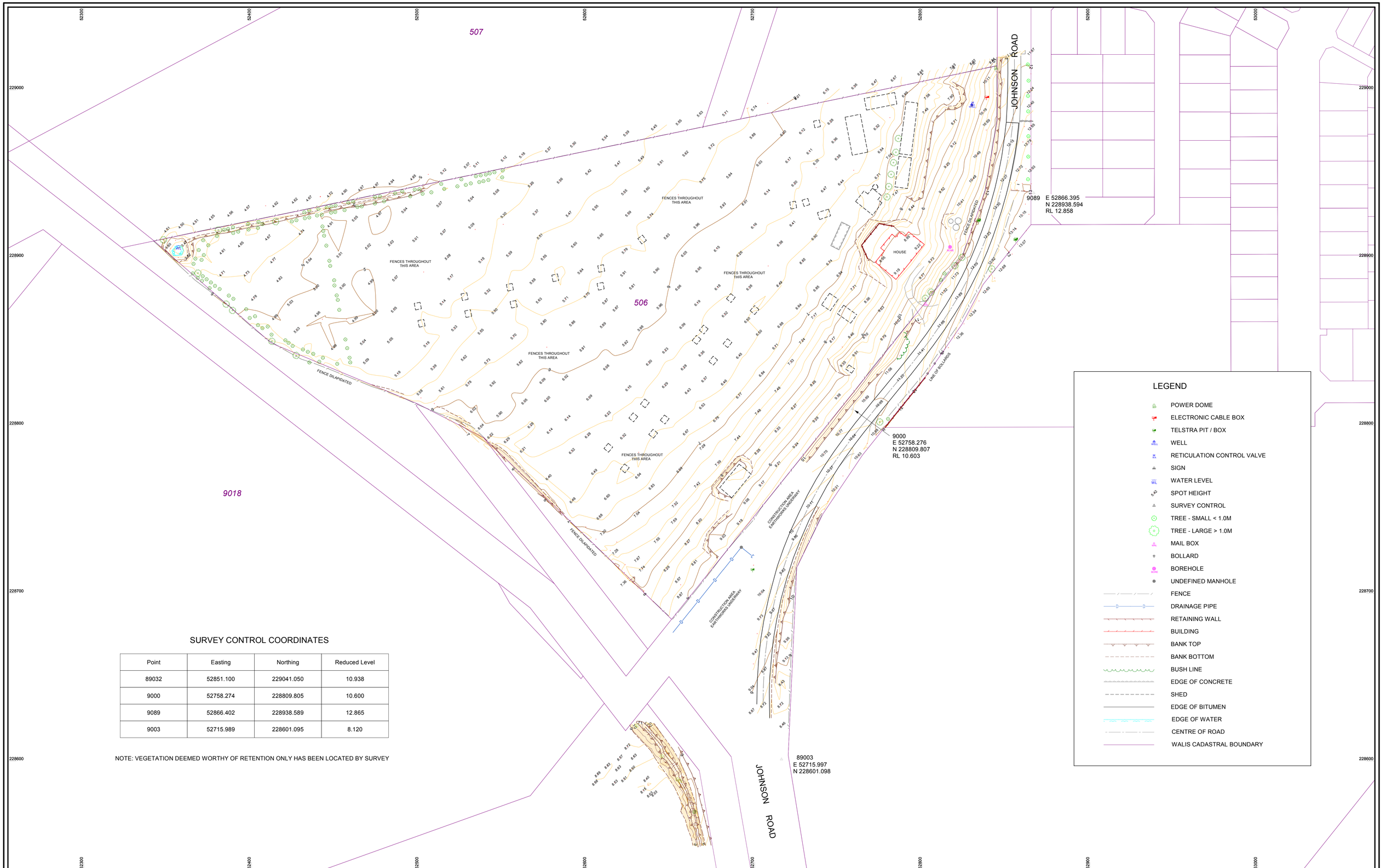
Eremophila glabra 'Roseworthy'
Eremophila

Myoporum parvifolium
Creeping Boobialla

Banksia Nivea
Honeypot Dryandra

Appendix D

Detailed Survey



LEGEND

- POWER DOME
- ELECTRONIC CABLE BOX
- TELSTRA PIT / BOX
- WELL
- RETICULATION CONTROL VALVE
- SIGN
- WATER LEVEL
- SPOT HEIGHT
- SURVEY CONTROL
- TREE - SMALL < 1.0M
- TREE - LARGE > 1.0M
- MAIL BOX
- BOLLARD
- BOREHOLE
- UNDEFINED MANHOLE
- FENCE
- DRAINAGE PIPE
- RETAINING WALL
- BUILDING
- BANK TOP
- BANK BOTTOM
- BUSH LINE
- EDGE OF CONCRETE
- SHED
- EDGE OF BITUMEN
- EDGE OF WATER
- CENTRE OF ROAD
- WALIS CADASTRAL BOUNDARY

SURVEY CONTROL COORDINATES

Point	Easting	Northing	Reduced Level
89032	52851.100	229041.050	10.938
9000	52758.274	228809.805	10.600
9089	52866.402	228938.589	12.865
9003	52715.989	228601.095	8.120

NOTE: VEGETATION DEEMED WORTHY OF RETENTION ONLY HAS BEEN LOCATED BY SURVEY

Rev.	Description	Drawn	Date	Checked
B	Additional Data Added	SAH	07/05/2015	CAY
A	Initial Issue	HBL	01/05/2015	CAY

SCALE 1:1000 @ A1

0 20 40 60 80 100

ALL DISTANCES ARE IN METRES

For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

The contents of this plan are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

Surveyor:- GSU
Survey Date:- 24/04/2015
Precal/Cad:- WALIS MAR 2014

bsi. ISO 9001 Quality Management
AS/NZS 4801:2001 Occupational Health and Safety Management
FS 565311 OSH 591267

N

The boundaries shown on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Existing easements, encumbrances or interests are not depicted and a title search is recommended to obtain this information. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.

MNG.
MCMULLEN NOLAN GROUP
Level 1, 2 Sabre Crescent
Jandakot, W.A. 6164
PO Box 3526, Success
W.A. 6964, Australia
Offices in: Broome, Bunbury, Kununurra, Newman, Onslow, Port Hedland
Tel: (08) 6436 1599
Fax: (08) 6436 1500
info@mngsurvey.com.au
www.mngsurvey.com.au
ABN 90 009 363 311

LOT 506 JOHNSON ROAD WELLARD DETAIL SURVEY

CLIENT: *EASTCOURT PROPERTY GROUP*

Project Mngr.	Charles Younge	Datum	PCG94 / AHD

96766 - DE - 117 - B

Job Number | Type | Plan Number | Revision

Appendix E

Geotechnical Report

Geotechnical and Geological Consultants

Geotechnical Investigation Report

Proposed Subdivision Development
Providence East Estate
Wellard WA

GGC221986

August 2022

433 Vincent Street West
West Leederville WA 6007
Tel. +61 8 6146 1196
www.ggconsultants.com.au

This page has been intentionally left blank.

Geotechnical and Geological Consultants

433 Vincent Street West
West Leederville WA 6007
Ph: +61 8 6146 1196
www.ggconsultants.com.au

ABN: 69 611 127 676

Geotechnical Investigation Report
Proposed Subdivision Development
Providence East Estate, Wellard WA

Our ref: GGC221986-R01-Rev0

Prepared for:

Eastcourt Property Group Pty Ltd.
756 Canning Highway
Applecross WA 6153

Prepared by:

Geotechnical and Geological Consultants Pty Ltd
433 Vincent Street West
West Leederville WA 6007

25 August 2022

For and on behalf of Geotechnical and Geological Consultants Pty Ltd

James Campbell
Associate Engineering Geologist

Quality information

Revision history:

Revision	Description	Date	Author	Reviewer	Signatory
Rev 0	Final Report	25 August 2022	JC	RAM	JC

Distribution:

Report Status	No. of copies	Format	Distributed to	Date
Rev 0	1	PDF	Eastcourt Property Group	25 August 2022
Rev 0	1	PDF	Geotechnical and Geological Consultants Pty Ltd Report Library	25 August 2022

TABLE OF CONTENTS

1 Introduction 5
2 Site description 5
3 Proposed development 8
4 Project objectives 8
5 Client provided information 9
6 GGC fieldwork 9
6.1 Summary 9
6.2 Infiltration testing 10
7 Laboratory testing 10
8 Site conditions 11
8.1 Published geological conditions 11
8.2 Groundwater information 11
8.3 Encountered subsurface conditions 12
8.4 Groundwater levels 13
8.5 Laboratory test results 15
9 Geotechnical assessments 16
9.1 Consolidation settlement 16
9.2 Site classification 16
9.3 Recommended site preparation measures 16
9.4 Assessment of excavated site won sand fill for reuse for reuse as structural fill 17
9.5 Assessment of excavated topsoil and organic materials for re-use as structural fill 17
9.6 Placement and compaction of approved structural fill 18
9.7 Subgrade CBR 19
9.8 Stormwater disposal 20
10 Important information about your GGC geotechnical report 20
11 References 21

IMPORTANT INFORMATION SHEETS

"*Your Geotechnical Report*"

FIGURES

Figure 1: Site Investigation Location Plan

APPENDICES

APPENDIX A: Client Supplied Information

APPENDIX B: Test pits logs and penetrometer results

APPENDIX C: CPT results

APPENDIX D: Laboratory test results

1 Introduction

This report presents the results geotechnical investigation carried out by Geotechnical and Geological Consultants Pty Ltd (GGC) on behalf of Eastcourt Property Group Pty Ltd ("client") for a proposed subdivision development at Providence East Estate, Wellard WA ("the site").

This work was commissioned by Matthew Palmieri, of Eastcourt Property Group, on 24 June 2022.

This report, and the information presented herein, must be read together with the important notes on the "*Your Geotechnical Report*" information sheets included after the main report text.

2 Site description

The site comprises an irregular/triangular shaped parcel of land which covers an area of about 82,000 m^2. The site is bound by Johnson Road to the east and southeast, the Peel Main Drain and Providence Estate subdivision development to the southwest, and the Bollard Bullrush Swamp and vacant land to the north.

A client supplied Concept Plan and Detail Survey Plan is included in ***Appendix A***.

The site can roughly be subdivided to three Zones, namely:

- ***Zone 1:*** the eastern portion of the site;
- ***Zone 2:*** the central portion of the site; and
- ***Zone 3:*** the western portion of the site.

The three Zones are shown on the Site Plan presented as ***Figure 1***.

The south-eastern boundary of the site, adjacent to Johnson Road, is elevated and ground levels range from approximately between 10.7 m AHD in the northeast to 8.8 m AHD in the southeast, along this boundary. The topography slopes downwards towards the western corner of the site to about 3.8 m AHD.

Grass vegetation and medium to large sized trees were present across the site. The tree alignment divided the site into number of paddock areas. Several existing shed structures, access tracks, an oval training track, fences and several old building pads associated with past land use were present across the site. We understand that the site used to be a previous horse training facility.

A small wooden retaining wall and associated elevated ground area was observed in the north-eastern portion of the site, which is likely to be associated with an old building platform in this area is shown in ***Plate 1***.

Plate 1: Small wooden retaining wall and associated elevated ground area adjacent to TP6

Based on GGC's site walk over and visual inspection, a strip of land, approximately 40 m wide, adjacent to Johnston Road had features such as old foundations slab (***Plate 2***), access tracks, construction of bunds to prevent access to the site from Johnston Road (***Plate 3*** and ***Plate 4***) and possibly raising of the land adjacent to Johnson Road (***Plate 5***)

Plate 2: Old foundation slab

Plate 3: Soil bund preventing access from Johnston Road

Plate 4: Soil bund preventing access from Johnston Road

Plate 5: Uncontrolled Fill and topsoil overlying natural Sand within test pit (TP 5)

3 Proposed development

Based on information provided, it is understood that the development will consist of a residential subdivision including approximately 124 lots, associated access roads and areas of Public Open Space (POS).

At the time of writing this report, a final design layout for the proposed development was not yet available. However, we understand the following:

- The site will generally be graded from Johnson Road, in the southeast to the Bollard Bullrush Swamp to the northwest.
- Zone 1 is likely to have minimal earthworks given the tie into Johnson Road.
- Zone 2 is likely to have nominally 1.2 m to 1.5 m of (imported) fill.
- Zone 3 is likely to have nominally 1 m of fill within the development area. The public open space, located within Zone 3, is likely to have minimal earthworks.

We understand that the design ground surface levels will be based on site hydrology and drainage requirements, and to be commensurate with Johnson Road and the adjacent (future) developments in the area.

4 Project objectives

The objectives of this study were to:

- Assess the subsurface and groundwater conditions across the site.
- Provide a site classification(s) in accordance with AS2870-2011 "*Residential Slabs and Footings*".
- Provide an assessment of the suitability of the site for onsite disposal of stormwater by infiltration.
- Assess the suitability of the existing materials for reuse as fill material.
- Provide recommended appropriate site preparation procedures including site preparation, compaction works, density testing and moisture conditioning.

- Provide a recommended subgrade California Bearing Ratio (CBR) value(s) for flexible pavement design (by others); and,
- Provide recommendations for any further investigations that may be required for detailed design of the proposed development at the site.

5 Client provided information

The following client provided information have been reviewed as part of this study:

- McMullen Nolan Group Pty Ltd, Lot 506 Johnson Road Wellard Detailed Survey, Reference Job No. 96766-DE-117-B dated 1 May 2015.
- Cossill & Webley Consulting Engineers, Drainage – Catchment Area 2 Preliminary Earthworks Plan, Reference Drawing No. 6165-00-SK35 Revision D), dated 5 May 2015.
- CLE Town Planning and Design, Concept Plan Lots 1, 504-506 and 1336 Wellard East, Reference Plan No. 2263-167-01 dated 16 July 2015; and,
- Douglas Partners Pty Ltd, "*Ground Test Results Lot 506 Johnson Road*", dated 15 Dec 2015.

Copies of the supplied information are included in ***Appendix A***.

6 GGC fieldwork

6.1 Summary

Fieldwork was carried out on 28 and 29 of June 2022 and 8 July 2022 under the full-time attendance of a Geotechnical Engineer from GGC. The fieldwork consisted of the following:

- Advancing of 25 Cone Penetrometer Test probes with pore pressure measurement (CPTu), denoted as CPT01 to CPT24, to depths of between 3.3 m and 5.2 m below existing ground level. The CPT probes were advanced from a 7-tonne tracked CPT rig owned and operated by Probedrill Pty Ltd. Shallow refusal was encountered at a depth of 3.3 m at CPT20 and CPT20A.
- Excavation of 12 test pits (TP01 to TP12) with an 8-tonne rubber tyred backhoe, to depths between 1.4 m and 2.5 m below existing ground level.
- Completion of 11 Perth Sand Penetrometer (PSP) tests and one Dynamic Cone Penetrometer (DCP) test across the site, adjacent the test pits, to depths up to 1.05 m below existing ground level.
- Completion of six infiltration tests (IT01 to IT06) within hand augered boreholes at depths of between 0.9 m and 1.0 m.
- On-site logging of test pits in general accordance with the soil guidance included in AS 1726 - 2017 *"Geotechnical Site Investigations"*; and
- Collection of samples for laboratory testing.

The investigation locations were selected and recorded by GGC using a handheld GPS with an accuracy of approximately +/-5 m. The approximate investigation locations are shown the Site Investigation Location Plan, ***Figure 1***, attached to this report.

The test pit logs showing the major units intersected and the depths at which samples were recovered, together with explanatory notes and PSP and DCP results are included in ***Appendix B***.

Copies of the CPT plots are included in ***Appendix C*** together with notes on the method of interpretation used by GGC.

6.2 Infiltration testing

Infiltration tests were completed in hand augured boreholes (IT1 to IT6). The infiltration tests were completed using the *"Inverse Auger Hole Method"* described by Cocks (2007). The results of the infiltration testing are summarised in ***Table 1***.

Table 1 – Summary of falling head infiltration tests

Test Reference and Location	Stratigraphy	Depth to base of test (m)#	Minimum Unsaturated Permeability, k (m/day)*
IT1	SAND FILL over SAND	0.94	5
IT2	Organic SILT over SAND	0.97	1
IT3	Organic SILT	0.90	<1.0
IT4	Organic Silt over SAND	0.94	1
IT5	Organic Sand over Sand	0.94	4
IT6	Organic Sand over SAND	0.92	>5

Notes: # All depths are relative to existing ground surface.
* Minimum unsaturated permeability values were estimated at the end of testing when head pressures was at a minimum.

7 Laboratory testing

Geotechnical laboratory testing was carried out in accordance with the general requirements of AS 1289 by Material Consultants at their NATA registered soils laboratory in Perth.

A summary of the laboratory testing completed for this study is presented in ***Table 2*** and the laboratory test certificates are included in ***Appendix D***.

Table 2 – Summary of laboratory testing

Type of Test	Test Method Reference	Number of Tests
Particle Size Distribution	AS1289.3.6.1	18
Atterberg Limits	AS1289.3.1.1 – 3.4.1	18
Compaction (MMDD)	AS1289.5.2.1	3
Soaked California Bearing Ratio	AS1289.6.1.1	3
Organic Matter Content	AS1289.4.1.1	8

8 Site conditions

8.1 Published geological conditions

The 1:50,000 Environmental Geology Series Map (Rockingham Sheet) produced by the Geological Survey of Western Australia indicates that the site is within an area underlain by:

- ***Bassendean Sand*** (S_8) described as "*very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin*" within Zone 1; and
- ***Sandy Silt*** (Ms_5 – Swamp Deposits) described as "*dark brownish grey silt, with disseminated fine-grained quartz sand, firm, variable clay content, of lacustrine origin*" within Zone 2 and Zone 3 (underlying the Bassendean Sand).

8.2 Groundwater information

Published groundwater information within the Perth Groundwater Map was limited across the project area. No minimum groundwater information was available across the site within the Perth Groundwater Map. The maximum groundwater contour information appeared to terminate adjacent to the site (i.e., the groundwater map did not completely cover site) and was only recorded on the eastern most boundary of the site.

The published maximum groundwater contours on the eastern portion of the site indicated groundwater elevations of 10 m AHD. Based on published topographic contours within the Perth Ground water map of 10 m AHD groundwater levels are expected at or near existing ground level along the eastern boundary of the site.

Average Annual Maximum Groundwater Level (AAMGL) contours, provided by RPS in 2016, have been developed for the northern portion of the site and are presented on the Cossill & Webley Consulting Engineers Drainage Catchment Area 2 Preliminary Earthworks Plan (Reference Drawing No. 6165-00-SK35). The plan indicates that the AAMGL contours for the site grade from approximately RL 4.8 m AHD in the north-eastern most corner of the site to approximately RL 3.8 m AHD in the western most corner of the site. No AAMGL data is currently available for the southern half of the site.

Based on AAMGL information and the approximate surface elevations, the AAMGL could range from about 5.8 m below existing ground levels in the north-eastern most corner of the site, to at or near the existing ground surface in the western most portion of the site.

8.3 Encountered subsurface conditions

GGC has developed a typical subsurface profile based on the results of the investigations completed at the site and this is summarised in ***Table 3.***

Table 3 – Typical subsurface profile

Layer/Unit	Typical Depth to Top of Layer (m)	Typical Depth to Bottom of Layer (m)	Thickness of Layer (m)	Typical Description/ Remarks
UNCONTROLLED FILL	0.0	0.7 m to 1.6 m	0.7 m to 1.6 m	FILL: SAND; fine to coarse grained, subangular to subrounded, grey mottled orange, dark grey; trace non-plastic fines. Containing occasional deleterious materials. Only encountered in TP05, TP06 and CPTu11.
TOPSOIL Organic SAND	0.0	0.2 m to 0.4 m	0.2 m to 0.4 m	TOPSOIL: Organic SAND: fine to coarse grained, subangular to subrounded, dark grey black. Only encountered in TP10, TP11 and TP12 in Zone 1.
TOPSOIL Organic SILT	0.0	0.4 m to 1.1 m	0.4 m to 1.1 m	TOPSOIL Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded. Not encountered in TP5 and TP6.
UPPER SAND	0.4 m to 1.6 m	3.5 m to 4.8 m	3.1 m to 4.4 m	SAND: fine to coarse grained, subangular to subrounded, pale grey mottled white. Typically, medium dense at top of unit becoming dense to very dense at depth. Loose sand was encountered at top of unit to depths of up to 1.8 m in CPTu19 and CPTu21. Not encountered in CPTu01. Base of Sand encountered at CPTu02, CPTu03 CPTu04, CPTu15, CPTu16, CPTu17, CPTu18, CPTu24. Shallow refusal was encountered within CPTu20 and CPTu20A.
UPPER CLAYEY MATERIAL	0.0	3.2 m	3.2 m	SANDY CLAY/CLAY: Low to medium plasticity, black mottled dark grey and yellow, brown, grey orange, firm to stiff. Only encountered at CPTu01 and TP01 location in Zone 3.
LOWER CLAYEY MATERIAL	3.5 m to 4.8 m	5 m	>1.5 m thick	SILTY CLAY / CLAY / CLAYEY SILT: Firm to stiff, thin layer of sensitive fine-grained material encountered within CPTu03 at 4.7 m depth, CPTu04 at 3.5 m and within CPTu24 at 4.8 m to base of probe. Possibly diatomaceous. Typically extending to depth of probe.
Lower Sand	5 m	Not proven	Not Proven	Sand. Very Dense. Only Encountered in CPTu03 and CPTu04

Notes: All depths are in metres below existing ground level. Depths and thicknesses are approximate only.

It should be noted that based on GGC's site walk over and visual inspection, it is likely that Uncontrolled Fill may be present within Zone 1 of the site. It is likely that the Uncontrolled Fill is associated with previous land use at the site e.g., previously existing buildings, raising of the land and barricading adjacent and to Johnson Road.

It should also be noted that based on GGC's site walk over and visual inspection, it is likely that the Organic Silt is not present in Zone 1 and is present across Zone 2 and Zone 3 in the lower lying areas.

The CPT probes completed by GGC were generally consistent with the CPT probes previously completed by Douglas Partners to a depth of 5 m below ground level. It should be noted that some of the CPT probes completed by Douglas Partner's extended to a maximum depth of 8.2 m.

Douglas Partners CPT probes inferred a 0.75 m to 1.2 m thick layer of very soft to very stiff Organic Layer (Clay, Silt, Sand) in CPT2, CPT3, CPT5, CPT42, CPT43, CPT44, CPT45, CPT46 at depths of between about 3.76 m to 6. 7m below ground level. Beneath the Organic Layer, typically, the CPT probes encountered a medium dense to very dense Sand between 4.4 m to 6.7m below ground level and extended to the base of the CPT probes. An inferred 1.0 m to 1.3 m layer of loose to medium dense silty Sand/ sandy Silt and Sand was encountered within CPT4 and CPT45 at depths of between 3.0 m and 5.7 m.

CPT1 completed by Douglas Partner's was discontinued at 4.06 m due to refusal on inferred by Douglas Partners as Limestone. CPTu20 and CPTu20A completed by GGC near CPT1 was also discontinued at 3.3 m due to high tip resistance and rod friction.

Test pits TP24 and TP26 completed by Douglas Partners indicated Sand with some Clay, clayey Sand at depths of between 1.5 m and 2.9 m. Clayey soils were only by GGC encountered within TP01.

8.4 Groundwater levels

Groundwater was recorded at several investigation locations during the fieldwork and is summarised in ***Table 4***. During the wetter months and periods of extended rainfall, the groundwater levels are likely to increase significantly at this site.

Table 4 – Recorded Groundwater Elevations

Location Ref.	Date recorded	Observed Depth to Groundwater (m)*	Notes
CPTu01	28 June 2022	1.8	-
CPTu02	28 June 2022	1.65	-
CPTu03	28 June 2022	1.8	-
CPTu04	28 June 2022	2.0	-
CPTu05	28 June 2022	1.7	-
CPTu06	28 June 2022	1.2	-
CPTu07	28 June 2022	1.3	-
CPTu08	28 June 2022	1.9	-
CPTu09	28 June 2022	Not Observed	Dry to 3.3 m
CPTu10	28 June 2022	Not Observed	Dry to 3.5 m
CPTu11	28 June 2022	Not Observed	Dry to 3.3 m
CPTu12	28 June 2022	4.0	-
CPTu13	28 June 2022	Not Observed	Dry to 2.0 m
CPTu14	28 June 2022	2.2	-
CPTu15	29 June 2022	1.7	-

Note: * All depths are relative to existing ground surface.

Table 4 (Continued) – Recorded Groundwater Elevations

Location Ref.	Date Recorded	Observed Depth to Groundwater (m)*	Notes
CPTu16	29 June 2022	1.6	-
CPTu17	29 June 2022	1.5	-
CPTu18	29 June 2022	1.7	-
CPTu19	29 June 2022	Not Observed	Dry to 3.0 m
CPTu20	29 June 2022	Not Observed	Dry to 3.0 m
CPTu20A	29 June 2022	Not Observed	Dry to 3.0 m
CPTu21	29 June 2022	2.0	-
CPTu22	29 June 2022	1.7	-
CPTu23	29 June 2022	1.5	-
CPTu24	29 June 2022	1.4	-
TP01	8 July 2022	Not Observed	-
TP02	8 July 2022	1.6	Water observed seeping through sidewall at 1.6 m
TP03	8 July 2022	1.7	Water observed seeping through sidewall at 1.7 m
TP04	8 July 2022	1.6	Water observed seeping through sidewall at 1.6 m
TP05	8 July 2022	Not Observed	-
TP06	8 July 2022	Not Observed	-
TP07	8 July 2022	2.0	Water observed seeping through sidewall at 2.0 m
TP08	8 July 2022	Not Observed	-
TP09	8 July 2022	2.1	Water observed seeping through sidewall at 2.1 m
TP10	8 July 2022	Not Observed	-
TP11	8 July 2022	Not Observed	
TP12	8 July 2022	Not Observed	
IT1		Not Observed	Hand auger boreholes advanced to 1 m
IT2		Not Observed	Hand auger boreholes advanced to 1 m
IT3		Not Observed	Hand auger boreholes advanced to 1 m
IT4		Not Observed	Hand auger boreholes advanced to 1 m
IT5		Not Observed	Hand auger boreholes advanced to 1 m
IT6		Not Observed	Hand auger boreholes advanced to 1 m

Note: * All depths are relative to existing ground surface.

8.5 Laboratory test results

The results of the laboratory testing completed on samples recovered during the investigation fieldwork are summarised in ***Table 5*** the laboratory test certificates are included in ***Appendix C***.

Table 5 – Summary of laboratory test results

Location Reference	Depth from (m)*1	Depth to (m)*1	Particle Size Distribution				Consistency Limit - Atterberg				CBR (%)	MDD (t/m^3)	OMC (%)	OM (% by mass)
			%Cobbles	% Gravel	% Sand	% Fines	Liquid Limit %	Plastic Limit %	Plasticity Index %	Linear Shrinkage %				
TP1	0.3	1	0	1	50	49	78	25	53	13	-	-	-	1.3
TP1	1.6	2.5	0	0	71	29	60	19	41	12	1.5	1.97	11	-
TP2	0	0.4	0	0	78	22	59	52	7	3	-	-	-	6.2
TP2	0.8	1.4	0	0	97	3	N/A	NP	NP	0	-	-	-	-
TP3	0	1.4	0	0	43	57	77	71	6	3	-	-	-	10.1
TP4	0	0.4	0	0	60	40	70	55	15	5	-	-	-	5.3
TP4	0.6	1.5	0	0	97	3	N/A	NP	NP	0	-	-	-	-
TP5	0.7	1.6	0	0	99	1	N/A	NP	NP	0	9	1.66	11.5	-
TP6	0.3	1.2	0	2	96	2	N/A	NP	NP	0	-	-	-	-
TP7	0	0.4	0	0	60	40	72	62	10	4	-	-	-	6.1
TP7	0.8	1.5	0	0	98	2	N/A	NP	NP	0	-	-	-	-
TP8	0	0.4	0	0	66	34	47	39	8	4	-	-	-	5.7
TP8	0.8	1.5	0	0	99	1	N/A	NP	NP	0	-	-	-	-
TP9	0	0.5	0	0	82	18	N/A	NP	NP	0	-	-	-	2
TP9	0.8	1.6	-	-	-	-	-	-	-	-	9	1.67	9	-
TP10	0.4	1.5	0	0	99	1	N/A	NP	NP	0	-	-	-	-
TP11	0	0.4	0	1	95	4	N/A	NP	NP	0	-	-	-	2.6
TP11	0.6	1.5	0	0	99	1	N/A	NP	NP	0	-	-	-	-
TP12	0.4	1.2	0	0	99	1	N/A	NP	NP	0	-	-	-	-

Notes: *1 all depths measured relative to existing surface level
OMC - Optimum Moisture Content
MDD - Maximum Dry Density completed using Modified Compactive Effort
CBR - California Bearing Ratio, soaked and remoulded to a dry density ratio of 95% MMDD, 4.5kg surcharge
OM – Organic Matter % by mass
NP – Non Plastic
N/A – Non Applicable

9 Geotechnical assessments

9.1 Consolidation settlement

Based on the results of the investigation, a firm to stiff clay was encountered underneath part of Zone 2 and near the Public Open Space in Zone 3. Based on the results of the investigation and our experience in the area, and the results of the investigations at the Wellard development to the west of the site, this is possibly diatomaceous materials.

The Public Open Space area within Zone 3 should remain as such with the boundary between the developed areas and the public open space confirmed by the civil designer and with further geotechnical investigations.

Across the remainder of Zone 3 and for Zone 2, where the clayey materials were encountered, it is likely that the placement of 1.5 m of fill would not result in significant primary consolidation of the clayey materials. In addition, should primary consolidation occur, based on the results of the previous development, the settlement should occur within approximately 6 weeks of earthworks being completed.

If more than 1.5 m of fill (thickness) is required across the site, then it is recommended that a review of the settlement be undertaken by GGC to assess the magnitude and timeframe for settlement to occur.

9.2 Site classification

GGC has assessed the site classification in accordance with AS2870 – 2011 and considers that a *"Class-P"* is appropriate for the site in its current condition, within proposed areas of lots and roads, due to the presence of Uncontrolled Fill and surficial Organic Silt present at the site.

A site classification of "*Class-A*" may be achieved in the areas proposed for residential development (as shown on the development plan in ***Appendix A***) provided that the recommendations of this report are adopted. It should be noted that the Public Open Space in Zone 3 would require a separate remediation strategy if this was to be considered for development.

9.3 Recommended site preparation measures

The following site preparation measures are recommended to achieve a site classification of "Class-A" and to prepare the site for construction of shallow footings and pavements.

- Remove any Uncontrolled Fill including building pads, building foundations, existing shed structures, access tracks and deleterious materials from across the site to expose underlying natural soil subgrade.

  It is recommended that GGC are on site to assess the removal of fill materials and delineate between the Sand Fill and natural Sand. In addition, shallow test pits may need to be excavated during the removal works to confirm that the Uncontrolled Fill has been removed. It should be noted that there may also be isolated pockets of Uncontrolled Fill associated with localised rubbish disposal across the site.

- Strip all Topsoil/Organic soil material and grub out all vegetation from proposed development areas, including removal of roots and stumps, to expose the underlying natural soils.

- Stockpile excavated materials for possible re-use (subject to approval by a geotechnical engineer) or arrange for disposal of unsuitable/ deleterious materials to a suitably licensed facility.

- Proof compact the exposed natural surface to a Dry Density Ratio (DDR) of 95% Maximum Modified Dry Density (MMDD) to a depth of at least 1 m. Where proof compaction reveals 'soft spots' or 'loose zones' these must be excavated and backfilled with granular fill and compacted to 95% MMDD.
- Loose sand was encountered at CPT19 and CPT21 to depths of up to 1.8 m. Following proof compaction in these areas, GGC recommend PSP testing to depth of up to 1.8 m. Where PSP testing indicates loose material, it must be delineated and remediated to achieve 95% MMDD.
- Where additional fill is required to achieve development levels (including to underside of footings, ground bearing slabs and top of subgrade) place Approved Structural Fill and compact in layers not exceeding 300 mm loose lift to achieve compaction requirements of ***Section 9.6***.
- Where required, import inert granular Sand Fill (Approved Structural Fill) to achieve a minimum thickness of 1.8 m inert soil above any clayey soils.
- A minimum separation of 1 m between the final site development surface and the highest design groundwater level is recommended by GGC.
- It should be noted that compaction within 1 m of the groundwater table is likely to be difficult. We recommend that earthworks be undertaken during summer months to avoid potential problems achieving compaction close to the groundwater table, consideration could also be given to dewatering as required.

9.4 Assessment of excavated site won sand fill for reuse for reuse as structural fill

The naturally occurring in situ Clean Bassendean Sand material is considered suitable for reuse as Approved Structural Fill.

Any site won sand used for Approved Structural Fill should be clean, cohesionless, and free of all silty, organic or any other deleterious inclusions and have a fines content of less than 5%.

9.5 Assessment of excavated topsoil and organic materials for re-use as structural fill

GGC have reviewed the results of the organic content laboratory test results for the organic soil material at the site. The results indicate the organic content ranges between 1.3 % and 10.1 %.

Given the variable nature of the organic matter content and the fact that it is yet to be excavated, stockpiled and blended to a homogenous material, little is known about the end properties of the of the excavated organic material.

GGC recommend an early small-scale trial of the approach detailed below to assess the practicality of blending site won organic soil with clean sand for reuse as Approved Structural Fill.

The organic soil may be suitable for reuse as and Approved Structural Fill at a blending ratio of up to 5:1 (clean sand to organic soil material).

Based on our review and given the variable organic content matter we recommend preliminary blending trial ratios of 5:1, 4:1, 3:1, 2:1 and 1:1 (clean sand to organic soil) subject to the criteria and recommendations outlined below.

For the organic soil to be suitable for re-use as Approved Structural Fill (to subgrade level) beneath lots and roads it must satisfy the following criteria:

- Be free from all vegetation (roots, sticks, stumps, grass etc).
- Have maximum permissible organic matter content (by mass) of 2%.

- Free from deleterious materials.
- Have a soaked CBR of no less the 9% provided it is compacted to a density ratio of not less than 95% of maximum modified density (MMDD).
- Be non-plastic.
- Be blended to a homogenous/uniform material and free of “clumps” of organic or fine-grained material and,
- Be a sand soil with less than 5% fines.

The following recommendations are aimed at achieving an Approved Structural Fill from the organic soil for re-use within areas as structural fill beneath the roads and lots:

- Following excavation, the earthworks contractor should stockpile excavated organic soil materials for possible reuse.
- Once stockpiled, the organic material should then be mixed to from a homogenous/uniform material at a ratio of 1:1, 2:1, 3:1, 4:1 and 5:1 clean sand (site won or import sand) to organic material, stockpiled separately and visually inspected by a geotechnical engineer. Each stockpile should have a volume of at least 50m^3.
- Each blended stockpile, including the original stockpile of organic soil and clean sand, material should then be sampled and tested by a NATA accredited laboratory. The testing suite should include Particle Size Distribution (PSD), Atterberg Limits, Optimum Moisture Content (OMC), Maximum Modified Dry Density (MMDD), soaked California Bearing Ratio (CBR), organic content tests and laboratory permeability testing at a minimum frequency of two test suites per stockpile (12 suites in total). The results should be provided to a geotechnical engineer for assessment.
- Following assessment of the laboratory test results and provided the criteria outlined above are achieved, a site-specific blend ratio and specifications may be assessed for the project.

The approach should be reviewed by a hydrology consultant as permeability rates should be expected to reduce within areas where material of this type is placed. The reduced permeability may result in the requirement for the addition of subsoil drainage. The approach should also be reviewed by an environmental consultant with regards to Acid Sulphate Soil management.

If assessed as suitable, the site-specific blend ratio should then be sampled and tested by a NATA accredited laboratory at a minimum frequency of one test per 2,500m^3 of material generated for reuse and placed and compacted to achieve requirements of ***Section 9.6***. The laboratory testing suite should include PSD, Atterberg Limits, OMC, MMDD, soaked CBR and organic content tests and laboratory permeability test. The laboratory results should be provided to a geotechnical engineer for approval.

Consideration should also be given to including field permeability testing of the site-specific blend ratio, if required.

9.6 Placement and compaction of approved structural fill

Inert granular Sand Fill free of organics and with less than 5% fines or Approved Site Won Sand material (Approved Structural Fill) should be used to build up levels across the site if required.

Approved Structural Fill must be compacted using suitable plant and equipment to a dry density ratio of at least 95% MMDD as determined in accordance with AS1289.5.2.1 and must comply with the material requirements of AS3798-2007 “*Guidelines on Earthworks for Commercial and Residential Developments*”.

Where sand with less than 5% fines is used, and the Perth Sand Penetrometer can be used for compaction control, the following minimum blow counts may be assumed to correlate approximately to a dry density ratio of 95% MMDD:

- Depth Range 0.0-0.15 m: SET.
- Depth Range 0.15-0.45 m: 8 blows.
- Depth Range 0.45 - 0.75 m: 10 blows; and,
- Depth Range 0.75 - 1.05 m: 12 blows.

Whilst the above can be used as a general guide for naturally occurring Perth sands with less than 5 % fines, experience indicates that correlation variations do occur. It is therefore recommended that a site-specific PSP/dry density correlation is undertaken for each material source used on this project.

Over excavation and replacement with approved granular fill may be required where the minimum dry density cannot be achieved. If compaction difficulties are noted, the advice of an experienced geotechnical engineer should be sought.

After compaction, verification testing is required to confirm the level of compaction that has been achieved by testing as follows:

- On each lift of fill on a 10 m grid.
- At each spread footing location – minimum of two tests per footing location.
- At 5 m centres along gravity retaining wall footings and all strip footings (where present); and,
- At 10 m centres below on-ground slabs and pavements.

Fill must be placed in horizontal layers not exceeding 300 mm loose lift thickness (depending on the compaction plant adopted). Each layer must be compacted by suitable compaction equipment, and carefully controlled to ensure even compaction over the full area and depth of each layer.

9.7 Subgrade CBR

Based on the results of the investigation GGC recommend the following subgrade CBR values:

- CBR for value of 9% for sand subgrade material; and,
- CBR of 1% for clayey subgrade material.

The above recommended CBR value assumes that the subgrade will be prepared and compacted in accordance with the recommendations in ***Section 9.3*** and ***Section 9.6***. to a depth of at least 0.5 m below top of subgrade level. Where the recommended CBR for sand soils is adopted a minimum 0.6 m thickness of sand subgrade material is required.

These recommendations assume that following the removal of organic material the exposed natural subgrade material is compacted to a dry density ratio of at least 95% maximum modified dry density (MMDD).

It should be noted that a shallow groundwater level may occur across the site following wet periods and in winter months and subsoil drainage may be required to control water levels beneath pavement areas and to provide drainage required to prevent rutting and deformation of the subgrade soils.

9.8 Stormwater disposal

Provided the Topsoil/organic material is excavated to expose natural sand subgrade and/or there is a minimum thickness of 1.8 m of inert Sand soil above any clayey soils and any imported Sand Fill used to raise the site has a permeability value (k) of at least 5 m/day, we recommend a design permeability value (k) for the site of 1 m/day to allow for the variability in materials and reduced permeability as a consequence of:

- Densification of sand during site preparation works.
- Natural variability in the Sands; and,
- Clogging of the sand around soak wells over time with fines.

It should be noted, soak wells are traditionally used in suitable free draining sands where the ground surface is at least 1.5 m above groundwater level any clayey soil. Drainage design will therefore need to consider the depth to groundwater across the site, as soak wells typically become less efficient where design groundwater is within 1 m of the base of the soakwell.

Separation between finished design level and groundwater design level should be considered (in consultation with civil designers, hydraulic designers and local council), as should the base of any soak wells be within 1 m of the groundwater, permeability rates should be expected to reduce (possibly significantly) during and following storm events and in winter months.

Soak wells should be positioned a minimum distance of 5 m from footings and ground bearing slabs (subject to council regulations). Discharge from soak wells can cause local densification of loose sandy soils, leading to settlement of footings and slabs overtime.

If soak wells are positioned closer than 5 m to building footings and slabs, consideration can be given to wrapping the soak well with a non-woven separation geotextile, but the specification for the geotextile must be provided by an experienced geotechnical engineer.

We also recommend a minimum separation spacing of at least 10 m between individual soak wells at this site. This minimum distance is intended to reduce the potential for reducing the local permeability and interaction between the soak wells that may reduce the effectiveness of soakage.

Consideration could be given to additional infiltration testing to confirm infiltration rates prior to finalising detailed design.

It must be noted that clayey material was encountered from the surface to depth of up to 3.2 m within GGC completed CPT01 in the proposed area POS and Drain area in Zone 3. We consider that the POS and Drain area is currently unsuitable for on-site disposal of stormwater by infiltration using soak wells, due to the presence of shallow groundwater and shallow clayey soils within this location.

10 Important information about your GGC geotechnical report

The reader's attention is drawn to the important information about this report which follows the main text.

11 References

The following published information sources have been reviewed by GGC in compiling this report:

- Standards Australia (2017) "*Geotechnical Site Investigations*" Australian Standard AS1726- 2017; and
- Standards Australia (2011) "*Residential Slabs and Footings*" Australian Standard AS2870 – 2011.
- Standards Australia (2007) "*Guidelines on Earthworks for Commercial and Residential Developments*" Australian Standard AS3798 – 2007.
- Perth Metropolitan Region 1:50 00 Environmental Geology Series – Rockingham, Sheet 2033 II and part of 2033 III (1985), Geological Survey of Western Australia.
- Cocks, G (2007), Journal and News of Australian Geomechanics Society, Volume 42 No. 3 pp 101-114 "*Disposal of Stormwater Runoff by Soakage in Perth Western Australia*".
- Department of Water, online Perth Groundwater Maps, (https://maps.water.wa.gov.au/Groundwater/)

IMPORTANT INFORMATION SHEETS

1 Introduction

The information contained in this document is to inform GGC's clients of the reasonable expectations of a geotechnical report and options to mitigate geotechnical risks and consequences. This information is provided to help clients understand where GGC's responsibility as a geotechnical engineer, acting reasonably, begin and end. In doing so, it also highlights the responsibility of our client and third parties.

Please contact the GGC Project Director should you not understand the report and the limitations of the information provided.

2 Collection and Interpretation of Data

Geotechnical investigations identify subsurface conditions only at the point of investigation. The material encountered during the investigation is recorded on logs and based on a visual assessment and (if undertaken) supported by laboratory test results. In the case of an Electric Friction Cone Penetrometer Test (CPT), the data recorded is a tip pressure and sleeve friction on a rod; from which ground conditions are inferred.

Actual conditions may differ from those encountered during the investigations and / or inferred a distance from the investigation stations. In addition, the actual interface between materials or units may be gradual or more abrupt than inferred from the results of the investigation.

A Chartered Geotechnical Engineer and / or Engineering Geologist should be retained through the various stages of the project to identify variances, conduct additional tests if required, and provide recommendations to address geotechnical / geological issues identified on site. The Chartered Geotechnical Engineer / Engineering Geologist should also review the actual conditions encountered to confirm that they are consistent with those inferred in this report.

3 Change in Subsurface Conditions

The geotechnical recommendations and parameters provided in this report are based on the ground conditions encountered at the time of the geotechnical investigation. Changes in the ground conditions can occur over time and include, but are not limited to, the following:

- Filling or excavation works (or other anthropologic events);
- Flooding;
- Groundwater fluctuations;
- Earthquakes or other such events;
- Works on neighbouring sites impacting on the subject site; and,
- Migration of pollutants from neighbouring properties.

GGC should be consulted if there is any protracted delay in the issue of this report and the use of the recommendations provided.

It is important to note that where ground conditions have changed, additional geotechnical investigations and testing may be required to assess the impacts of the changed ground conditions.

4 Specificity of Report

This geotechnical report has been prepared for a specific project and design; therefore, it has been written to address specific geotechnical issues. In doing so, the following has been taken into account:

- The project objectives as described in the report;
- The client's budget and programme constraints;
- The specific site mentioned in the report; and,
- The nature and extent of the development at the site.

This report should not be used for any other purpose other than what has been specifically described and should not be relied upon if:

- The report was not written for you;
- The report was not written for your specific site;
- The report does not address your specific development;
- There is a significant delay between undertaking the report and developing the site; or,
- Significant changes to the site have occurred.

Where the information and recommendations contained within this report are being used by others, GGC should be engaged during the design process to engage with the other members of the design team and review works being produced by the other design team members to confirm that it is consistent with the geotechnical report.

5 Environmental Issues

Unless specifically addressed in this report, environmental and contamination considerations are not included. The investigation methods required for environmental investigation often differ to those used for geotechnical investigations and the information contained within this report may not be appropriate for use by environmental engineering consultants and scientists.

This report was not prepared to address environmental issues and the client is responsible to ensure environmental considerations have been taken into account for the project. GGC can provide information on environmental engineering consultants, should this be required.

6 Construction

The method of ground investigation used for geotechnical investigations limits GGC's ability to know every detail about the ground conditions on site. GGC use reasonable engineering judgement to form an assessment of the subsurface conditions at the site based on information obtained at specific locations.

Ground conditions may be encountered during construction that were not anticipated during the geotechnical investigation. Should this be the case, GGC should be engaged to provide construction support as a means of mitigating the consequence of encountering unexpected ground conditions.

7 Responsibility of Others

GGC has prepared this report for the use by our client. GGC does not accept any responsibility from any third party, other than our client, who uses the information contained in this report. GGC takes no responsibility for any damages suffered by any third party as a consequence of any decisions or action that have been made based on this report.

Further information regarding the responsibility of clients and other third parties should also be obtained from the following:

- "Guidelines for the Provision of Geotechnical Information in Construction", published by the Institution of Engineers Australia;
- Australian Standard AS 2870 – 2011, Residential Slabs and Footings;
- Australian Standard, AS 5100 – 2004, Bridge Design Set; and,
- Any other Standard or Code of Practice applicable to the development.

FIGURES

LEGEND - APPROXIMATE FIELD INVESTIGATION LOCATIONS

- ▼ CONE PENETRATION TEST (CPT) LOCATION
- ⊡ TEST PIT (TP) LOCATION
- ▽ INFILTRATION TEST (IT) LOCATION
- ▬ ▬ ▬ APPROXIMATE SITE BOUNDARY

GEOTECHNICAL INVESTIGATION BY:

- ⊡ ▼ ▽ GGC (2022)
- ⊡ ▼ Douglas Partners (2014)

Maps Image: © 2022 Nearmap

GGC
Geotechnical and Geological Consultants

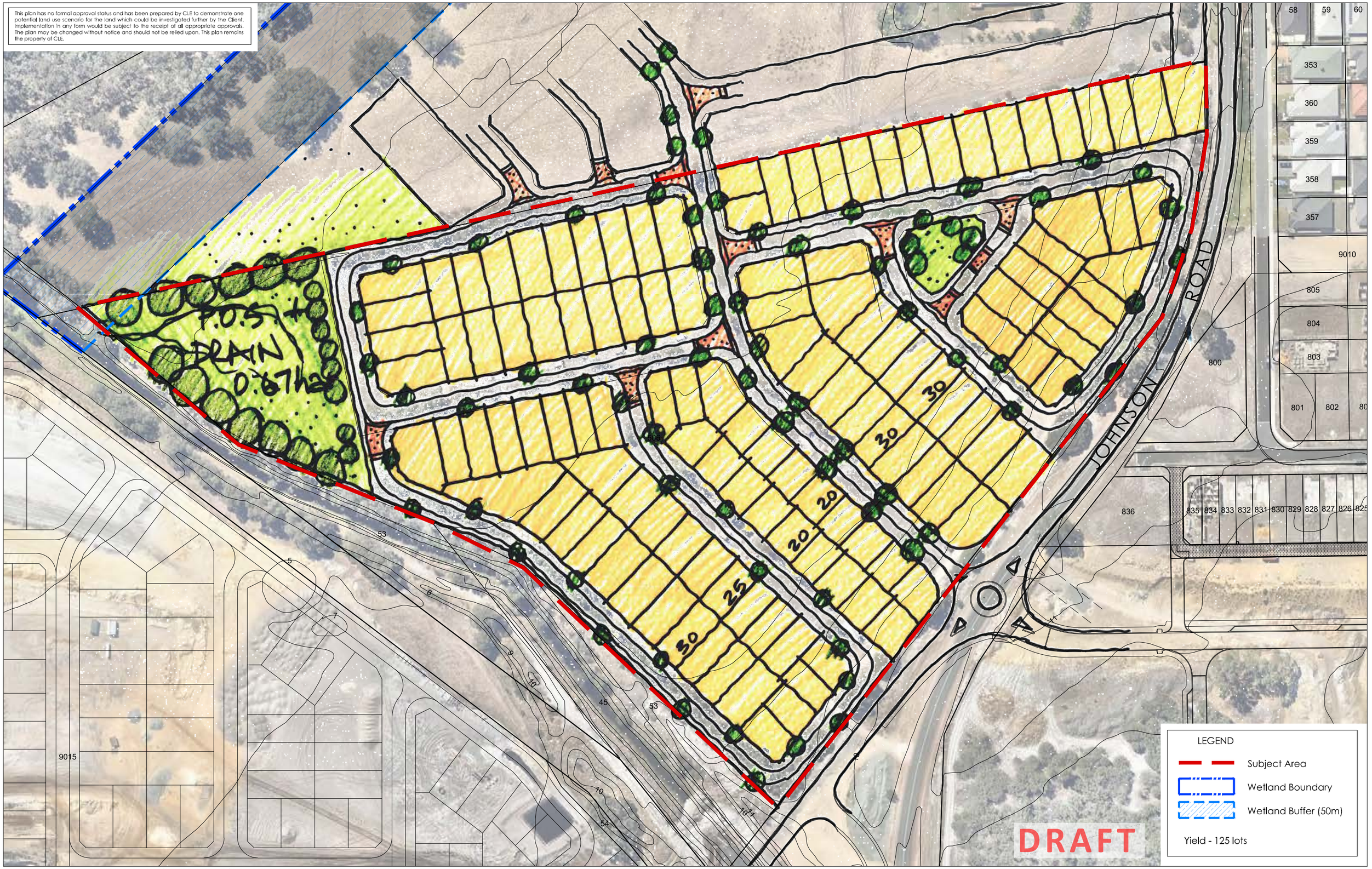
TITLE

Site Investigation Location Plan
Proposed Subdivision Development
Providence East Estate
Eastcourt Property Development

DRAWN C. STEWART	DATE 18-07-2022		
CHECKED L.CHANDRARATHNA	DATE 23-08-2022		
PROJECT No GGC221986-R01-Rev0		A3	
SCALE N.T.S.	FIGURE No 1	REV 0	

APPENDIX A:
Client Supplied Information

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.



Source: TBB Lot 507 Sub Design (15_007_019A_CONP_L503-505_507_900_(150703)_Default.dwg)

0 10 20 30 40 50 60 70 80 90 100m

CONCEPT PLAN

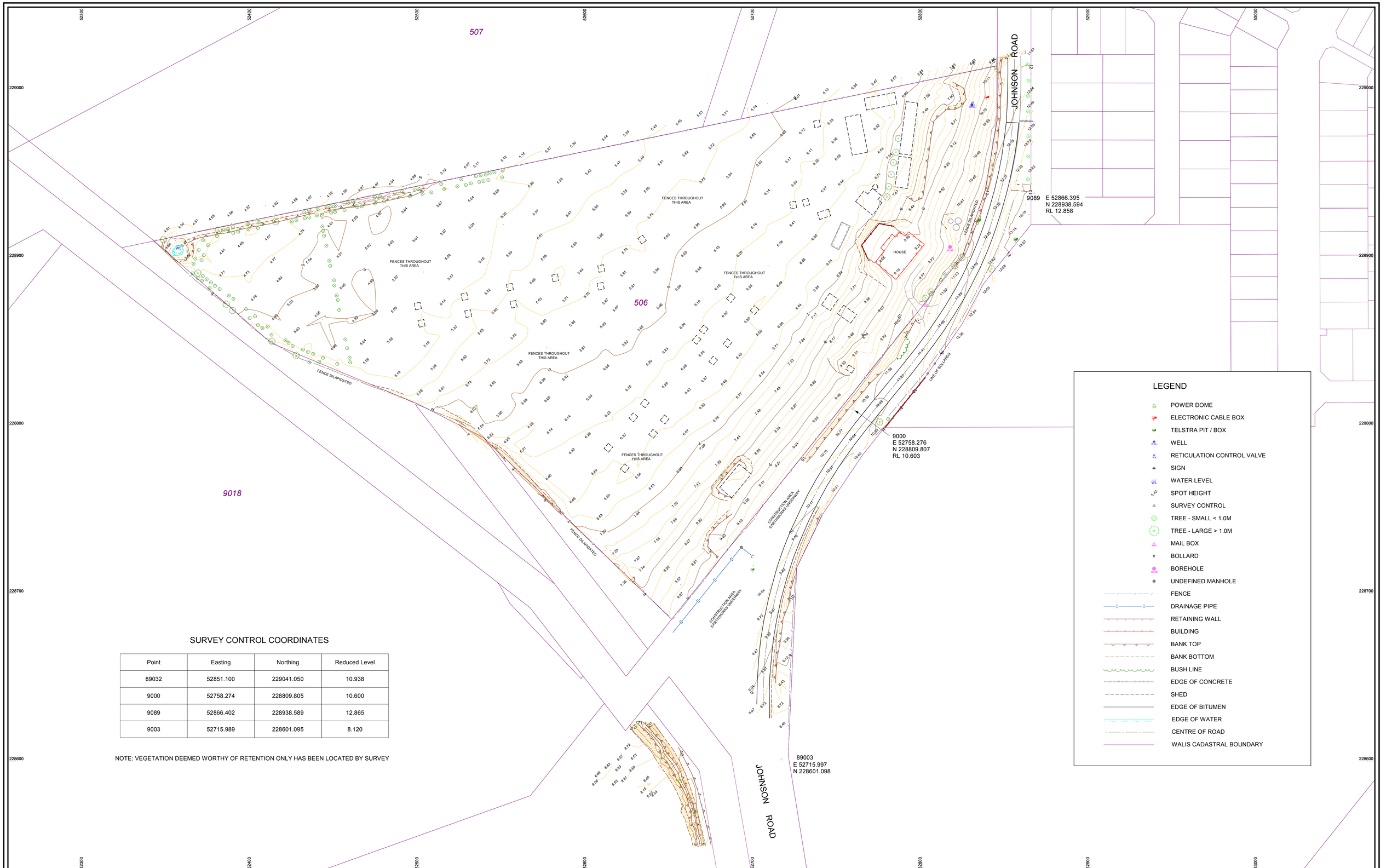
Lots 1, 504-506 & 1336 Wellard East
City of Kwinana

06.03.2015 nearmap.com

plan no: 2263-167-01
scale: 1:1500 @ A3
date: 16.07.2015

CLE TOWN PLANNING + DESIGN

This plan is current at the revised date & subject to approval, survey & engineering detail. This plan remains the property of CLE © www.cleplan.com.au



LEGEND

- POWER DOME
- ELECTRONIC CABLE BOX
- TELSTRA PIT / BOX
- WELL
- RETICULATION CONTROL VALVE
- SIGN
- WATER LEVEL
- SPOT HEIGHT
- SURVEY CONTROL
- TREE - SMALL < 1.0M
- TREE - LARGE > 1.0M
- MAIL BOX
- BOLLARD
- BOREHOLE
- UNDEFINED MANHOLE
- FENCE
- DRAINAGE PIPE
- RETAINING WALL
- BUILDING
- BANK TOP
- BANK BOTTOM
- BUSH LINE
- EDGE OF CONCRETE
- SHED
- EDGE OF BITUMEN
- EDGE OF WATER
- CENTRE OF ROAD
- WALIS CADASTRAL BOUNDARY

SURVEY CONTROL COORDINATES

Point	Easting	Northing	Reduced Level
89032	52851.100	229041.050	10.938
9000	52758.274	228809.805	10.600
9089	52866.402	228938.589	12.865
9003	52715.989	228601.095	8.120

NOTE: VEGETATION DEEMED WORTHY OF RETENTION ONLY HAS BEEN LOCATED BY SURVEY

Rev.	Description	Drawn	Date	Checked
B	Additional Data Added	SAH	07/05/2015	CAY
A	Initial Issue	HBL	01/05/2015	CAY

SCALE 1:1000 @ A1

0 20 40 60 80 100

ALL DISTANCES ARE IN METRES

For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

The contents of this plan are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

Surveyor:- GSU
Survey Date:- 24/04/2015
Precal/Cad:- WALIS MAR 2014

bsi. ISO 9001 Quality Management
AS/NZS 4801:2001 Occupational Health and Safety Management
FS 565311 OSH 591267

N

The boundaries shown on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Existing easements, encumbrances or interests are not depicted and a title search is recommended to obtain this information. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.

MNG.
MCMULLEN NOLAN GROUP
Level 1, 2 Sabre Crescent
Jandakot, W.A. 6164
PO Box 3526, Success
W.A. 6964, Australia
Offices in: Broome, Bunbury, Kununurra, Newman, Onslow, Port Hedland
Tel: (08) 6436 1599
Fax: (08) 6436 1500
info@mngsurvey.com.au
www.mngsurvey.com.au
ABN 90 009 363 311

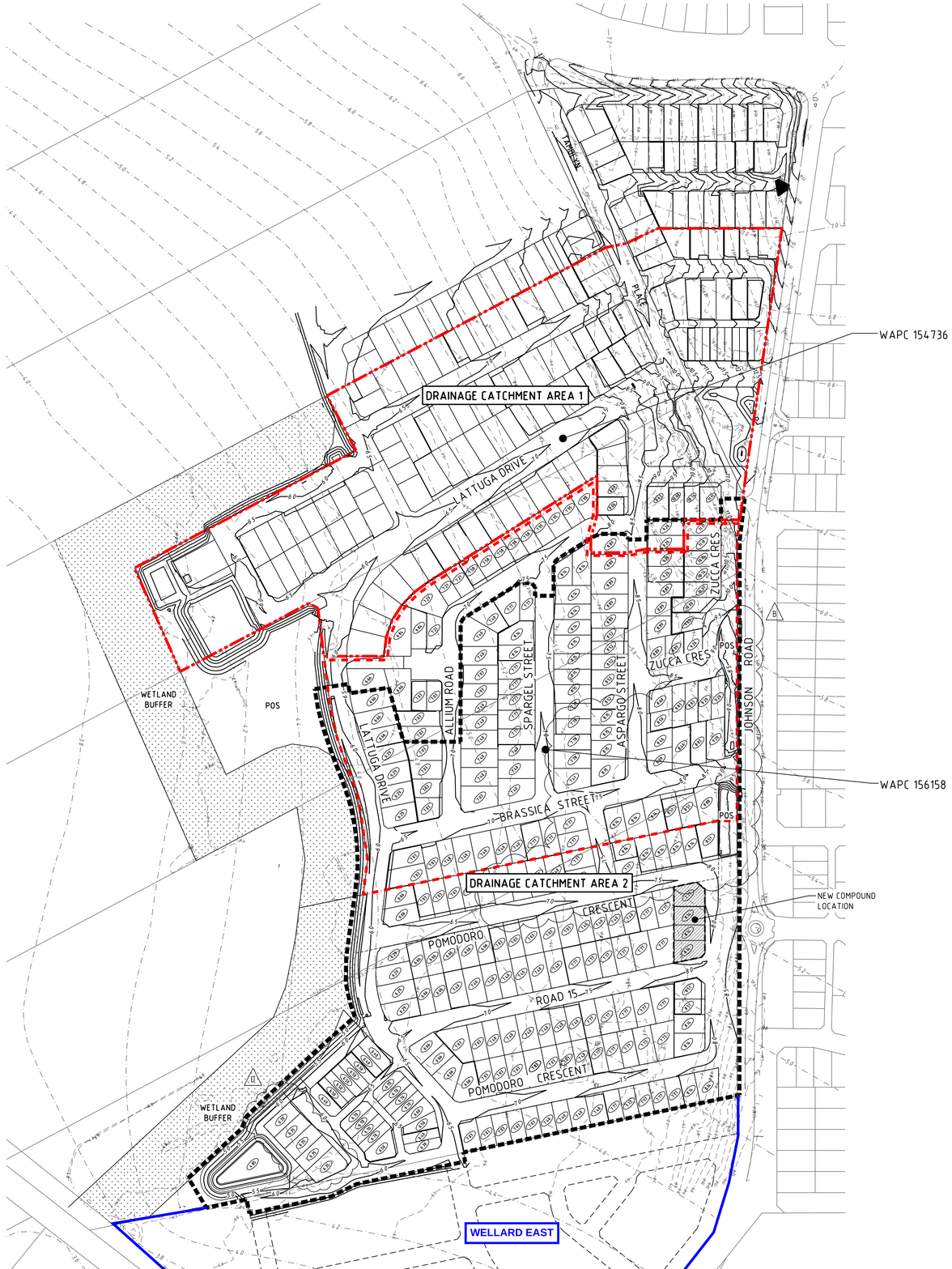
LOT 506 JOHNSON ROAD WELLARD DETAIL SURVEY

CLIENT: *EASTCOURT PROPERTY GROUP*

Project Mngr.	Charles Younge	Datum	PCG94 / AHD

96766 - DE - 117 - B

Job Number | Type | Plan Number | Revision



LEGEND

- DRAINAGE CATCHMENT BOUNDARY
- 7.0 DESIGN SURFACE CONTOUR (0.5m INTERVALS)
- 10.0 EXISTING CONTOUR (1m INTERVALS)
- 5.8 GROUNDWATER CONTOUR (2.0m) *(AAMGL - PROVIDED BY RPS ON 22/11/2016)*
- WAPC 154736 BOUNDARY
- WAPC 156158 BOUNDARY
- R35 DESIGN LOT LEVEL

REV	DATE	DRN	CKD	APP	AMENDMENT
D	02.10.20	AMP	MH		DESIGN LOT LEVELS AMENDED
C	18.09.20	AMP	MH	M. WALLIS	STAGE 5 CADASTRAL AND CONTOURS UPDATED
B	01.08.19	AMP	MH	M. WALLIS	AAMGL GROUNDWATER CONTOURS ADDED
A	06.05.19	AMP	SL	M. WALLIS	ISSUED FOR APPROVAL

N

1:2000 0m 40 80 120

COPYRIGHT
The concepts and information contained in this document are the Copyright of Cossill & Webley Pty Ltd. Use or copying of the document in whole or part without the written permission of Cossill & Webley Pty Ltd constitutes an infringement of copyright.

This plan shall only be printed in full colour. If this plan is printed in black and white or grey scale it is not to be used for construction

This plan is not to be used for construction unless issued as revision 0 or higher

Cossill & Webley CONSULTING ENGINEERS
Mailing Address: PO Box 680, Subiaco WA 6904
Street Address: B12 (Level 2) 431 Roberts Road, Subiaco WA 6008
T (08) 9422 5800 F (08) 9422 5801 E admin@cosweb.com.au

CLIENT: LWP PROPERTY GROUP

APPROVED: mjWall

DESIGNED: AMP

SCALE: 1:2000

PROJECT: BULLRUSH SWAMP, WELLARD

TITLE: DRAINAGE - CATCHMENT AREA 2 PRELIMINARY EARTHWORKS PLAN

WAPC No.: WAPC No. 154736/156158

DRAWING No.: 6165-00-SK35

REVISION: D

ORIGINAL SIZE: A1

P:\6165 Bullrush Swamp\6165-00\Acad\6165-00-SK35.dwg, 21/10/2020 8:44:50 AM, andrewp, Digital Signing PDF.pc3, 1:1, - CW Reference

FAX

To:	Sam Gill	**From:**	Bob Baxter
Fax:	9316 0999	**Pages:**	22
Phone:	0417988167	**Date**	15 D ec 2015
Re:	Ground test results Lot 506 Johnson Road	**CC:**	[Type text]

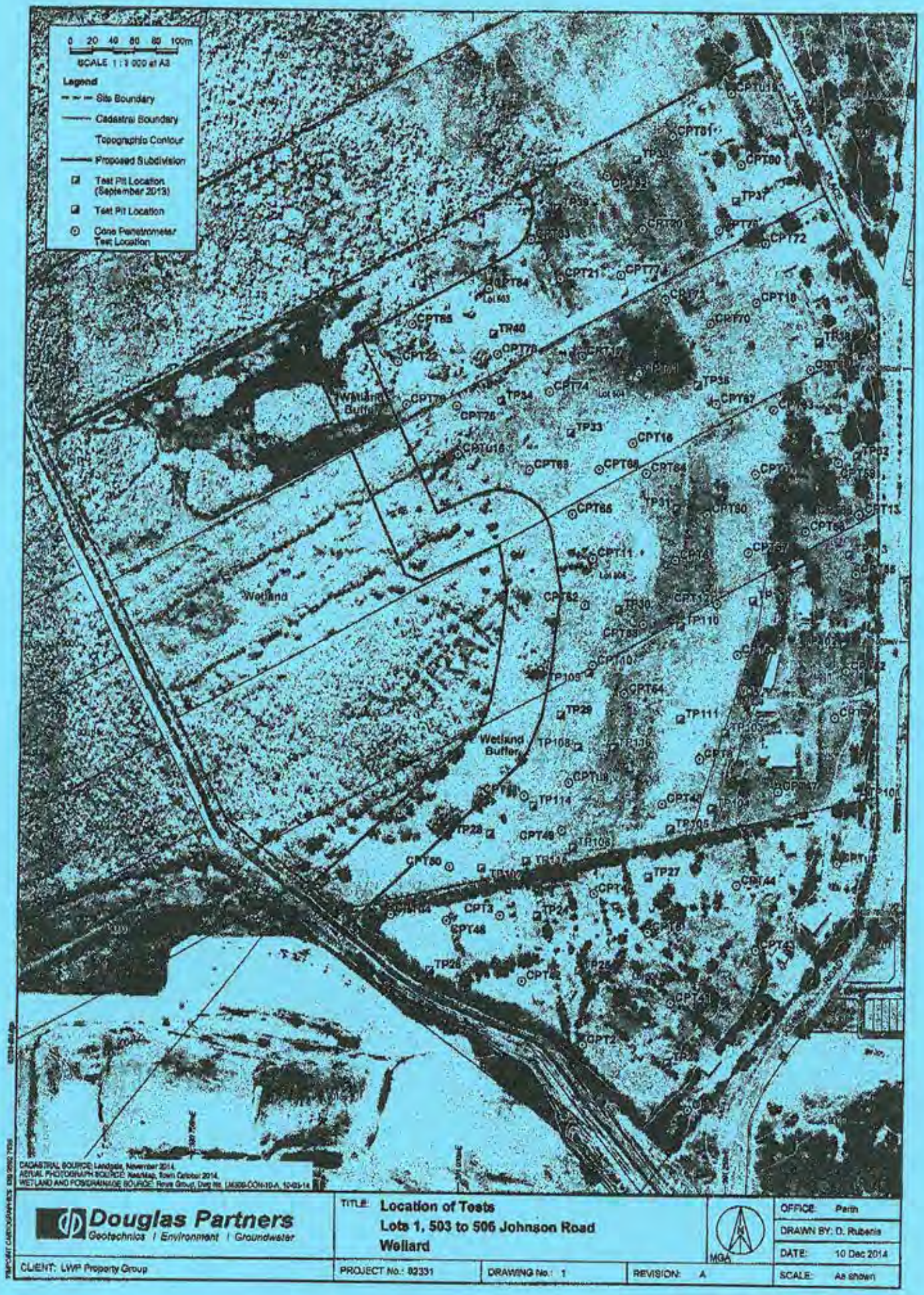
[x] Urgent [ ] For Review [ ] Please Comment [ ] Please Reply [ ] Please Recycle

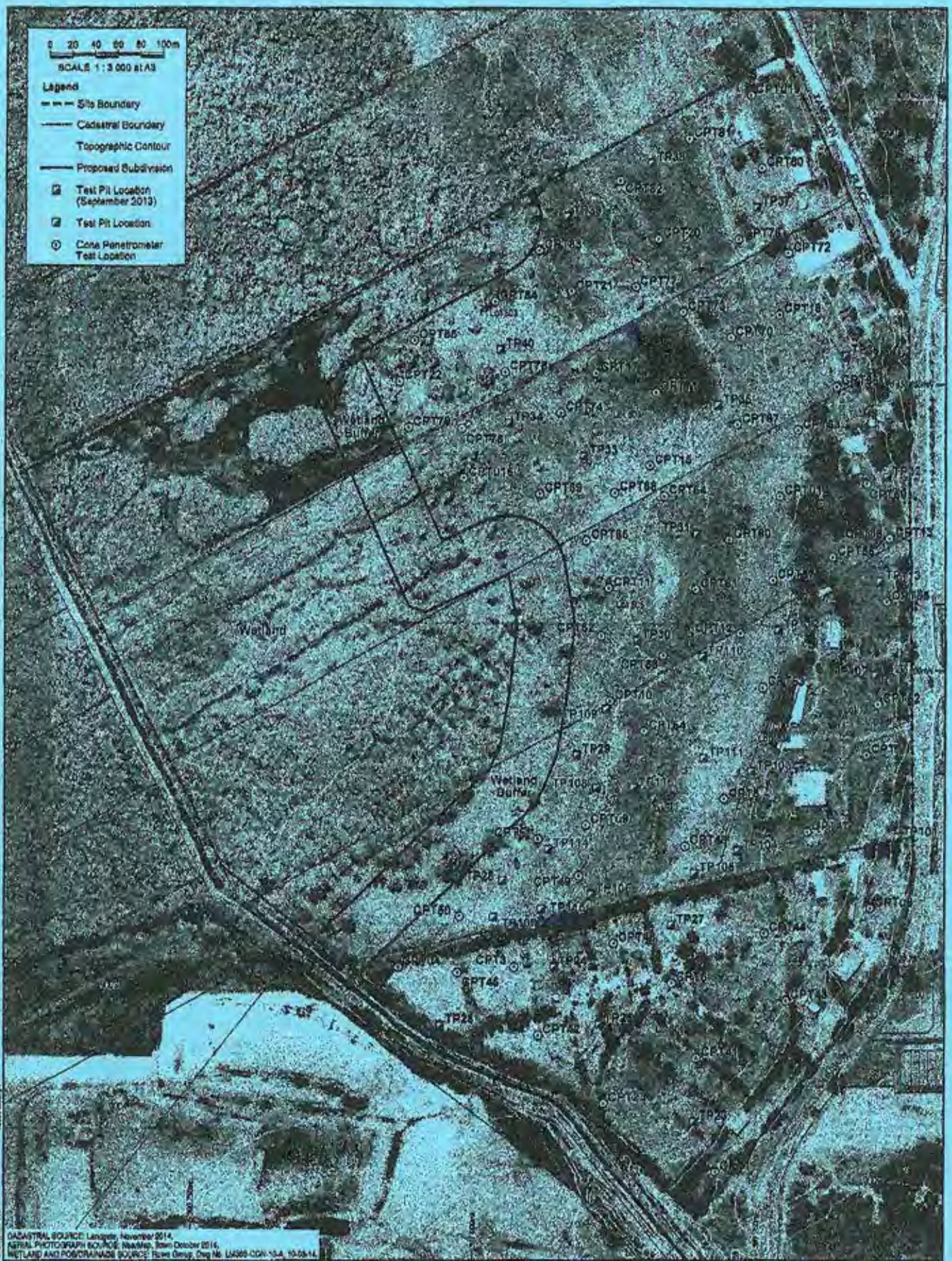
Comments:

Attached are the results, as requested.

R Baxter

9.26.2011


0 20 40 60 80 100m
SCALE 1 : 3 000 at A3
Legend
Site Boundary
Cadastral Boundary
Topographic Contour
Proposed Subdivision
Test Pit Location (September 2013)
Test Pit Location
Cone Penetrometer Test Location
Wetland
Wetland Buffer
Lot 503
Lot 504
Lot 505
Lot 506
CADASTRAL SOURCE: Landgate, November 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, Town Cabbage 2014.
WETLAND AND POS/DRAINAGE SOURCE: Rowe Group, Dwg No. LM309-CON-10-A, 10-03-14
Douglas Partners
Geotechnics / Environment / Groundwater
TITLE: Location of Tests
Lots 1, 503 to 506 Johnson Road
Wellard
MGA
OFFICE: Perth
DRAWN BY: D. Rubanis
DATE: 10 Dec 2014
SCALE: As shown
CLIENT: LWP Property Group
PROJECT No.: 82331
DRAWING No.: 1
REVISION: A


0 20 40 60 80 100m
SCALE 1 : 3 000 at A3
Legend
Site Boundary
Cadastral Boundary
Topographic Contour
Proposed Subdivision
Test Pit Location (September 2013)
Test Pit Location
Cone Penetrometer Test Location
Wetland
Wetland Buffer
CADASTRAL SOURCE: Landgate, November 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, 30cm October 2014.
WETLAND AND POS/DRAINAGE SOURCE: Rowe Group, Dwg No. LA366-CON-10-A, 10-09-14.
Douglas Partners
Geotechnics / Environment / Groundwater
TITLE: Location of Tests
Lots 1, 503 to 506 Johnson Road
Wellard
MGA
OFFICE: Perth
DRAWN BY: D. Rubenis
DATE: 10 Dec 2014
SCALE: As shown
CLIENT: LWP Property Group
PROJECT No.: 82331
DRAWING No.: 1
REVISION: A

TEST PIT LOG

CLIENT: LWP Property
PROJECT: Lots 1, 503 to 506 Johnson Road
LOCATION: Wellard, WA

SURFACE LEVEL: 4.6 m AHD*
EASTING: 391023
NORTHING: 6430279

PIT No: TP40
PROJECT No: 82331
DATE: 13/11/2014
SHEET 1 OF 1

Rd.	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		PEATY CLAYEY SILT - very soft, dark brown to black, peaty clayey silt, moist.		D	0.6				
	0.65	SAND - medium dense, grey, fine to medium grained, sand with a trace of silt, wet.							
		-becoming green sand with some silt from 0.9 m.		D	1.4				
	3.0	Pit discontinued at 3.0m (Target)							

RIG: Kubota 5 tonne excavator with a 600 mm bucket.

LOGGED: D Rubenis

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater seepage observed from 1.3 m.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	⊳	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LWP Property
PROJECT: Lots 1, 503 to 506 Johnson Road
LOCATION: Wellard, WA

SURFACE LEVEL: 5.8 m AHD*
EASTING: 391175
NORTHING: 6429780

PIT No: TP27
PROJECT No: 82331
DATE: 12/11/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		PEATY SILT - firm, dark brown to black, slightly sandy peaty silt with some clay, dry.		D	0.2				
	0.3	SAND - dense, light grey to white, fine to medium grained, sand with a trace of silt, moist.							
		-becoming wet from 0.7 m.							
		-becoming brown from 1.6 m.						12-11-14	
	2.4	Pit discontinued at 2.4m (Collapsing)							

RIG: Kubota 5 tonne excavator with a 600 mm bucket.
LOGGED: D Rubenis
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed from 1.35 m.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U,	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

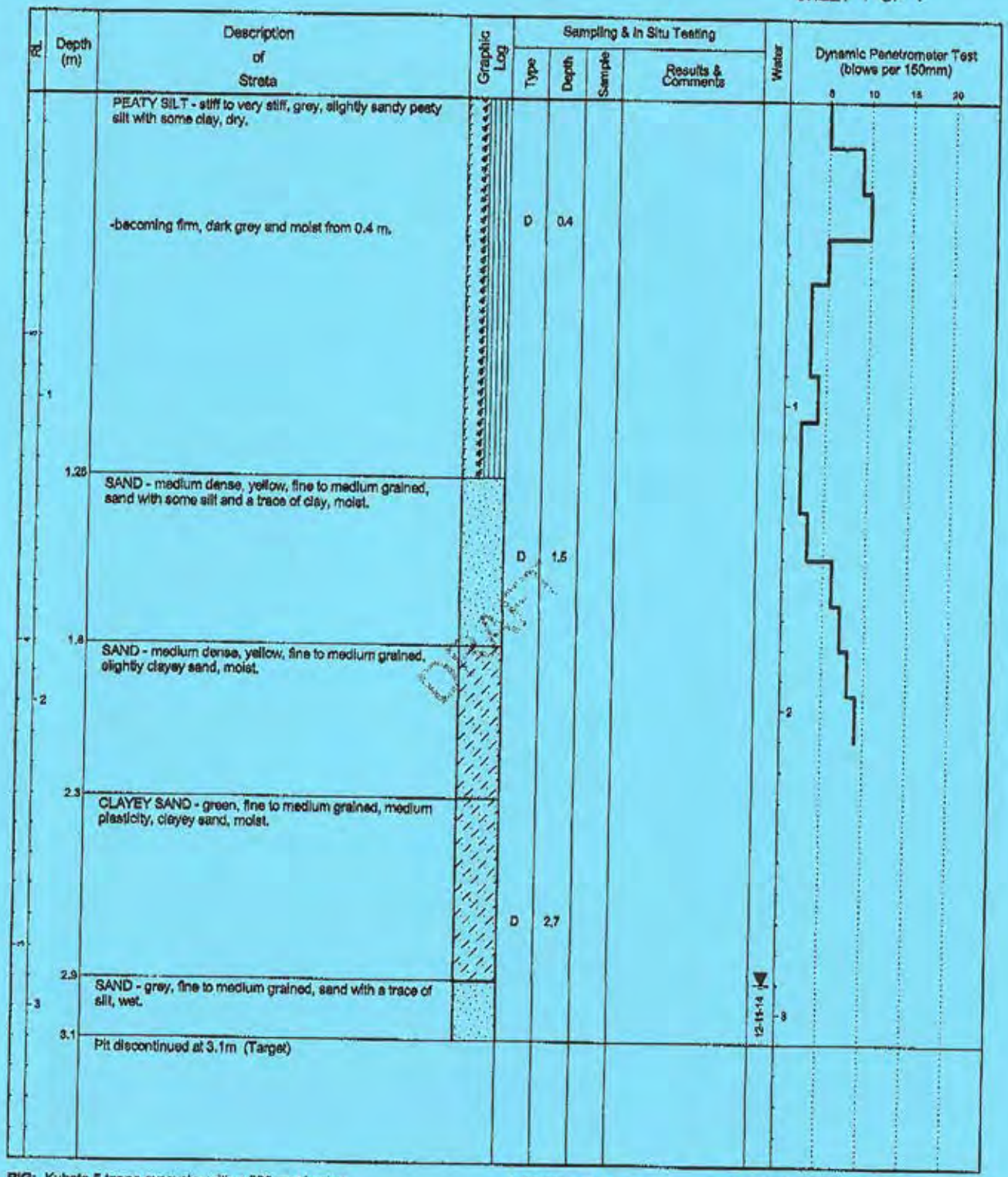
Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LWP Property
PROJECT: Lots 1, 503 to 506 Johnson Road
LOCATION: Wellard, WA

SURFACE LEVEL: 5.8 m AHD*
EASTING: 390971
NORTHING: 6429693

PIT No: TP26
PROJECT No: 82331
DATE: 12/11/2014
SHEET 1 OF 1



RIG: Kubota 5 tonne excavator with a 600 mm bucket.
LOGGED: D Rubenis
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed from 2.9 m.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo Ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LWP Property
PROJECT: Lots 1, 503 to 506 Johnson Road
LOCATION: Wellard, WA

SURFACE LEVEL: 5.9 m AHD*
EASTING: 391111
NORTHING: 6429694

PIT No: TP25
PROJECT No: 82331
DATE: 12/11/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		PEATY SILT - firm, dark brown to black, slightly sandy peaty silt with some clay, dry.		D	0.1				
	0.25	SAND - medium dense, grey, fine to medium grained, sand with a trace of silt, dry.							
				D	0.9				
	1	-becoming moist from 1.0 m.							
		-becoming wet from 1.7 m.						12-11-14	
	2								
	2.5	Pit discontinued at 2.5m (Collapsing)							
	3								

RIG: Kubota 5 tonne excavator with a 600 mm bucket.
LOGGED: D Rubenis
SURVEY DATUM: MGA94

WATER OBSERVATIONS: Free groundwater observed from 1.65 m.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

☒ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: LWP Property
PROJECT: Lots 1, 503 to 506 Johnson Road
LOCATION: Wellard, WA

SURFACE LEVEL: 5.5 m AHD*
EASTING: 391071
NORTHING: 6429743

PIT No: TP24
PROJECT No: 82331
DATE: 12/11/2014
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
5		PEATY SILT - firm, dark grey, slightly sandy peaty silt with some clay, dry to moist.		D	0.5				
	0.75	SAND - medium dense, yellow-grey, fine to medium grained, sand with a trace of silt, wet.							
4	1	-becoming medium dense to dense and dark grey from 1.1 m.						▽	1
	1.5	SAND - medium dense, green, fine to medium grained, sand with some clay, wet.		D	1.6				
3	2								2
	2.3	SAND - grey, fine to medium grained, sand with a trace of silt, wet.							
2	3								3
	3.0	Pit discontinued at 3.0m (Target)							

RIG: Kubota 5 tonne excavator with a 600 mm bucket.

LOGGED: D Rubenis

SURVEY DATUM: MGA94

WATER OBSERVATIONS: Groundwater seepage observed from 1.0 m.

REMARKS: *Surface level interpolated from a survey plan provided by the client.

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

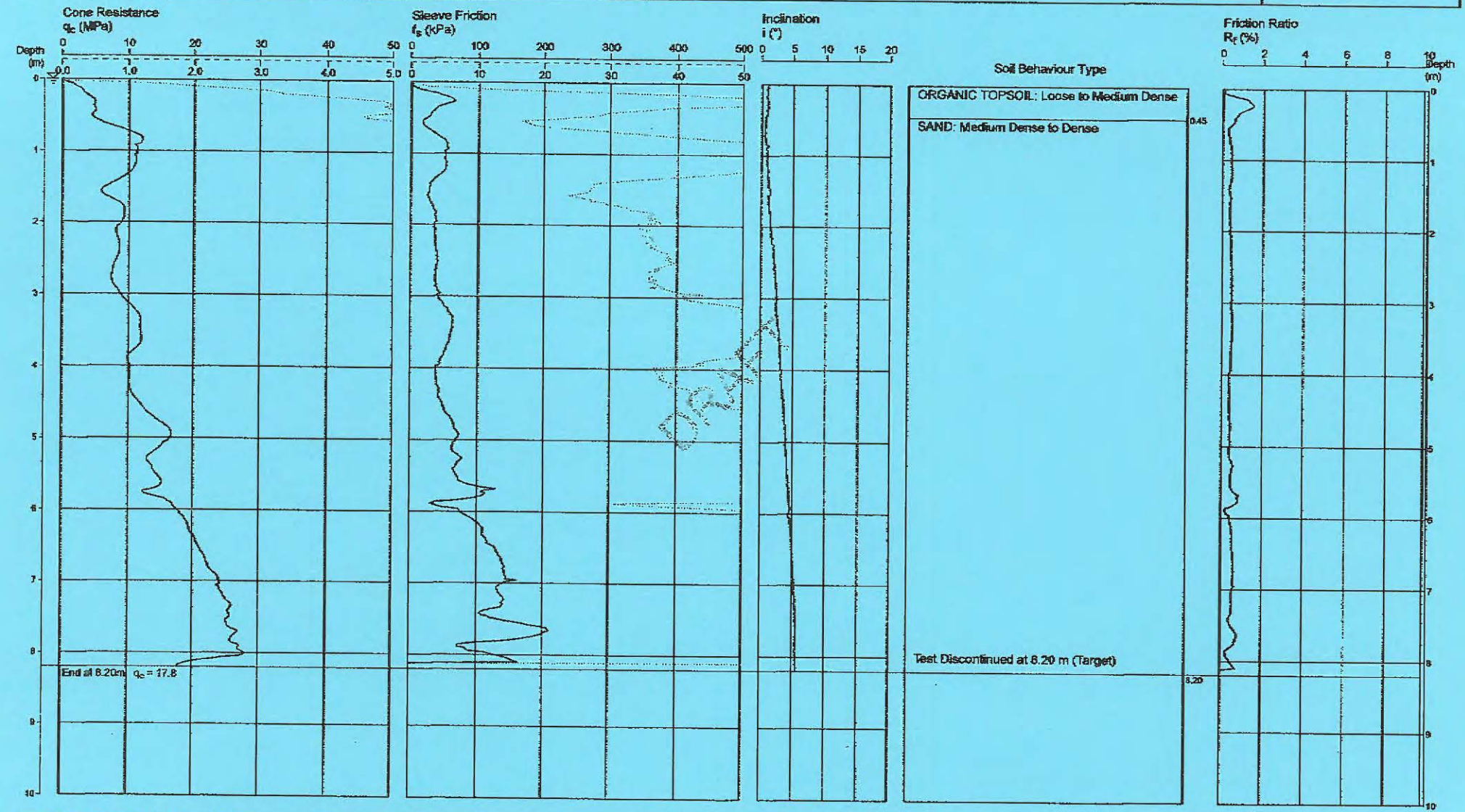
REDUCED LEVEL: 6.4 m AHD*

COORDINATES: 391295E 6429860N

CPT 47
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 47.CP5
Cone ID: Probedrill **Type:** EC33

Water depth after test: Dry to 1.2 m

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:39 R & K Baxter 94394708 PAGE. 9/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

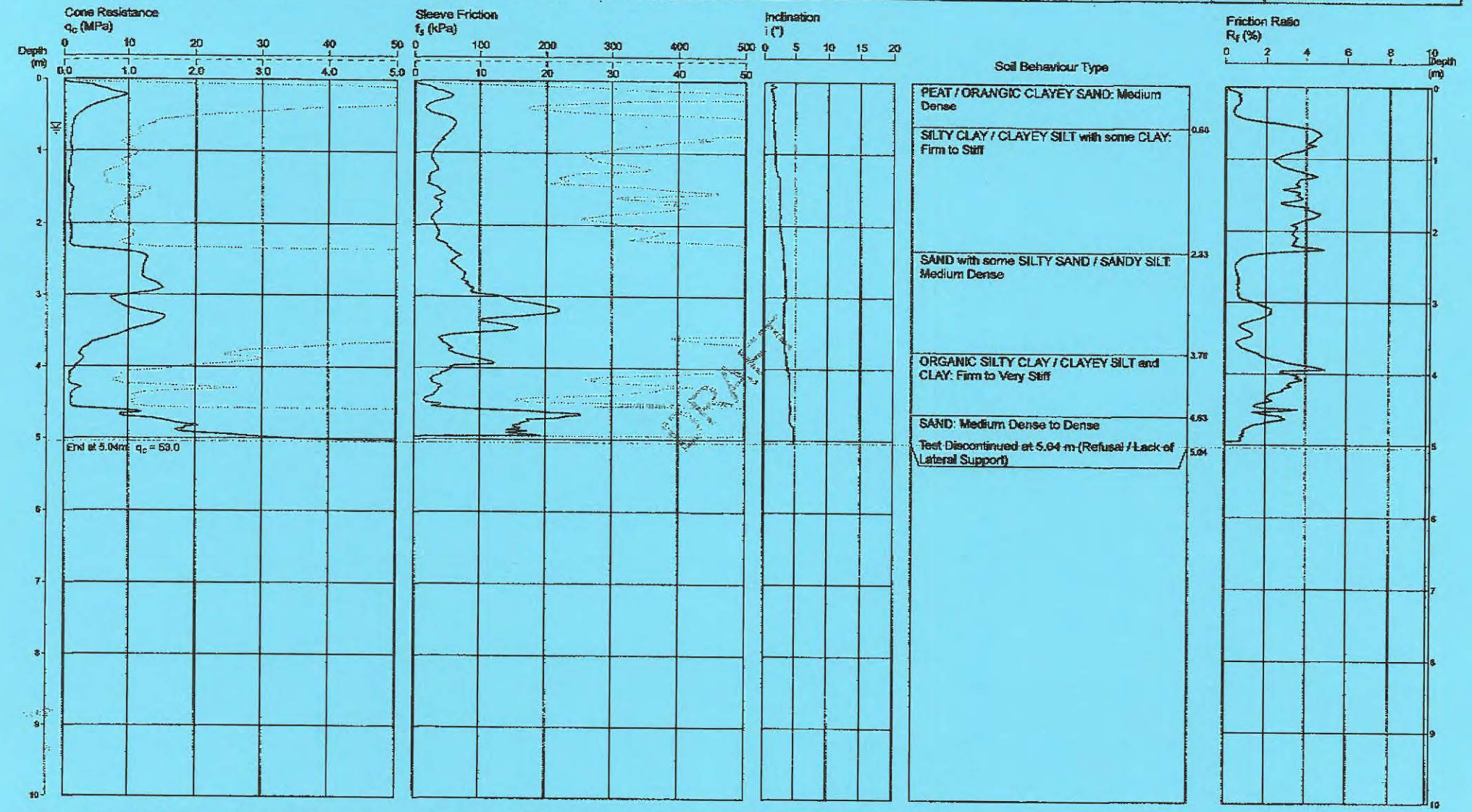
REDUCED LEVEL: 5.2 m AHD*

COORDINATES: 390986E 6429738N

CPT 46
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 46.CP5
Cone ID: Probedrill **Type:** EC33

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Water depth after test: 0.7 m

Douglas Partners
Geotechnics | Environment | Groundwater

2014.12.15 11:40 R & K Baxter 94394708 PAGE. 10/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

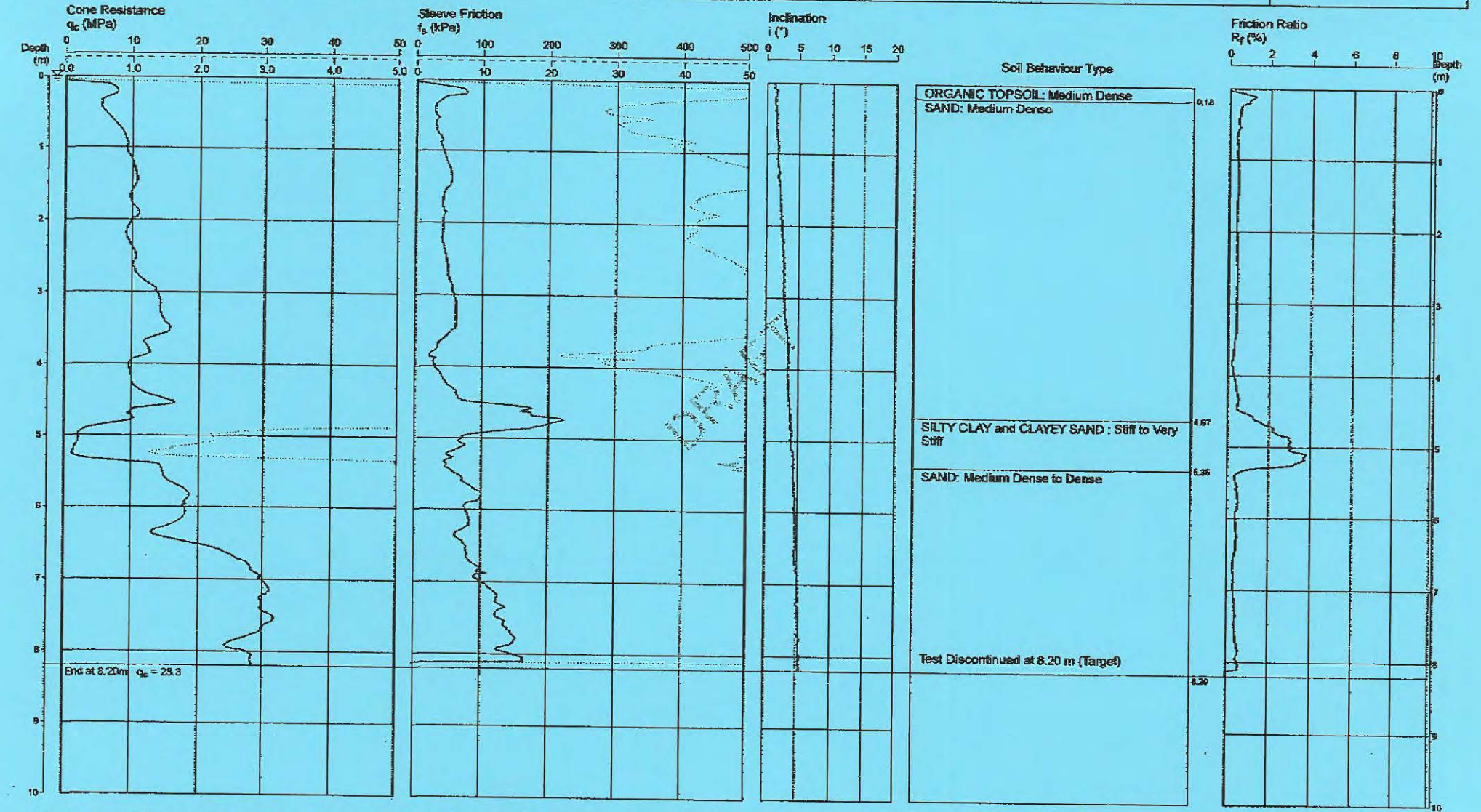
REDUCED LEVEL: 6.6 m AHD

COORDINATES: 391197E 6429865N

CPT 41
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 41.CP5

Cone ID: Probedrill **Type:** EC33

Water depth after test: Dry to 1.6 m

ConePlot Version 5.8.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

2014.12.15 11:40 R & K Baxter 94394708 PAGE 11/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

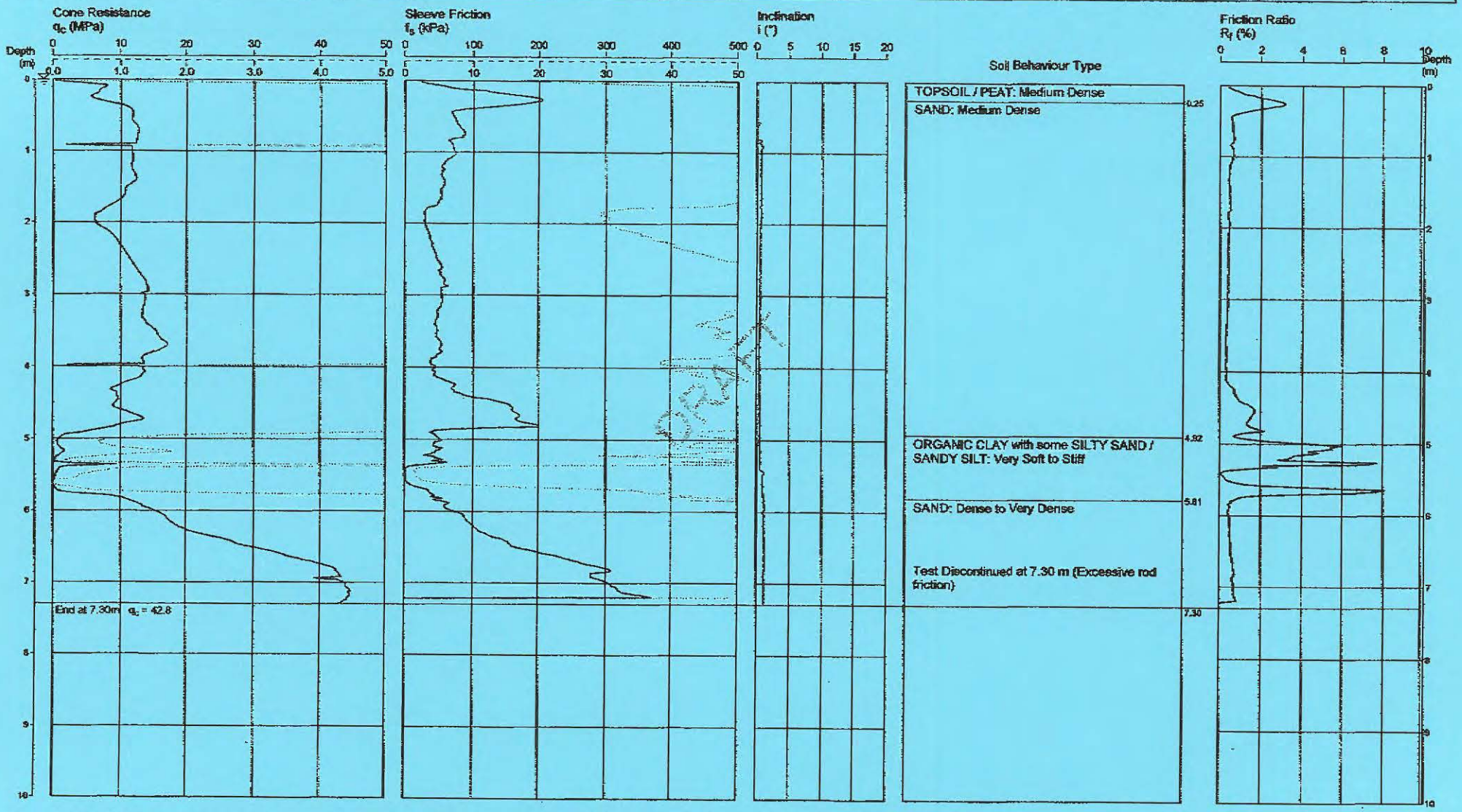
REDUCED LEVEL: 6.0 m AHD*

COORDINATES: 391175 6429729

CPT 5
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

Water depth after test: Dry to 1.2 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 5.CPS
Cone ID: Probedrill **Type:** EC21

ConePlot Version 5.9.1
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:41 R & K Baxter 94394708 PAGE 12/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

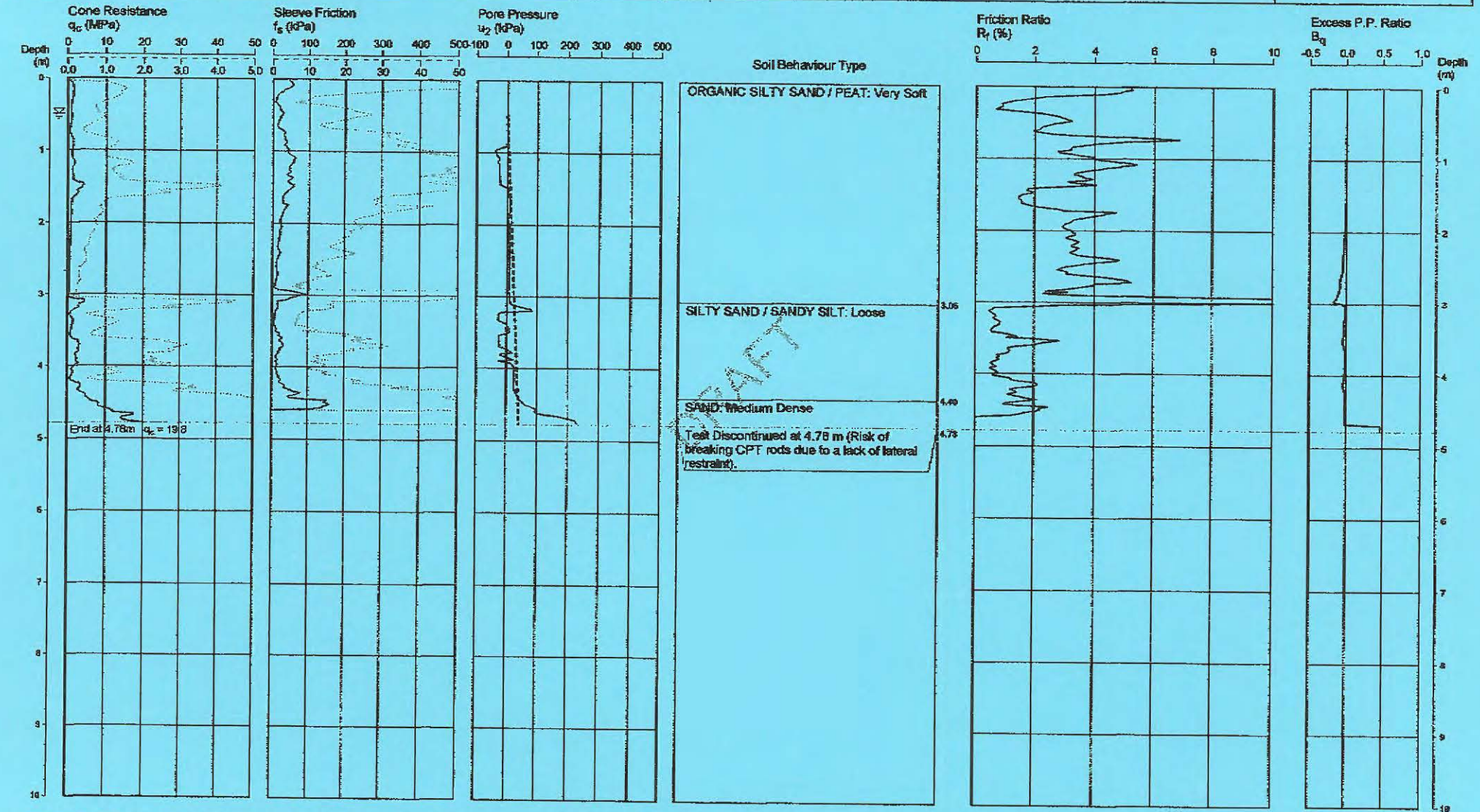
REDUCED LEVEL: 5.0 m AHD*

COORDINATES: 390934 6429743

CPTU 4
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

Water depth after test: 0.5 m

File: P:\82331 Welland, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPTU 4.CP5
Cone ID: Probedrill Type: EC33

ConeRol Version 5.9.1
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:41 R & K Baxter 94394708 PAGE. 13/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

REDUCED LEVEL: 6.5 m AHD*

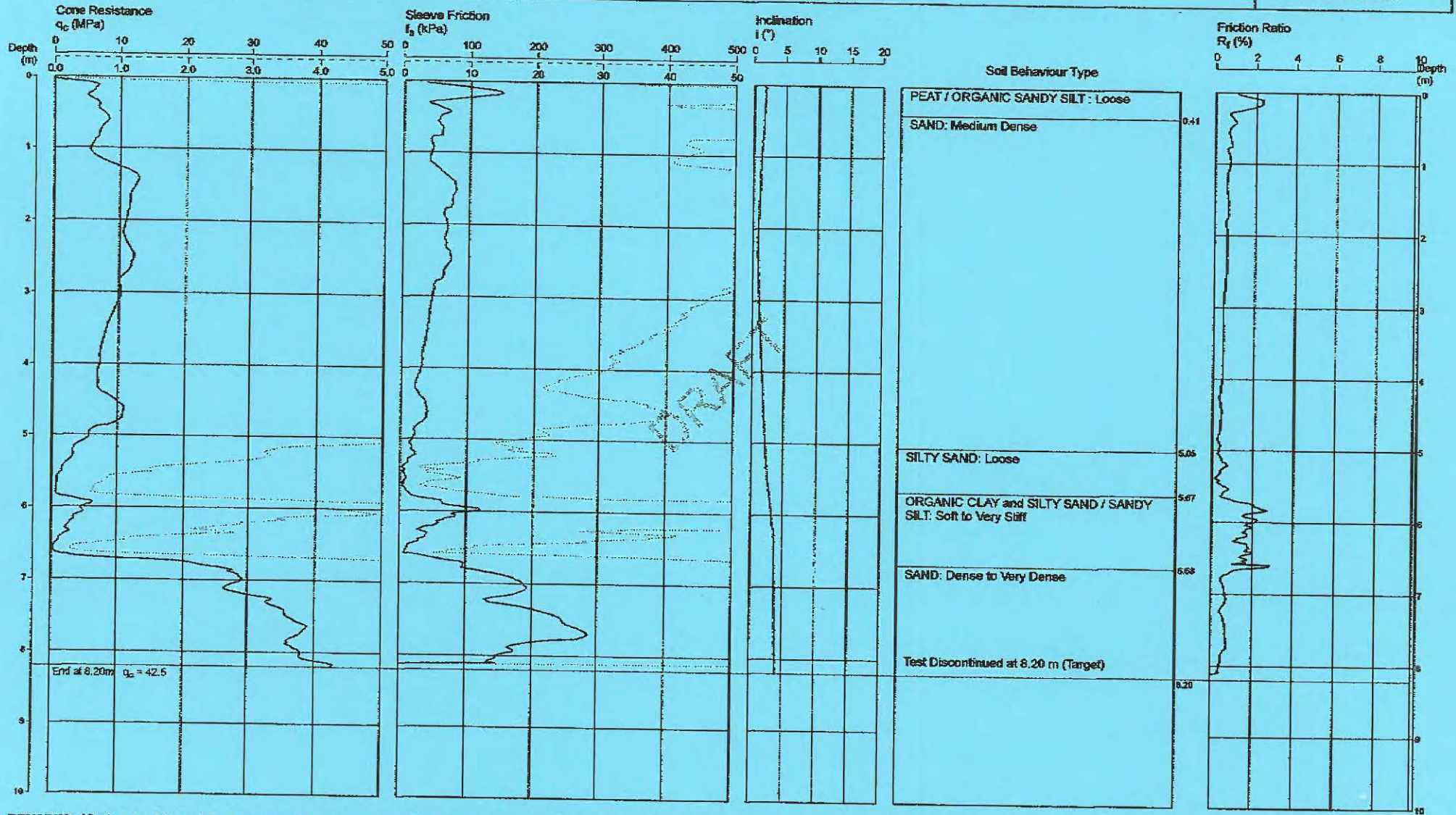
COORDINATES: 391276E 6429714N

CPT 44

Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 44.CP5

Cone ID: Probedrill **Type:** EC33

CorePlot Version 5.9.2

© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

2014.12.15 11:41 R & K Baxter 94394708 PAGE. 14/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

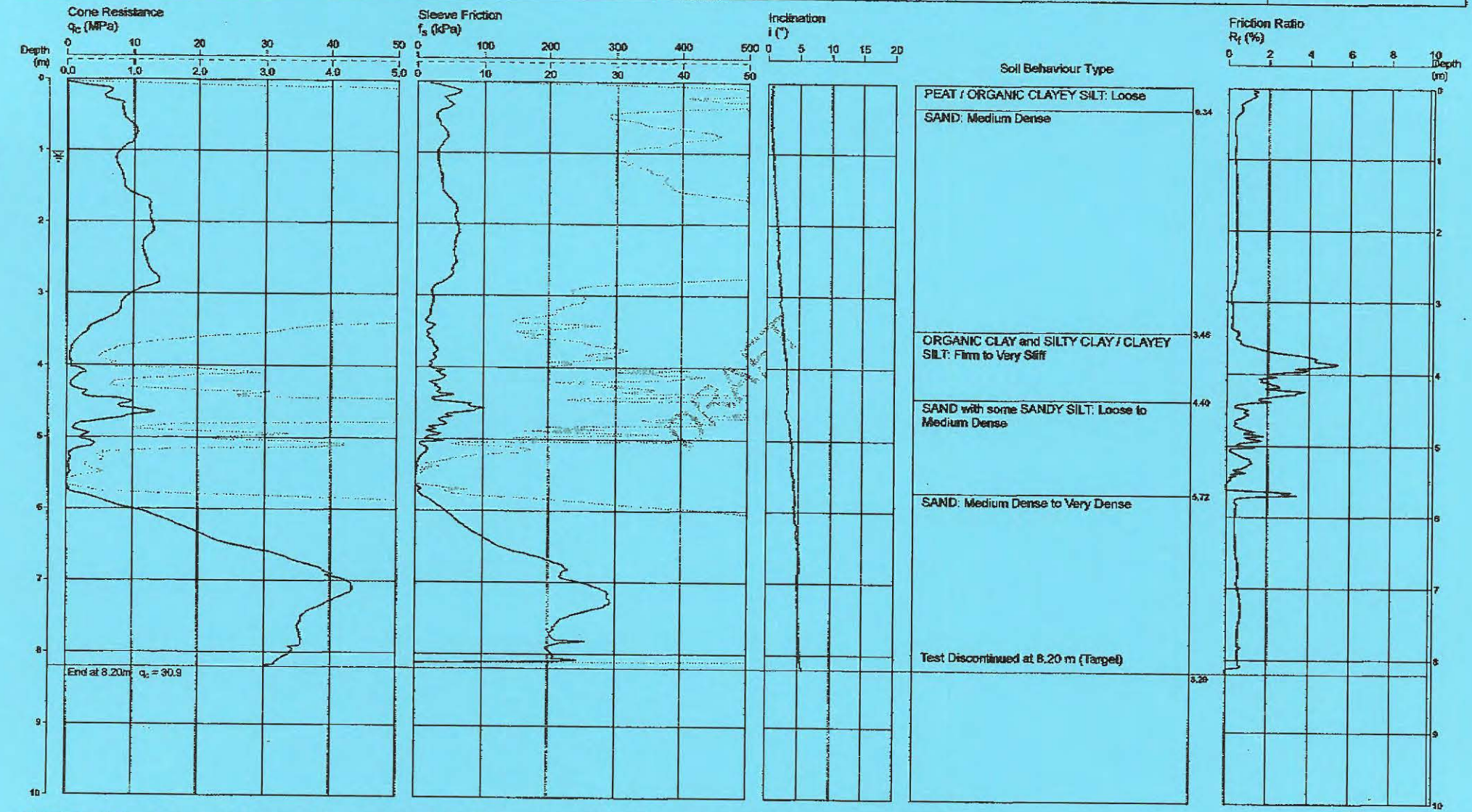
REDUCED LEVEL: 5.6 m AHD*

COORDINATES: 391124E 6429764N

CPT 45
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

Water depth after test: 1.1 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 45.CP5
Cone ID: Probedrill Type: EC33

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:42 R & K Baxter 94394708 PAGE 15/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

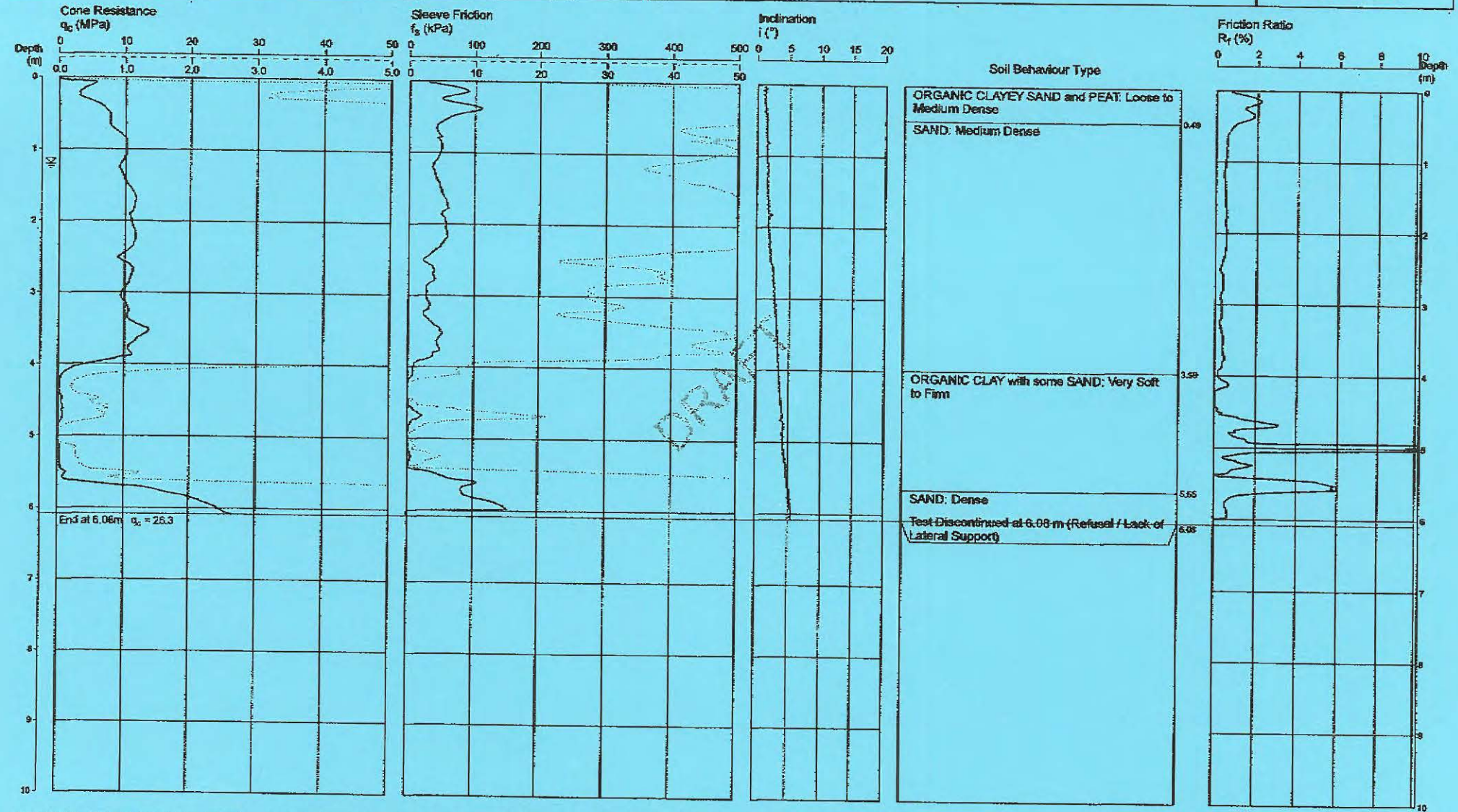
REDUCED LEVEL: 5.7 m AHD

COORDINATES: 391057E 6429684N

CPT 42
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

Water depth after test: 1.2 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 42.CP5
Cone ID: Probedrill Type: EC33

CorePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:42 R & K Baxter 94394708 PAGE. 16/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

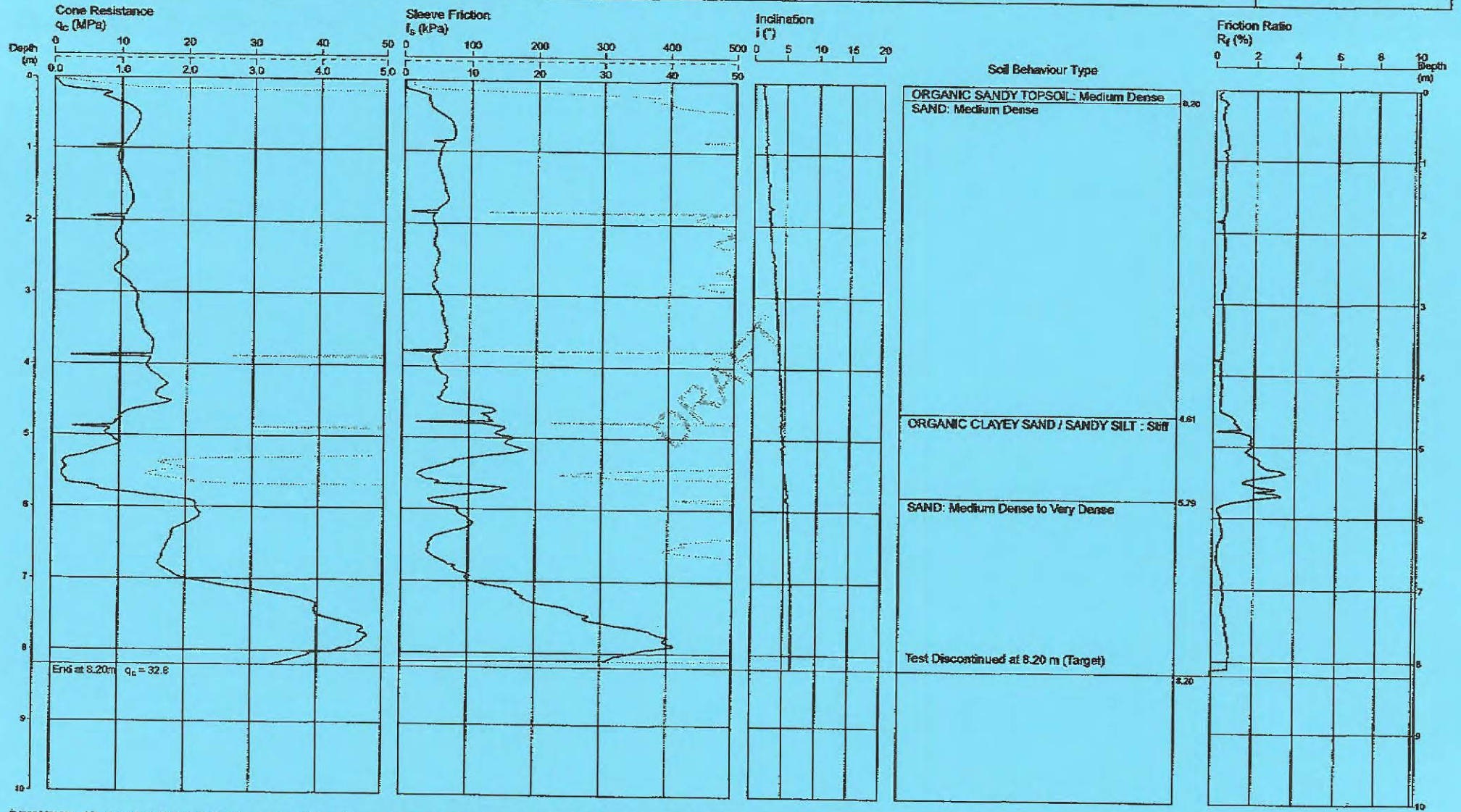
REDUCED LEVEL: 7.0 m AHD*

COORDINATES: 391276E 8429714N

CPT 43
Page 1 of 1

DATE 3/12/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from survey information provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 43.CP5
Cone ID: Probedrill **Type:** EC33

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics ! Environment ! Groundwater

2014.12.15 11:43 R & K Baxter 94394708 PAGE. 17/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

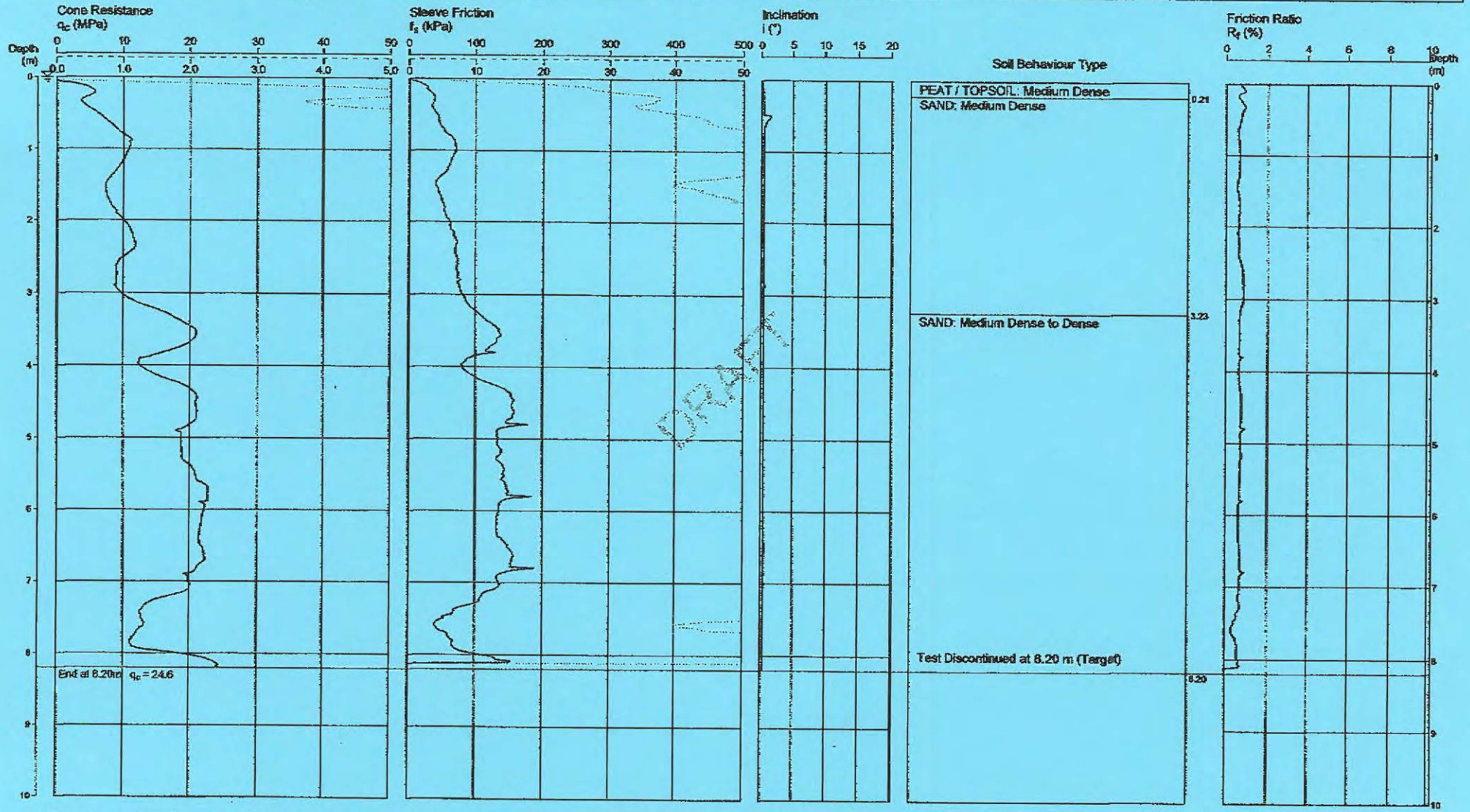
REDUCED LEVEL: 6.8 m AHD*

COORDINATES: 391347 6429928

CPT 7
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

Water depth after test: Dry to 1.2 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 7.CP5
Cone ID: Probedrill **Type:** EC33

CorePlot Version 5.9.1
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:43 R & K Baxter 94394708 PAGE. 18/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

REDUCED LEVEL: 9.2 m AHD*

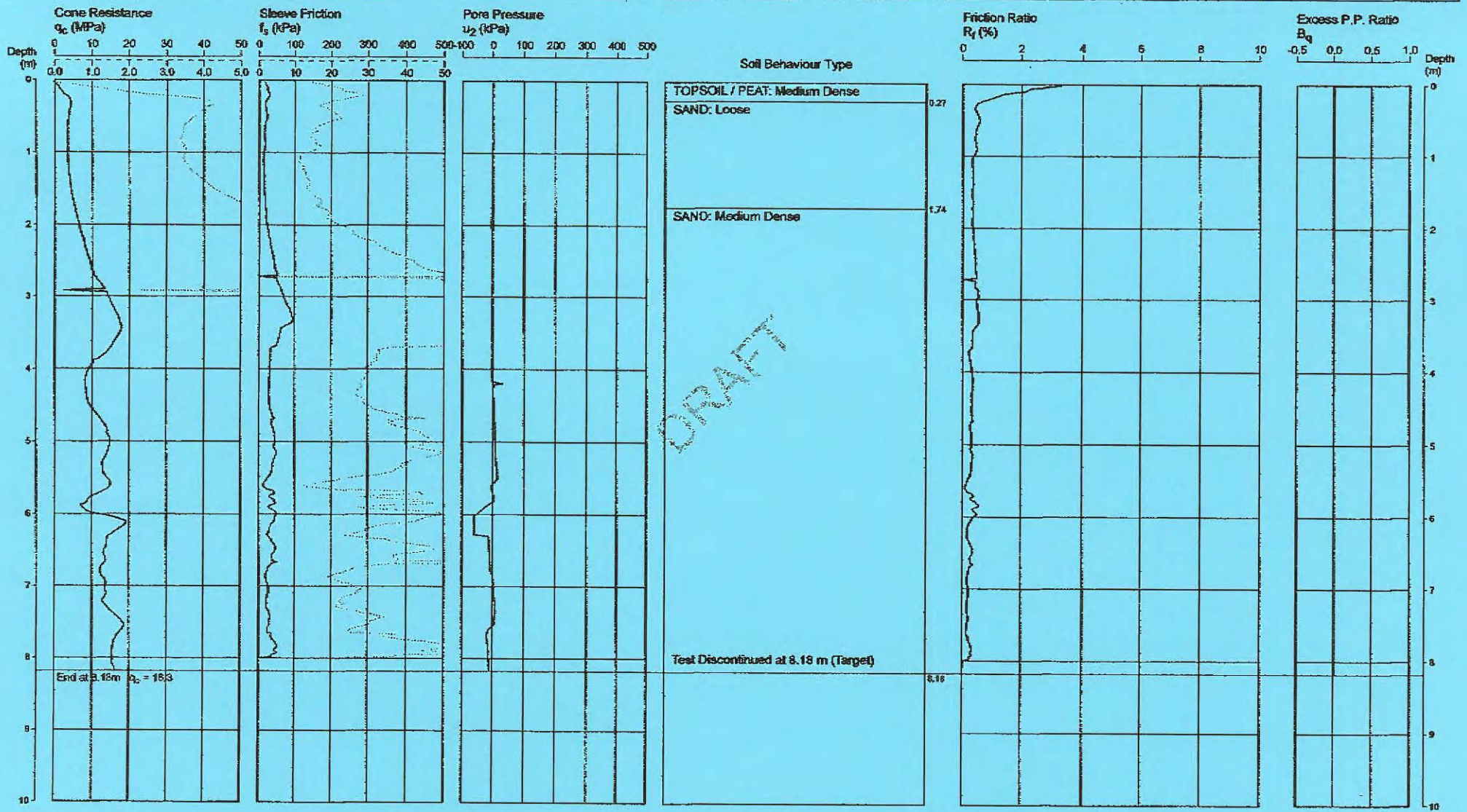
COORDINATES: 391351E 6429795N

CPTU 6

Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPTU 6.CP5
Cone ID: Probedrill **Type:** EC21

ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics | Environment | Groundwater

2014.12.15 11:44 R & K Baxter 94394708 PAGE. 19/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

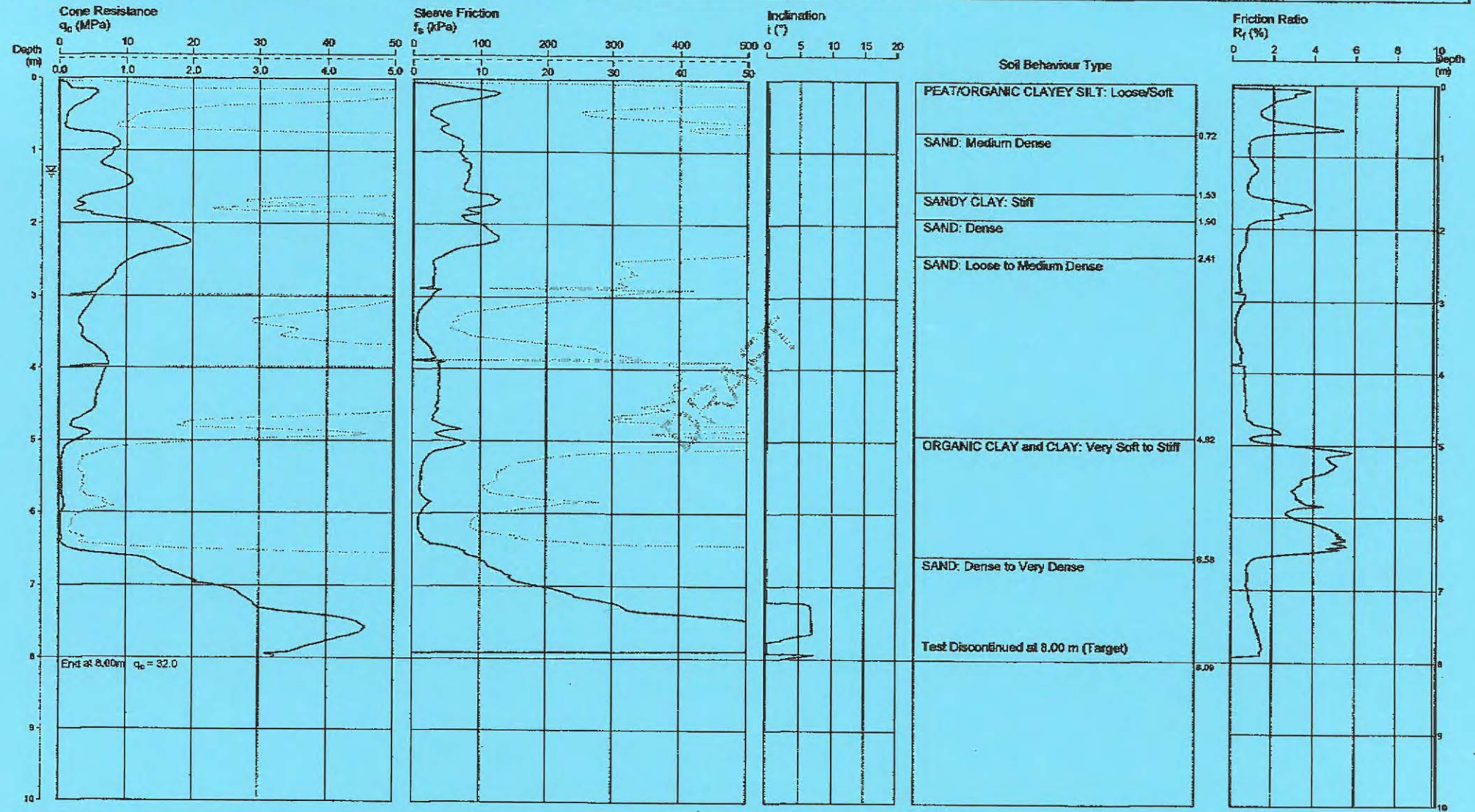
REDUCED LEVEL: 5.3 m AHD*

COORDINATES: 391036 6428743

CPT 3
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

Water depth after test: 1.3 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 3.CP5
Cone ID: Probedrill **Type:** EC33

ConePlot Version 5.9.1
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:44 R & K Baxter 94394708 PAGE. 20/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

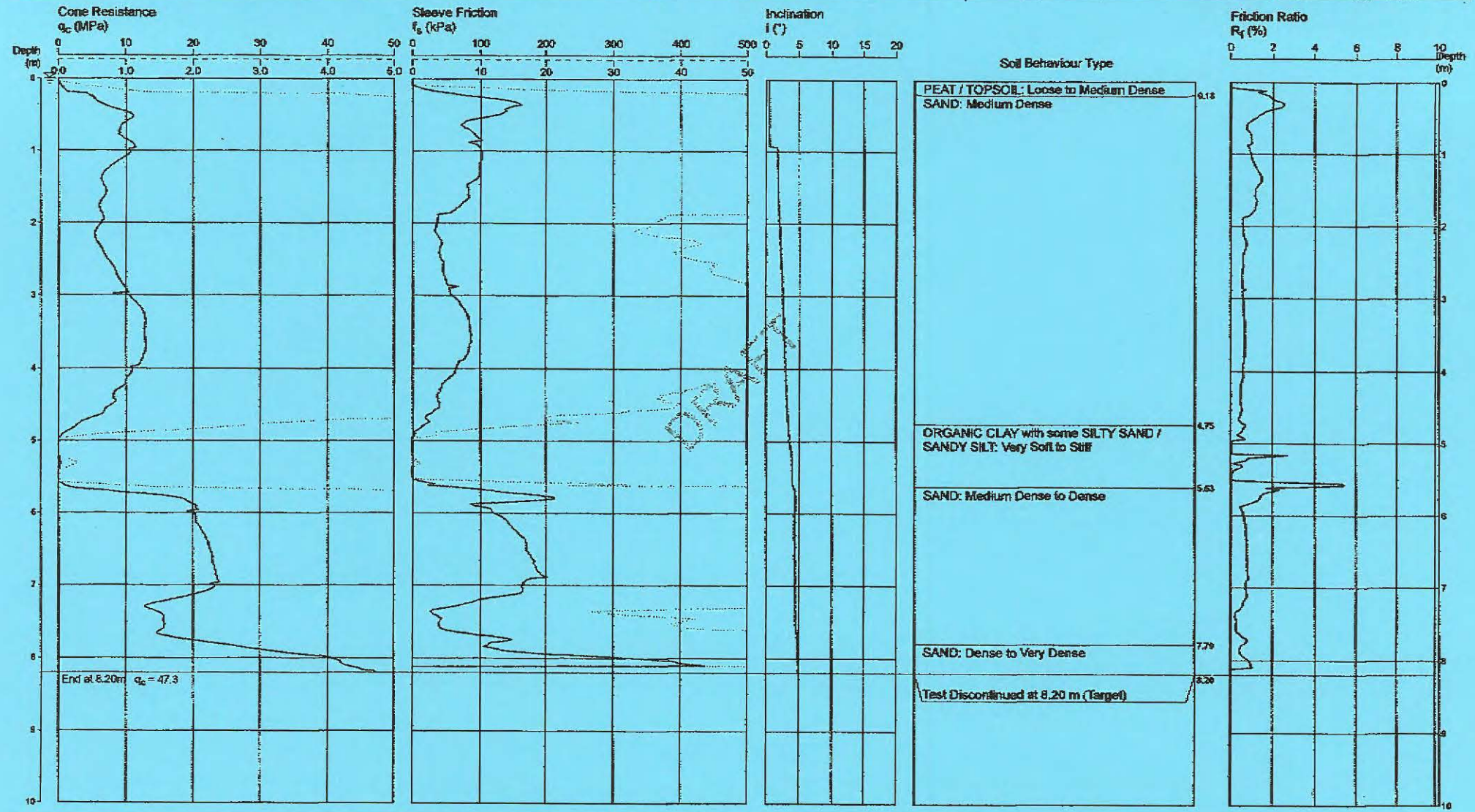
REDUCED LEVEL: 6.4 m AHD*

COORDINATES: 391115E 6429625N

CPT 2
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 2.CPS
Cone ID: Probedrill **Type:** EC33

CorePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Water depth after test: Dry to 1.2 m

Douglas Partners
Geotechnics | Environment | Groundwater

2014.12.15 11:44 R & K Baxter 94394708 PAGE. 21/ 22

CONE PENETRATION TEST

CLIENT: LWP Property Group

PROJECT: Lots 1, 503 to 506 Johnson Road

LOCATION: Wellard, WA

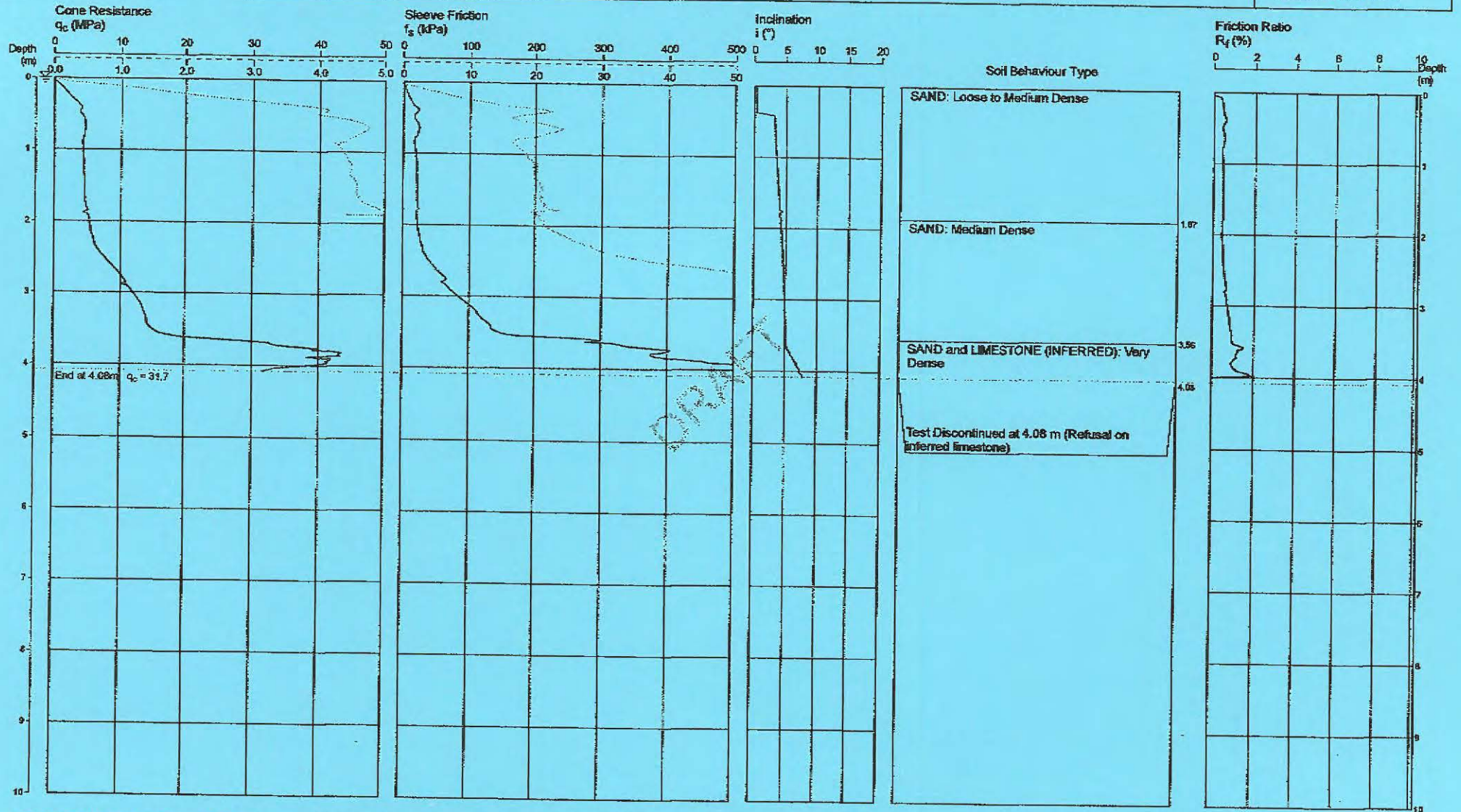
REDUCED LEVEL: 6.8 m AHD*

COORDINATES: 391214E 6429565N

CPT 1
Page 1 of 1

DATE 17/11/2014

PROJECT No: 82331



REMARKS: *Surface level interpolated from a survey plan provided by the client.

Water depth after test: Dry to 3.1 m

File: P:\82331 Wellard, Lots 1, 504-506 Johnson Road\Field\CPT\82331 - CPT 1.CP5
Cone ID: Probedrill Type: EC33

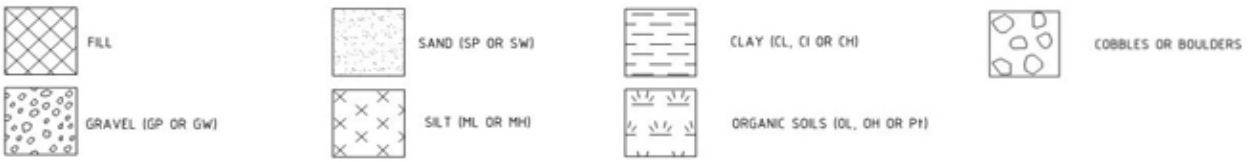
ConePlot Version 5.9.2
© 2003 Douglas Partners Pty Ltd

Douglas Partners
Geotechnics / Environment / Groundwater

2014.12.15 11:45 R & K Baxter 94394708 PAGE. 22/ 22

APPENDIX B:
Test pits logs and penetrometer results

EXPLANATORY NOTES - SOIL DESCRIPTION



Combinations of these basic symboles can be used to indicate mixed materials (eg. Clayey Gravel)

GP	Poorly Graded Gravel	SM	Silty Sand	CH	High Plasticity Clay
GW	Well Graded Gravel	SC	Clayey Sand	OL	Organic Soils (LP)
GM	Silty Gravel	ML	Low Plasticity Silt	OH	Organic Soils (HP)
GC	Clayey Gravel	MH	High Plasticity Silt	PT	Peat
SP	Poorly Graded Sand	CL	Low Plasticity Clay	-	Cobbles and Boulders
SW	Well Graded Sand	CI	Medium Plasticity Clay	Fill	Fill / Made Ground

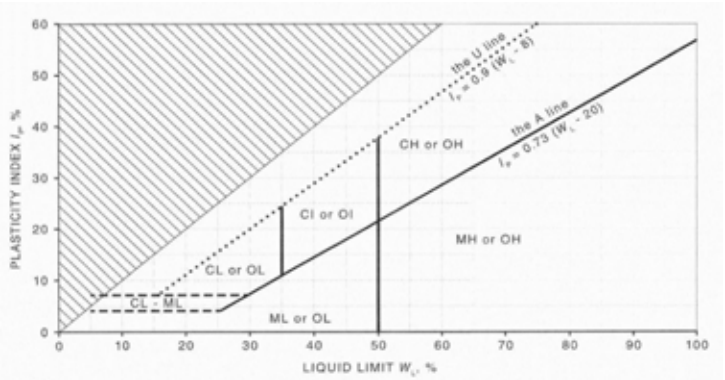
SOIL CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil descriptions are based on AS1726:2017, Section 6.2. Material properties are assessed in the filed by visual/tactile methods in combination with field testing techniques (where used).

PARTICLE SIZE

Soil Name		Particle Size (mm)
BOULDERS		>200
COBBLES		63 to 200
GRAVEL	Coarse	20 to 63
	Medium	6 to 20
	Fine	2 to 6
SAND	Coarse	0.6 to 2.0
	Medium	0.2 to 0.6
	Fine	0.075 to 0.2
FINES	SILT	0.002 to 0.075
	CLAY	<0.002

PLASTICITY PROPERTIES



MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT IN:
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties if primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

RESISTENCE TO EXCAVATION

Symbol	Term	Description
VE	Very easy	All resistences are relative to the selected method of excavation.
E	Easy	
F	Firm	
H	Hard	
VH	Very hard	

MOISTURE CONDITION

Symbol	Term	Description
D	Dry	Sands and gravels are free flowing. Clays and silts may be brittle or friable and powdery
M	Moist	Soils are darker than in the dry condition and may feel cool. Sands and gravels tend to cohere.
W	Wet	Soils exude free water. Sands and gravels tend to cohere.

CONSISTENCY AND DENSITY

Symbol	Term	Undrained Shear Strength (kPa)	SPT "N"	DCP blows per 100mm
VS	Very soft	0 to 12	0 to 2	<1
S	Soft	12 ti 25	2 to 4	<1
F	Firm	25 to 50	4 to 8	1 to 2
St	Stiff	50 to 100	8 to 15	3 to 4
VSt	Very Stiff	100 to 200	15 to 30	5 to 10
H	Hard	>200	>30	>10

Symbol	Term	Density Index (%)	SPT "N"	DCP blows per 100mm	PSP blows per 300mm
VL	Very Loose	<15	0 to 4	<1	0 to 2
L	Loose	15 to 35	4 to 10	1 to 2	2 to 6
MD	Medium Dense	35 to 65	10 to 30	2 to 3	6 to 8
D	Dense	65 to 85	30 to 50	4 to 8	8 to 15
VD	Very Dense	>85	>50	>8	>15

Note: PSP correlations only valid 450mm depth

Consistency and density may also be inferred from excavation performance and material behaviour.

Geotechnical and Geological Consultants

Penetrometer Test Results
AS1289.6.3.2

Project ID: GGC221986

CLIENT: Eastcourt Property Group	**DATE:** 08/07/2022
PROJECT: Providence East Estate	**TESTED BY:** LC
LOCATION: Wellard	**HAMMER MASS:** 9 kg
SOIL TYPE: Topsoil/Sandy Clay	**HAMMER DROP HEIGHT:** 510 mm

Test Location	**TP01**					
Test Depth mm	Blows/100mm					
0-100	SET	SET	SET	SET	SET	SET
100-200	1					
200-300	2					
300-400	2					
400-500	1					
500-600	2					
600-700	2					
700-800	2					
800-900	3					
900-1000	5					

Test Location						
Test Depth mm	Blows/100mm					
0-100	SET	SET	SET	SET	SET	SET
100-200						
200-300						
300-400						
400-500						
500-600						
600-700						
700-800						
800-900						
900-1000						

Test Location						
Test Depth mm	Blows/100mm					
0-100	SET	SET	SET	SET	SET	SET
100-200						
200-300						
300-400						
400-500						
500-600						
600-700						
700-800						
800-900						
900-1000						

Geotechnical and Geological Consultants

Penetrometer Test Results
AS1289.6.3.3

Project ID: GGC221986

CLIENT: Eastcourt Property Group	**DATE:** 08/07/2022
PROJECT: Providence East Estate	**TESTED BY:** LC
LOCATION: Wellard	**HAMMER MASS:** 9 kg
SOIL TYPE: Organic SILT/Sand/Topsoil/Fill	**HAMMER DROP HEIGHT:** 600 mm

Test Location	TP02	TP03	TP04	TP05	TP06	TP07
Test Depth mm	Blows/150mm					
0-150	SET	SET	SET	SET	SET	SET
150-300	4	5	1	1	2	3
300-450	6	8	3	2	3	6
450-600	8	8	4	2	5	7
600-750	8	10	6	3	8	9
750-900	10	10	8	3	9	8
900-1050	10	11	8	3	9	8

Test Location	TP08	TP09	TP10	TP11	TP12	
Test Depth mm	Blows/150mm					
0-150	SET	SET	SET	SET	SET	SET
150-300	4	3	1	1	3	
300-450	8	6	3	3	4	
450-600	10	7	4	5	4	
600-750	9	6	4	5	4	
750-900	6	5	3	6	3	
900-1050	7	5	4	8	4	

Test Location						
Test Depth mm	Blows/150mm					
0-150	SET	SET	SET	SET	SET	SET
150-300						
300-450						
450-600						
600-750						
750-900						
900-1050						

Test Location						
Test Depth mm	Blows/150mm					
0-150	SET	SET	SET	SET	SET	SET
150-300						
300-450						
450-600						
600-750						
750-900						
900-1050						

TEST PIT NUMBER: TP01

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **390999**
NORTHING (m): **6429728**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.5 m**
EXCAVATION WIDTH: **1 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered		0.0				TOPSOIL: SILT: Low plasticity, black mottled dark grey; with Sand, fine to coarse grained, subangular to subrounded.			0.00: Roots and rootlets between 0.0 to 0.3 m depth up to 2 mm diameter.
			0.30m					0.20m Sandy CLAY: high plasticity, firm, black mottled dark grey; Sand, fine to coarse grained, subangular to subrounded.			
			B	0.5							
			1.00m	1.0				... 1.1 m becoming yellow mottled brown	M		
			1.60m	1.5				1.60m CLAY: medium to high plasticity, firm to stiff, yellow brown mottled grey orange; trace to with sand, fine to coarse grained, subangular to subrounded.			
			B	2.0							
			2.50m	2.5				2.50m Hole Terminated at 2.50 m Target depth			
				3.0							
				3.5							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP02

PAGE: 1 OF 1

PROJECT NUMBER: **GGC221986**

PROJECT NAME: **Geotechnical Investigation**

PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**

ELEVATION (mAHD):

EASTING (m): **391113**

NORTHING (m): **6429744**

EQUIPMENT: **8t Backhoe**

EXCAVATION LENGTH: **2.5 m**

EXCAVATION WIDTH: **1 m**

EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**

DATE COMPLETED: **8/07/2022**

LOGGED BY: **LC**

CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			B 0.40m	0.0				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded.			0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 2 mm diameter.
			0.80m	0.5				SAND: fine to coarse grained, subangular to subrounded, pale grey orange mottled.	M		
			B 1.40m	1.0							
		08/07/22		1.5				... 1.6 m - 1.8 m layer of Sand, fine to coarse grained, subangular to subrounded, brown.	W		1.60: Observed Water seeping through side walls.
				2.0				Hole Terminated at 2.10 m Collapse			
				2.5							
				3.0							
				3.5							

METHOD

- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT

- T Timbering

PENETRATION

VE E F H VH — No Resistance

WATER

- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION

Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP03

PAGE: 1 OF 1

PROJECT NUMBER: **GGC221986**

PROJECT NAME: **Geotechnical Investigation**

PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**

ELEVATION (mAHD):

EASTING (m): **391054**

NORTHING (m): **6429667**

EQUIPMENT: **8t Backhoe**

EXCAVATION LENGTH: **2.2 m**

EXCAVATION WIDTH: **0.8 m**

EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**

DATE COMPLETED: **8/07/2022**

LOGGED BY: **LC**

CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			B 0.40m	0.0				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded; trace Clay, low plasticity.			0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 2 mm diameter.
			0.70m	0.5				0.40m SAND: fine to coarse grained, subangular to subrounded, pale grey mottled white.	M		
		08/07/22	B 1.50m	1.0 1.5							1.70: Observed Water seeping through side walls at 1.7 m.
				2.0 2.5 3.0 3.5				1.90m Hole Terminated at 1.90 m Collapse	W		

METHOD

- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT

- T Timbering

PENETRATION

VE E F H VH — No Resistance

WATER

- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION

Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP04

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391262**
NORTHING (m): **6429813**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.1 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			B 0.40m	0.0				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded. 0.40m			0.0 - 0.2 m: Abundance of roots and root fibres up to 5 mm diameter. 0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 15 mm diameter.
			0.60m	0.5				SAND: fine to coarse grained, subangular to subrounded, pale grey mottled white.			0.2 - 0.4 m: Occasional root fibres up to 2 mm diameter.
			B	1.0					M		
		08/07/22	1.50m	1.5				1.90m			1.60: Observed Water seeping through side walls at 1.6 m
				2.0				Hole Terminated at 1.90 m Collapse			
				2.5							
				3.0							
				3.5							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP05

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391350**
NORTHING (m): **6429833**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.1 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION							MATERIAL					
VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered	0.70m	0.0				FILL: SAND; fine to coarse grained, subangular to subrounded, grey mottled orange, dark grey; trace non plastic fines.	D		0.00: Abundance of roots, rootlets between 0 - 600 mm depth up tp 40 mm diameter.
			B	0.5				0.70m SAND: fine to coarse grained, subangular to subrounded, pale grey mottled white.	M		
			1.60m	1.0 1.5				1.60m Hole Terminated at 1.60 m Collapse			
				2.0 2.5 3.0 3.5							

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP06

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391320**
NORTHING (m): **6429748**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.2 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION						MATERIAL					
VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered	0.30m	0.0				FILL: SAND; fine to coarse grained, subangular to subrounded, dark grey orange mottled.	D		0.00: Abundance of roots and rootlets between 0 - 400 mm depth up to 10 mm diameter. 0.30: Observed plastic bags between 0.3 - 0.5 m depth. 0.40: Occassional rootlets between 400 mm - 1000 mm depth up to 2 mm diameter.
			B	0.5					M		0.60: Observed a PVC pipe at 0.6 m depth. 1.30: Observed wooden pieces at 1.3 m depth. 1.50: Observed a sack (filled with unknown material).
			1.20m	1.0							
				1.5				1.60m Hole Terminated at 1.60 m Collapse			1.60: Potentially natural layer is starting after 1.6 m.
				2.0							
				2.5							
				3.0							
				3.5							

METHOD
N Natural Exposure
X Existing Excavation
BH Backhoe Bucket
B Bulldozer Blade
R Ripper

SUPPORT
T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
10 Oct., 73 Water Level on Date shown
water outflow
water inflow

SAMPLES & FIELD TESTS
U - Undisturbed Sample
D - Disturbed Sample
B - Bulk Disturbed Sample
MC - Moisture Content
HP - Hand Penetrometer (UCS kPa)
VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
D - Dry
M - Moist
W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP07

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391228**
NORTHING (m): **6429724**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.3 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

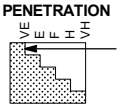
EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			B 0.40m	0.0				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded.			0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 2 mm diameter.
				0.5				0.40m SAND: fine to coarse grained, subangular to subrounded, orange mottled brown.			
			0.80m					... 0.7 m becoming pale grey.			
			B 1.50m	1.0					M		
		08/07/22		1.5							
				2.0							2.00: Observed Water seeping through side walls at 2.0 m
								2.30m Hole Terminated at 2.30 m Collapse			
				2.5							
				3.0							
				3.5							

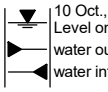
METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION



WATER



SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP08

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391164**
NORTHING (m): **6429702**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.2 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

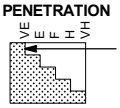
DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION						MATERIAL					
VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered	B 0.40m	0.0				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded.	M		0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 2 mm diameter.
			0.80m	0.5				0.40m SAND: fine to coarse grained, subangular to subrounded, pale grey brown.			
			B 1.50m	1.0 1.5							
				2.0 2.5 3.0 3.5				1.80m Hole Terminated at 1.80 m Collapse			

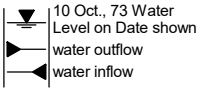
METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION



WATER



SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP09

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391126**
NORTHING (m): **6429616**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.3 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
			B 0.50m	0.0 0.5				Organic SILT: low plasticity, black mottled dark grey; trace Sand, fine to coarse grained, subangular to subrounded.			0.00: Roots and rootlets between 0.0 to 0.4 m depth up to 2 mm diameter.
			0.80m B	1.0				0.60m SAND: fine to coarse grained, subangular to subrounded, pale grey mottled white.	M		
		08/07/22	1.60m	1.5 2.0				... 1.7 m becoming orange brown mottled. 2.20m			2.10: Observed Water seeping through side walls at 2.1 m
				2.5 3.0 3.5				Hole Terminated at 2.20 m Collapse			

METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION
VE E F H VH — No Resistance

WATER
- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-04 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP10

PAGE: 1 OF 1

PROJECT NUMBER: **GGC221986**

PROJECT NAME: **Geotechnical Investigation**

PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**

ELEVATION (mAHD):

EASTING (m): **391200**

NORTHING (m): **6429580**

EQUIPMENT: **8t Backhoe**

EXCAVATION LENGTH: **2.2 m**

EXCAVATION WIDTH: **0.8 m**

EXCAVATION ORIENTATION: **-**

DATE STARTED: **8/07/2022**

DATE COMPLETED: **8/07/2022**

LOGGED BY: **LC**

CHECKED BY: **JC**

EXCAVATION | MATERIAL

VE / PENETRATION / F / H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered		0.0				TOPSOIL: SAND: fine to coarse grained, subangular to subrounded, dark grey black.	D		0.00: Abundance of roots and rootlets between 0 - 300 mm depth up to 50 mm diameter.
				0.20m				SAND: fine to coarse grained, subangular to subroubnded, pale grey yellow to pale grey.			
			0.40m B	0.5					M		
				1.0							
				1.5							
			1.70m					1.70m			
								Hole Terminated at 1.70 m Collapse			
				2.0							
				2.5							
				3.0							
				3.5							

METHOD

- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT

- T Timbering

PENETRATION

VE E F H VH — No Resistance

WATER

- 10 Oct., 73 Water Level on Date shown
- water outflow
- water inflow

SAMPLES & FIELD TESTS

- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION

Based on Unified Classification System

MOISTURE

- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP11

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391219**
NORTHING (m): **6429642**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.2 m**
EXCAVATION WIDTH: **0.9 m**
EXCAVATION ORIENTATION: **-**

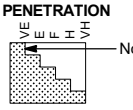
DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION						MATERIAL					
VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered	B 0.40m	0.0				TOPSOIL: SAND: fine to coarse grained, subangular to subrounded, dark grey black.	M		0.00: Abundance of roots and rootlets between 0 - 300 mm depth up to 10 mm diameter.
			0.60m	0.5				0.40m SAND: fine to coarse grained, subangular to subroubnded, pale grey yellow to pale grey.			
			B 1.50m	1.0 1.5				1.80m Hole Terminated at 1.80 m Collapse			1.30: Side wall collapsing between 1.3 m to 1.5 m, unable to further excavate.
				2.0 2.5 3.0 3.5							

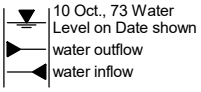
METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION



WATER



SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

TEST PIT NUMBER: TP12

PROJECT NUMBER: **GGC221986**
PROJECT NAME: **Geotechnical Investigation**
PROJECT LOCATION: **Providence East Estate**

Geotechnical and Geological Consultants

DATUM: **MGA94 Zone 50**
ELEVATION (mAHD):
EASTING (m): **391295**
NORTHING (m): **6429686**

EQUIPMENT: **8t Backhoe**
EXCAVATION LENGTH: **2.3 m**
EXCAVATION WIDTH: **1.3 m**
EXCAVATION ORIENTATION: **-**

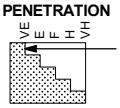
DATE STARTED: **8/07/2022**
DATE COMPLETED: **8/07/2022**
LOGGED BY: **LC**
CHECKED BY: **JC**

EXCAVATION						MATERIAL					
VE E PENETRATION F H	SUPPORT	GROUND WATER LEVELS	SAMPLES & FIELD TESTS	DEPTH (m)	Elevation (m AHD)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION Soil Name, Plasticity or Particle Characteristic, Colour, Secondary Soil Components, Minor Components and Origin	MOISTURE CONDITION	CONSISTENCY RELATIVE DENSITY	STRUCTURE & Other Observations
		Not Encountered	0.40m	0.0				TOPSOIL: SAND: fine to coarse grained, subangular to subrounded, dark grey black; trace non plastic fines.			0.00: Roots and rootlets between 0 - 200 mm depth up to 2 mm diameter.
				0.4				0.40m			
			B	0.5				SAND: fine to coarse grained, subangular to subroubnded, pale grey to pale grey.	M		0.80: Side wall collapsing between 0.8 m to 1.4 m, unable to further excavate.
			1.40m	1.0				1.40m			
				1.5				Hole Terminated at 1.40 m Collapse			
				2.0							
				2.5							
				3.0							
				3.5							

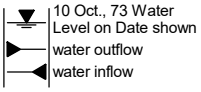
METHOD
- N Natural Exposure
- X Existing Excavation
- BH Backhoe Bucket
- B Bulldozer Blade
- R Ripper

SUPPORT
- T Timbering

PENETRATION



WATER



SAMPLES & FIELD TESTS
- U - Undisturbed Sample
- D - Disturbed Sample
- B - Bulk Disturbed Sample
- MC - Moisture Content
- HP - Hand Penetrometer (UCS kPa)
- VS - Vane Shear; P-Peak, R-Remouded (uncorrected kPa)
- ES - Environmental Sample

CLASSIFICATION SYMBOLS & SOIL DESCRIPTION
Based on Unified Classification System

MOISTURE
- D - Dry
- M - Moist
- W - Wet

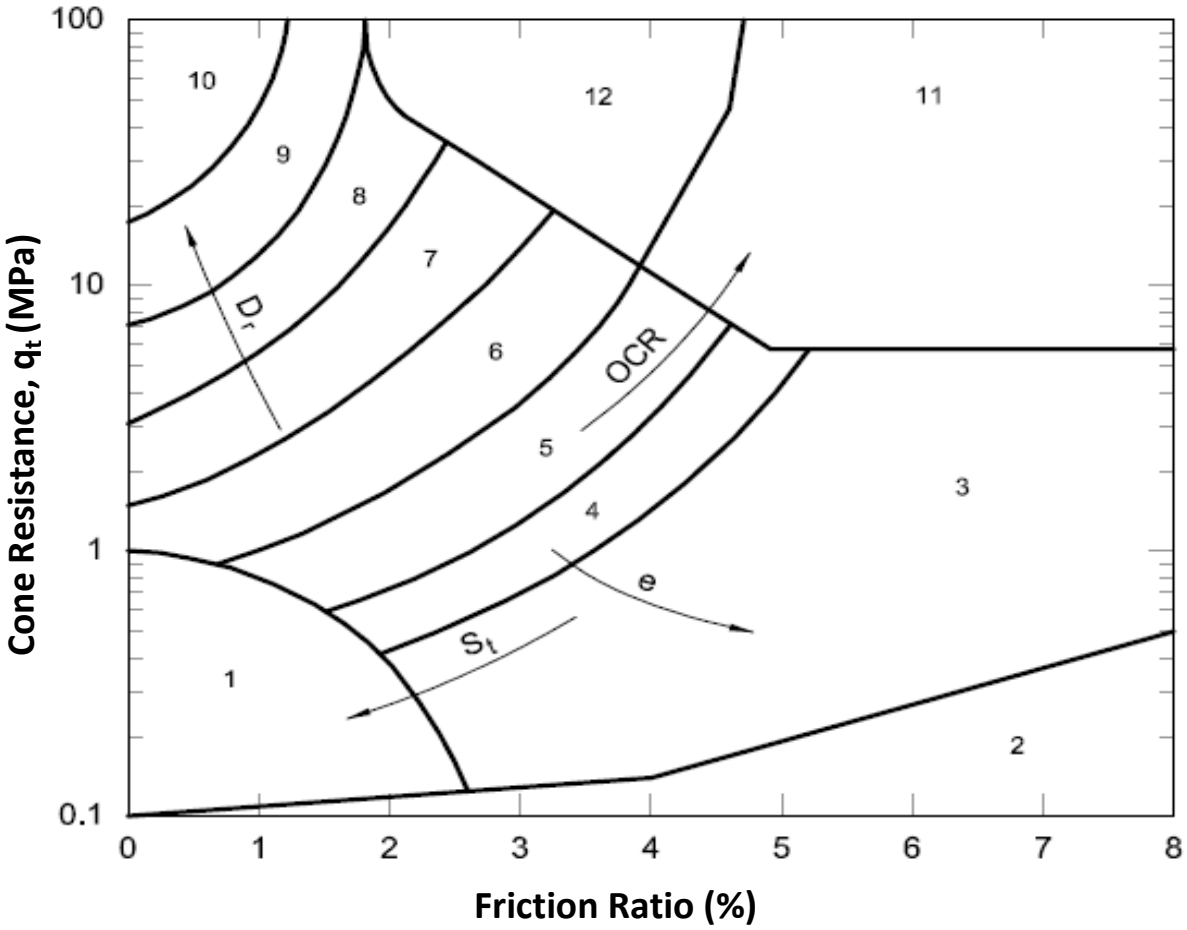
CONSISTENCY/ RELATIVE DENSITY

VS	- Very Soft
S	- Soft
F	- Firm
St	- Stiff
VSt	- Very Stiff
H	- Hard
Fr	- Friable
VL	- Very Loose
L	- Loose
MD	- Medium Dense
D	- Dense
VD	- Very Dense

See Explanatory Notes for details of abbreviations & basis of descriptions.

GGC 2.00.3 LIB BETA PU IMPORT.GLB Log GGC TEST PIT GGC221986 TP LOGS.GPJ <<DrawingFile>> 24/09/2022 15:44 10.02.00.04 Datgel Lab and In Situ Tool - DGD | Lib: GGC 2.00.2 2020-05-08 Prj: JDSI 1.00 2015-12-09

APPENDIX C:
CPT results



DEFINITIONS

q_t : Cone tip resistance corrected for pore water pressure

S_t : Sensitivity

e : Void ratio

D_r : Relative density

OCR : Overconsolidation ratio

SOIL BEHAVIOUR TYPES

1. Sensitive fine grained
2. Organic material
3. Clay
4. Silty clay to clay
5. Clayey silt to silty clay
6. Sandy silt to clayey silt
7. Silty sand to sandy silt
8. Sand to silty sand
9. Sand
10. Gravelly sand to sand
11. Very stiff fine grained material (OC/cemented)
12. Sand to clayey sand (OC/cemented)

IMPORTANT NOTES

i. *The above chart is intended for natural soils only and is not directly applicable to FILL materials.*

ii. *Some overlap in soil zones should be expected. Soil types may be confirmed visually.*

iii. *Correlations based on local experience should be used where available and may indicate differing boundaries to those shown in the chart.*

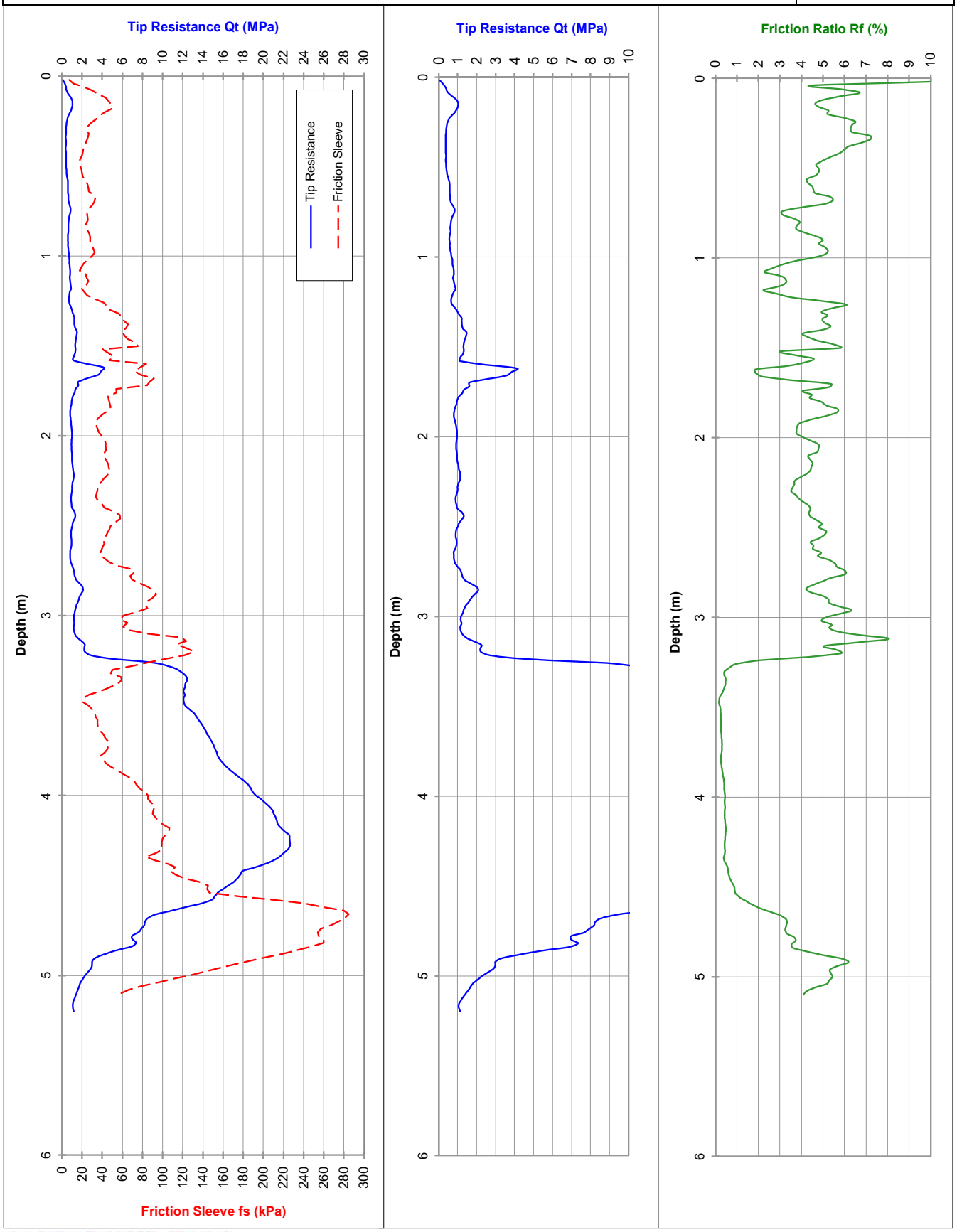
Reference: Robertson, P.K., Campanella, R.G., Gillespie, D. and Grieg, J. (1986) "Use of Piezometer Cone Data". Proceedings of the ASCE Speciality Conference In Situ '86: Use of In Situ Tests in Geotechnical Engineering, Blacksburg, pp 1263-80, American Society of Civil Engineers (ASCE)

GGC
Geotechnical and Geological Consultants

CONE PENETRATION TESTING SOIL TYPE INTERPRETATION

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 01**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.8

Dummy probe to (m):

Refusal:

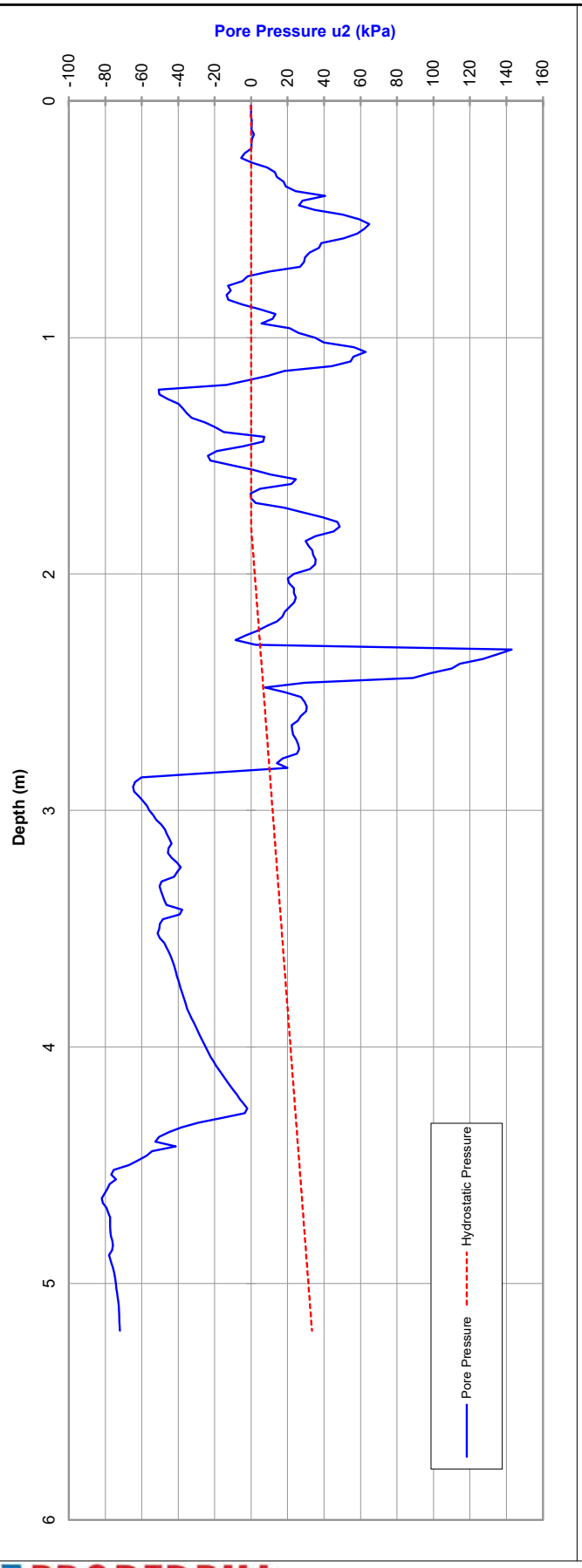
Cone I.D.: EC28

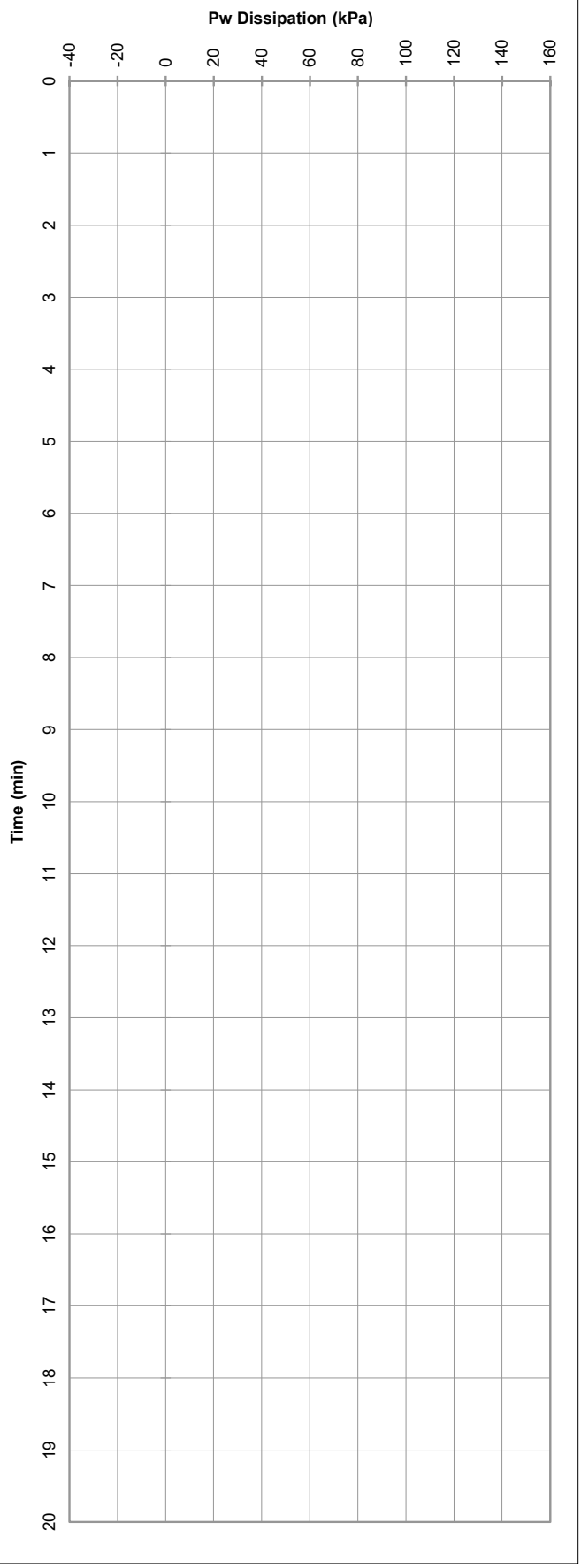
File: GG0047T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 01**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

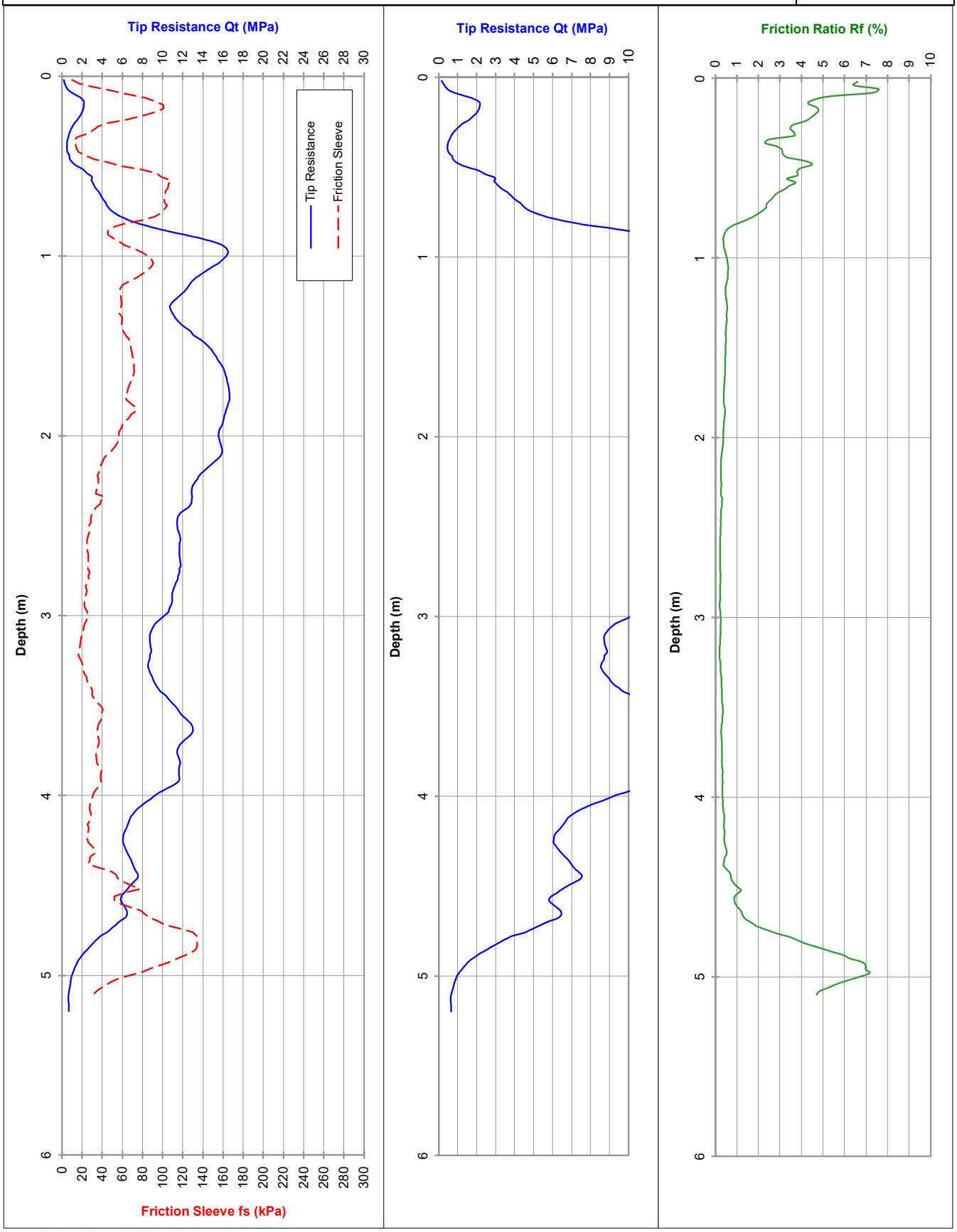
Approx. Water (m): 1.8

File: GG0047T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 02**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.65

Dummy probe to (m):

Refusal:

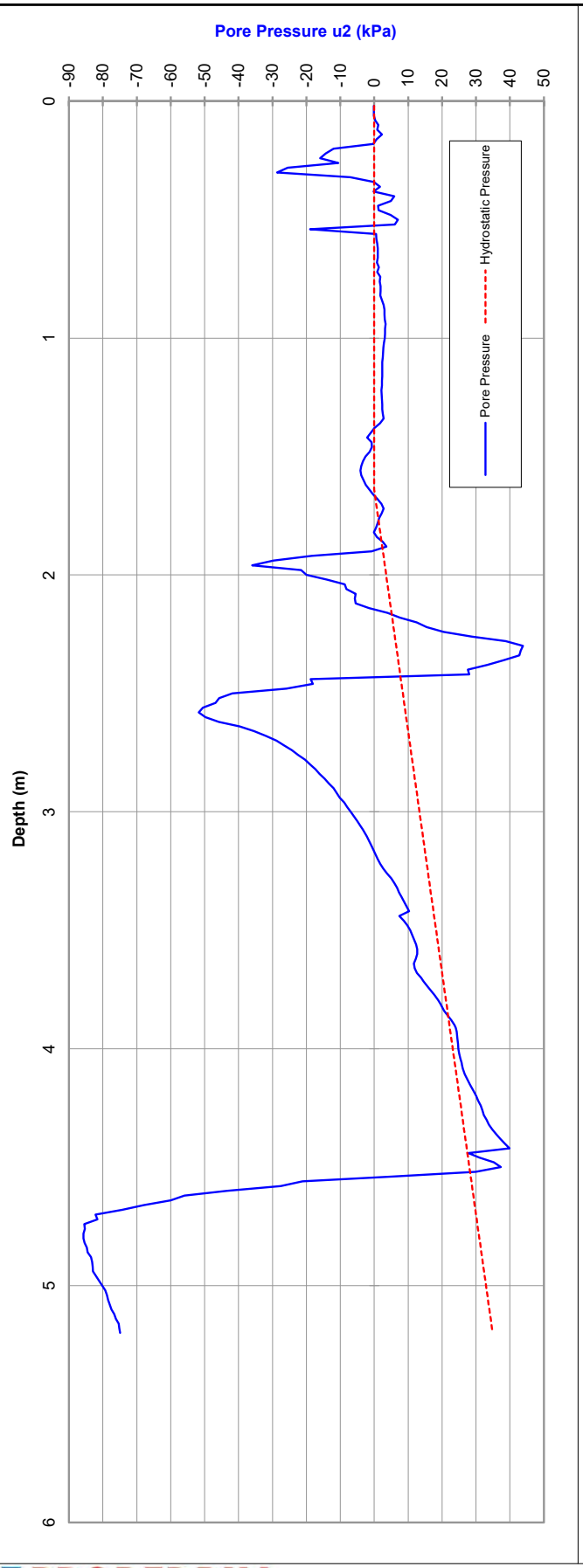
Cone I.D.: EC28

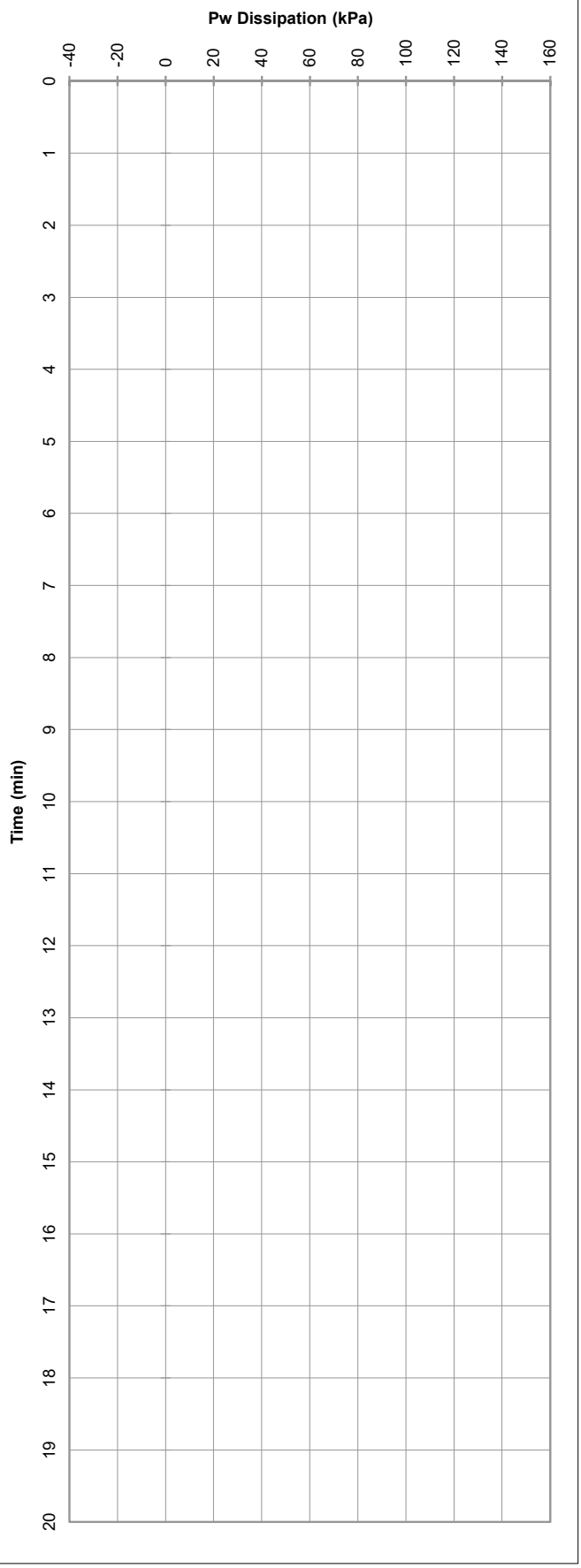
File: GG0048T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 02**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

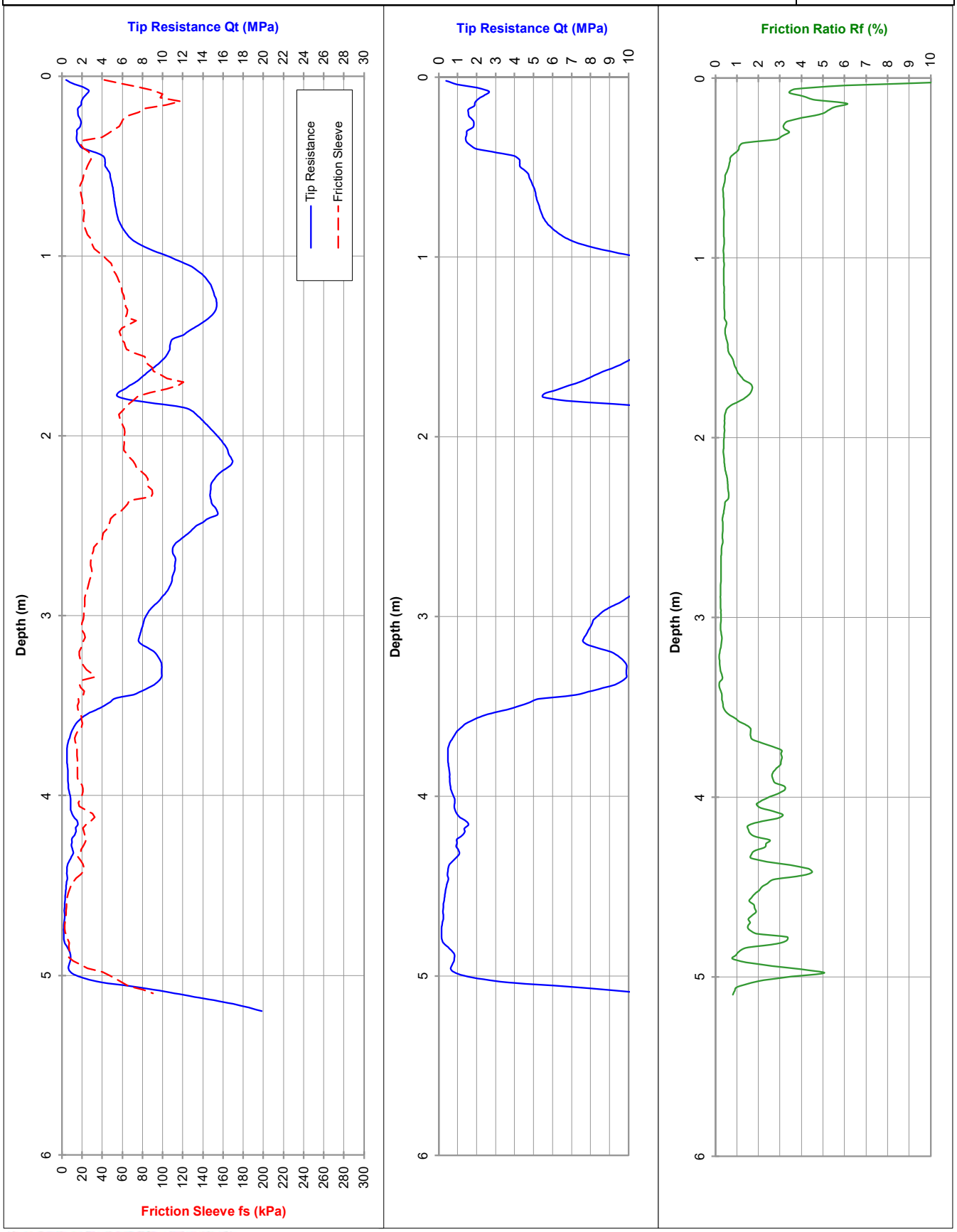
Approx. Water (m): 1.65

File: GG0048T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 03**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.8

Dummy probe to (m):

Refusal:

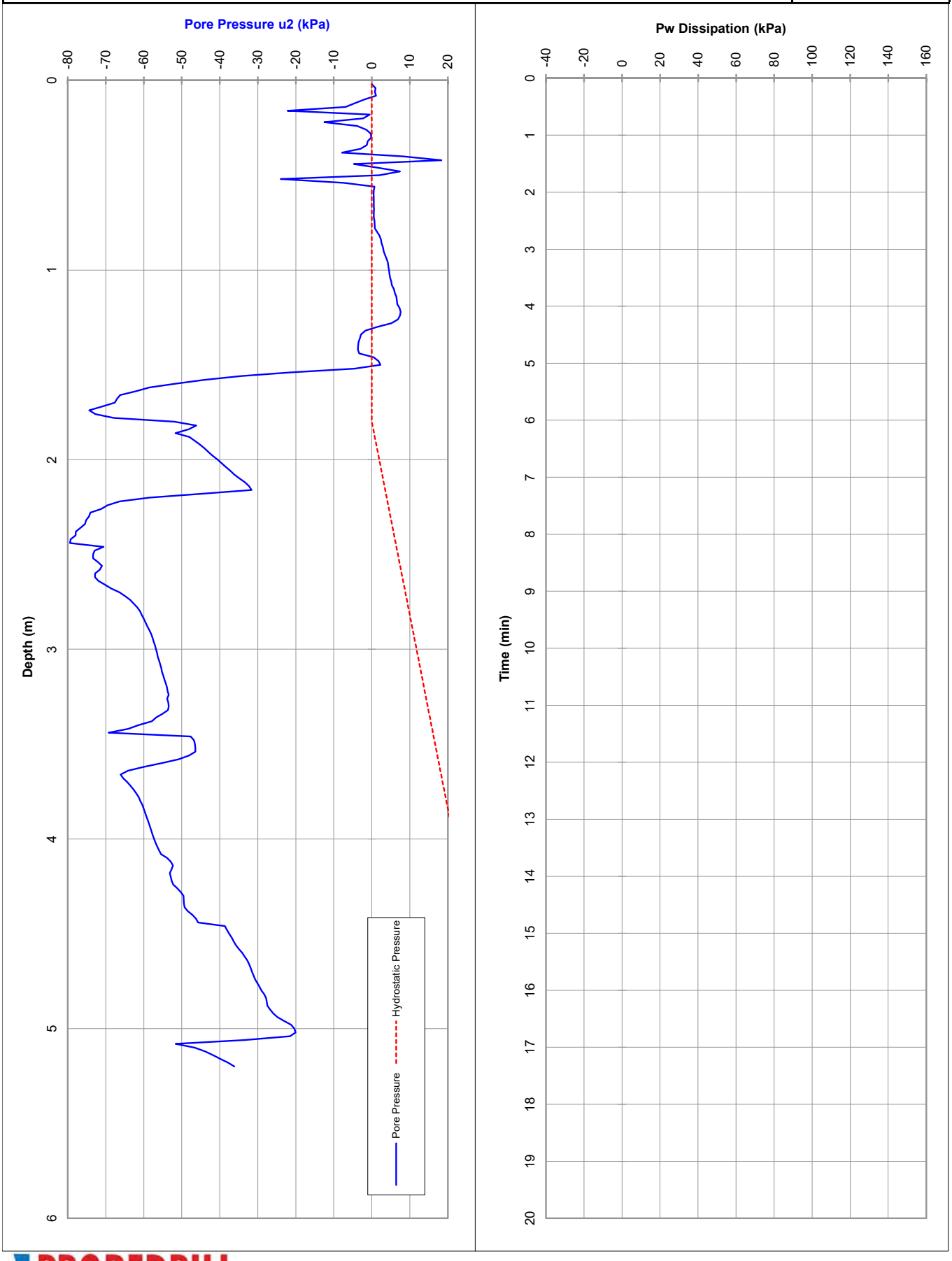
Cone I.D.: EC28

File: GG0049T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 03**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

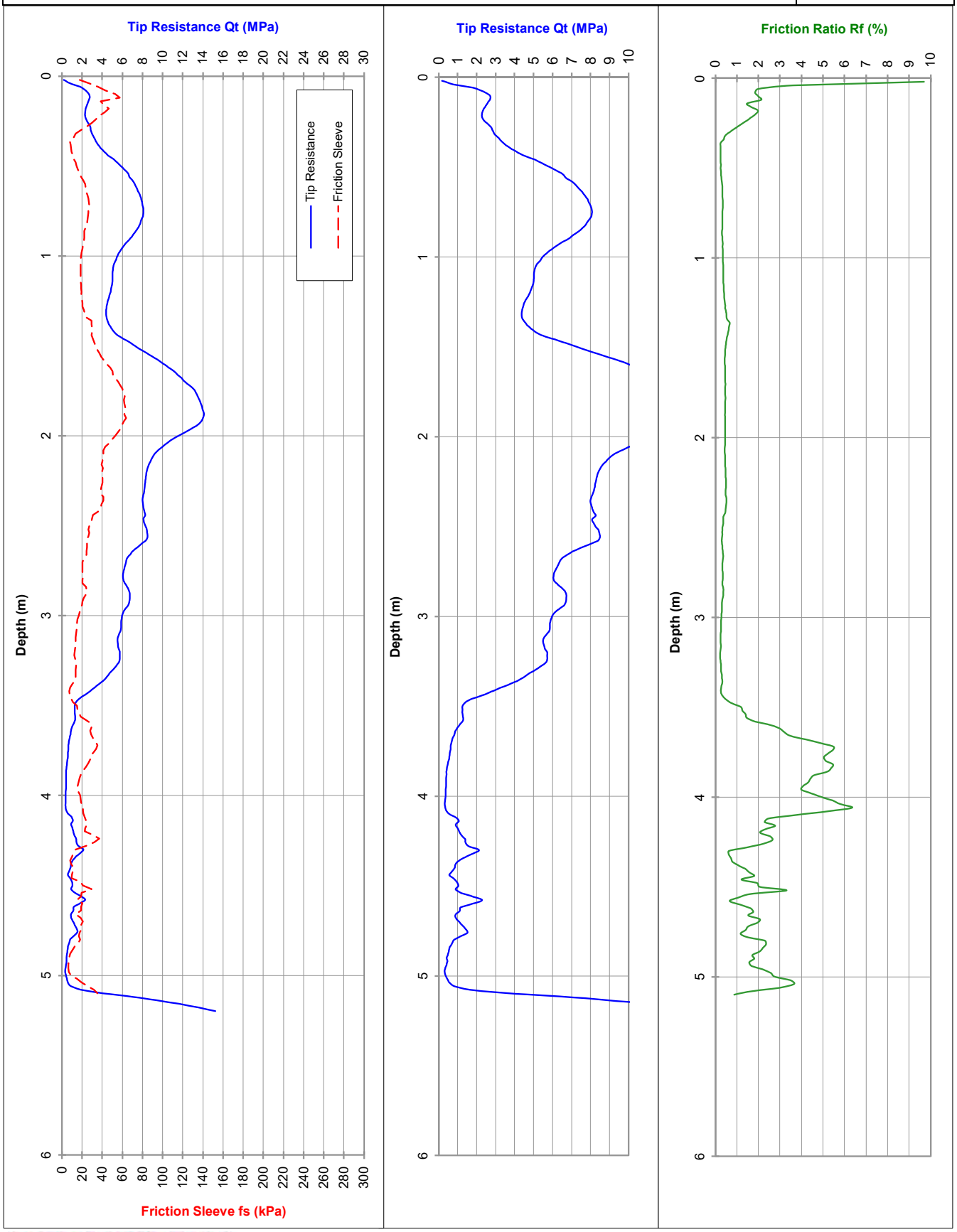
Approx. Water (m): 1.8

File: GG0049T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 04**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 2.0

Dummy probe to (m):

Refusal:

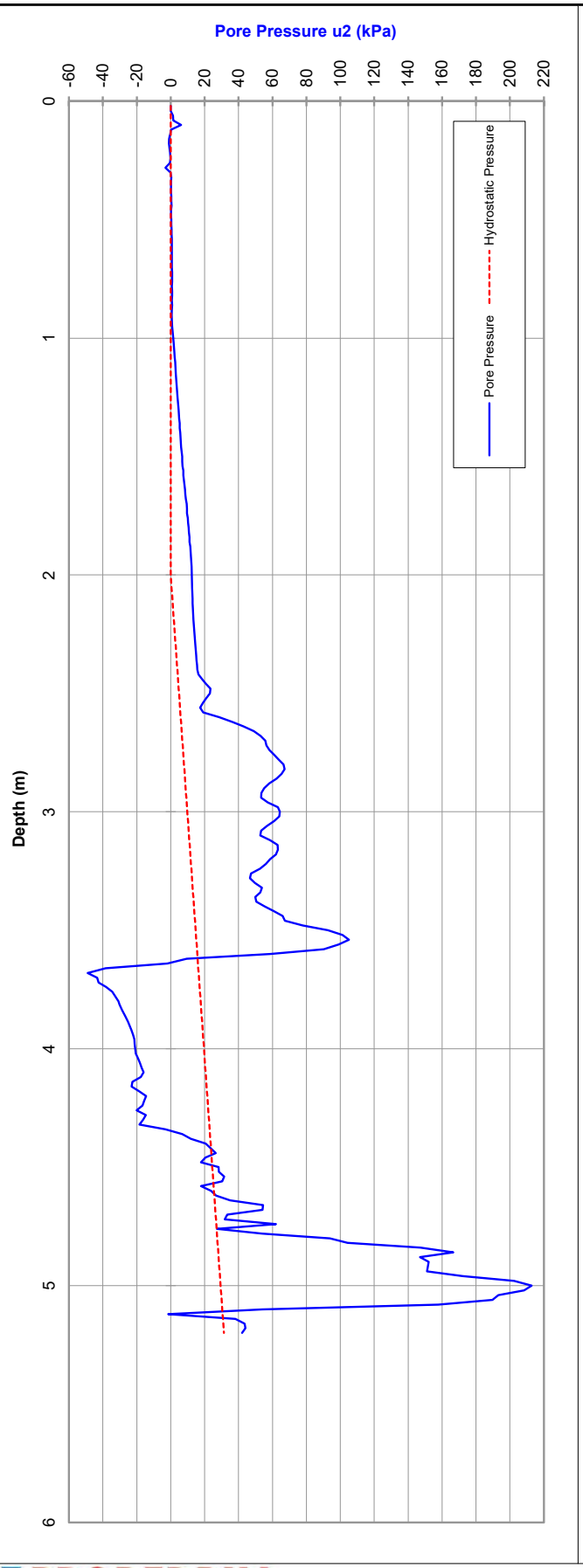
Cone I.D.: EC28

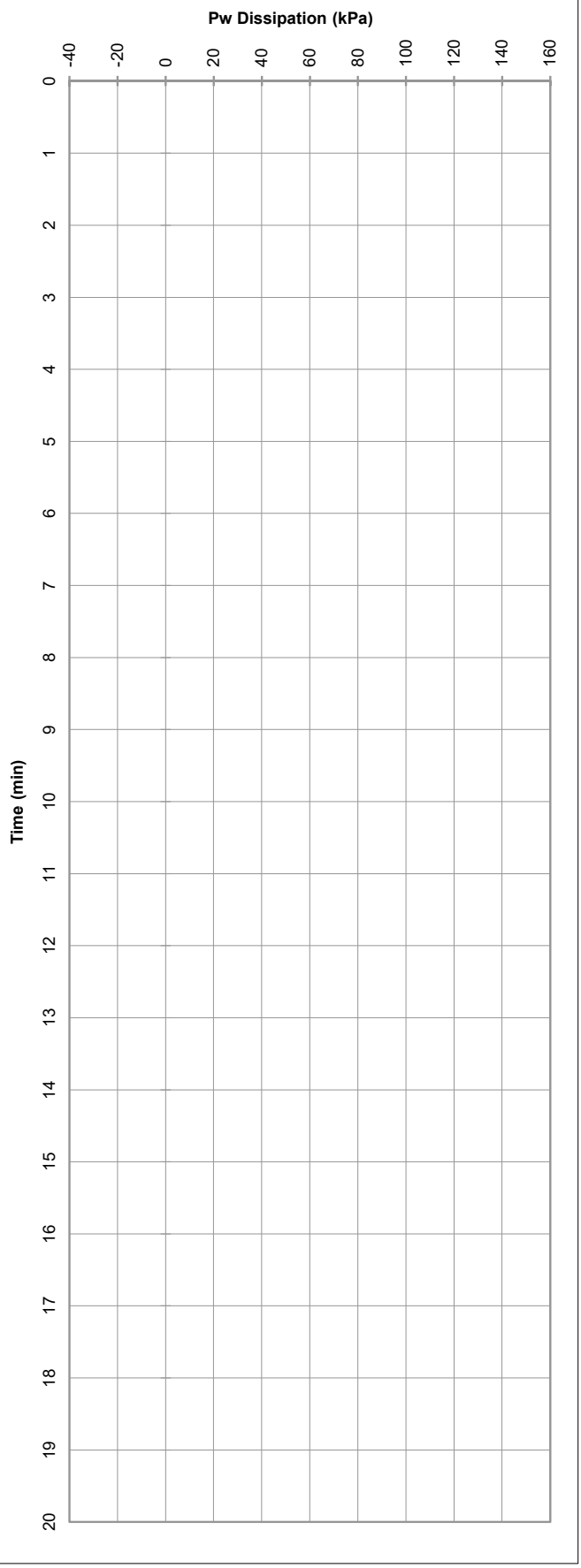
File: GG0050T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 04**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

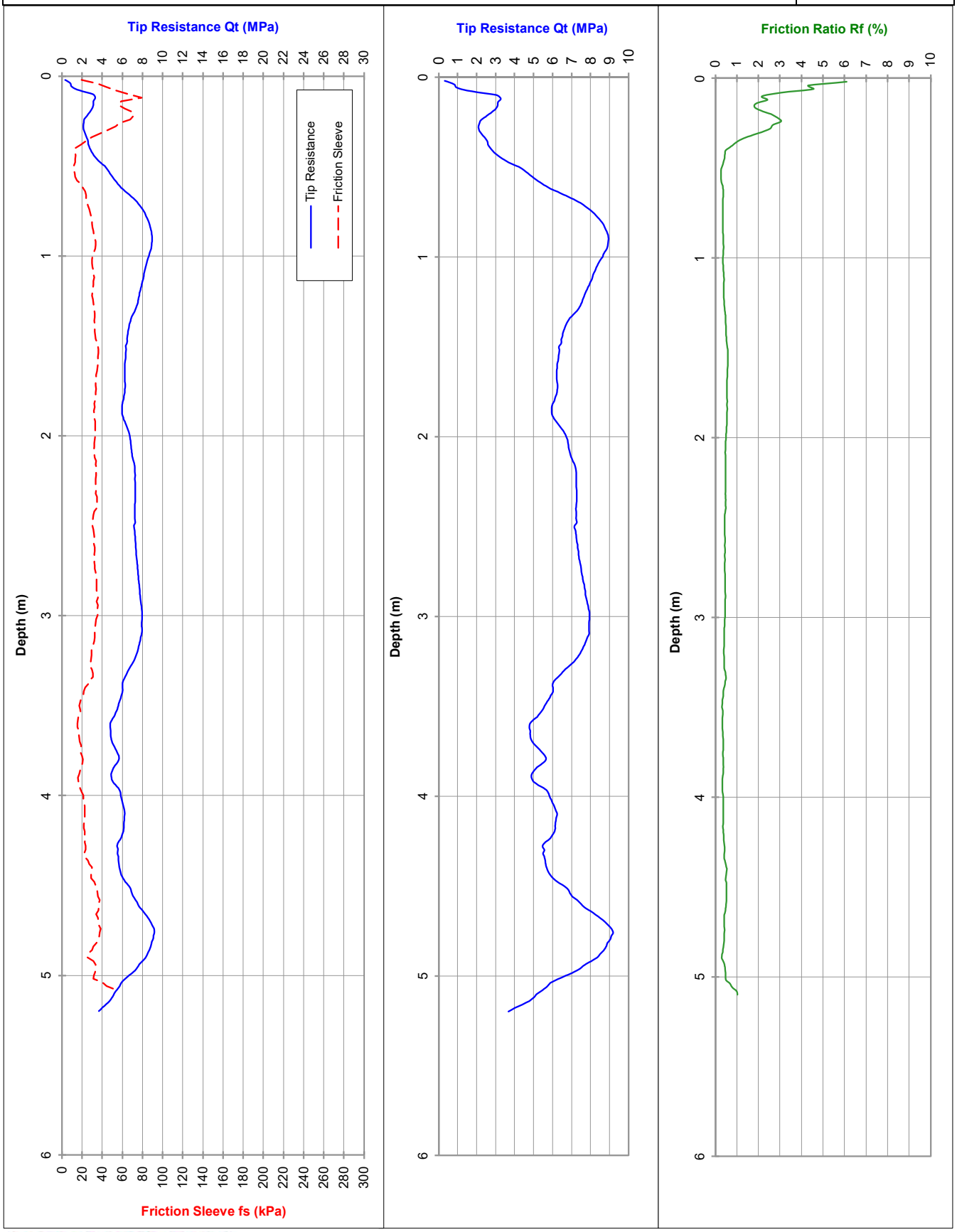
Approx. Water (m): 2

File: GG0050T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 05**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.70

Dummy probe to (m):

Refusal:

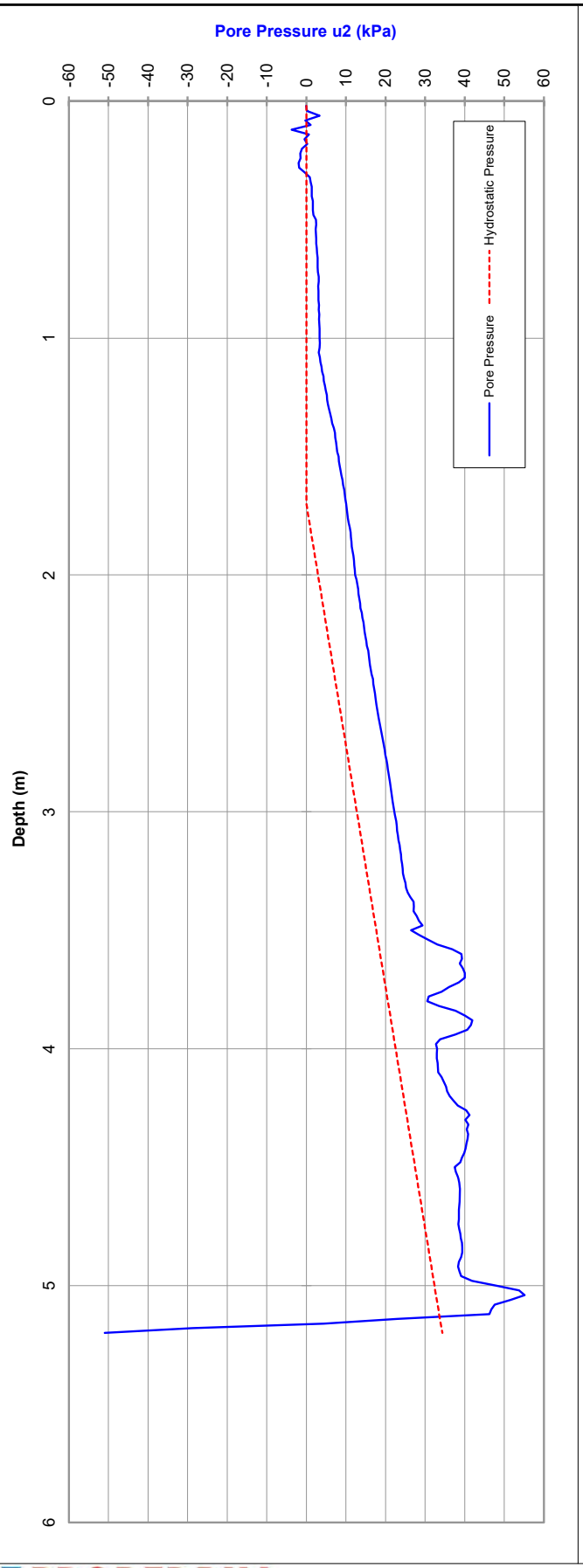
Cone I.D.: EC28

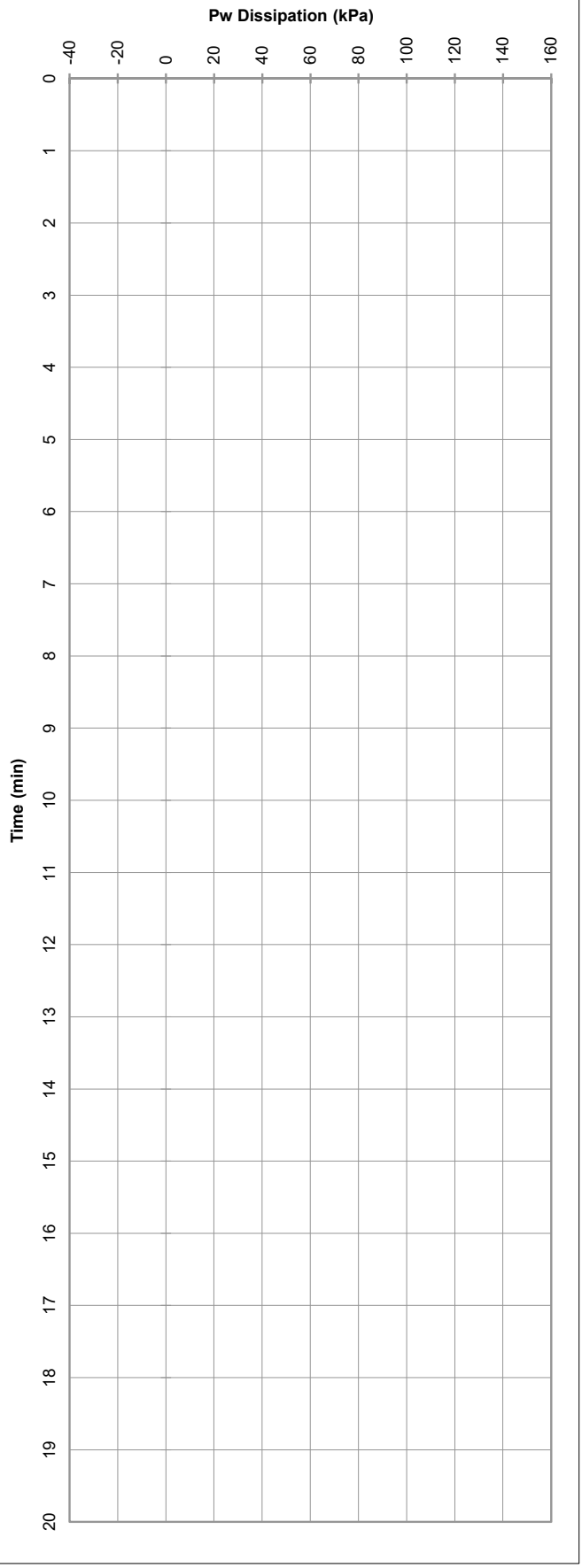
File: GG0051T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 05**
LOCATION:	Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

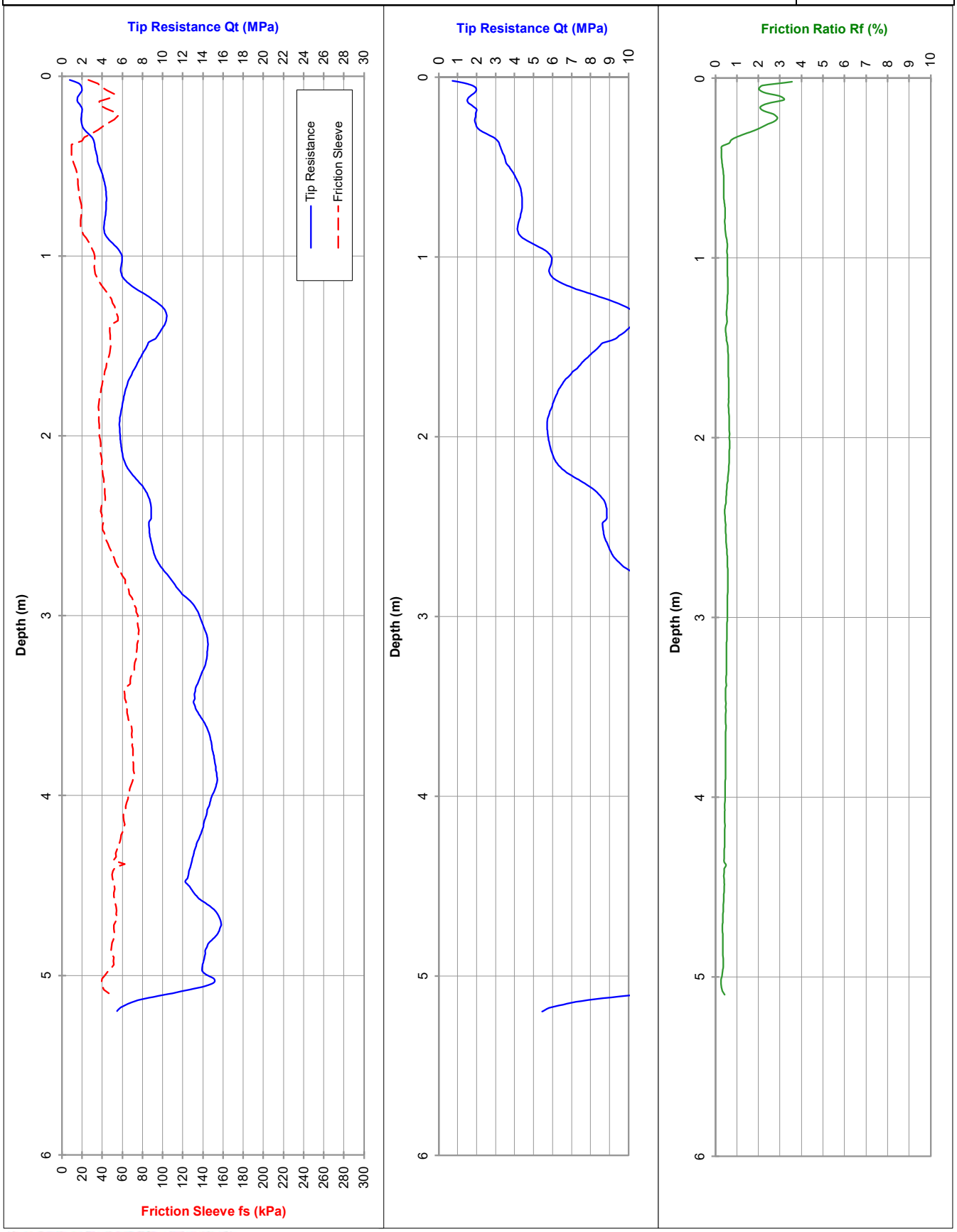
Approx. Water (m): 1.7

File: GG0051T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 06**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.2

Dummy probe to (m):

Refusal:

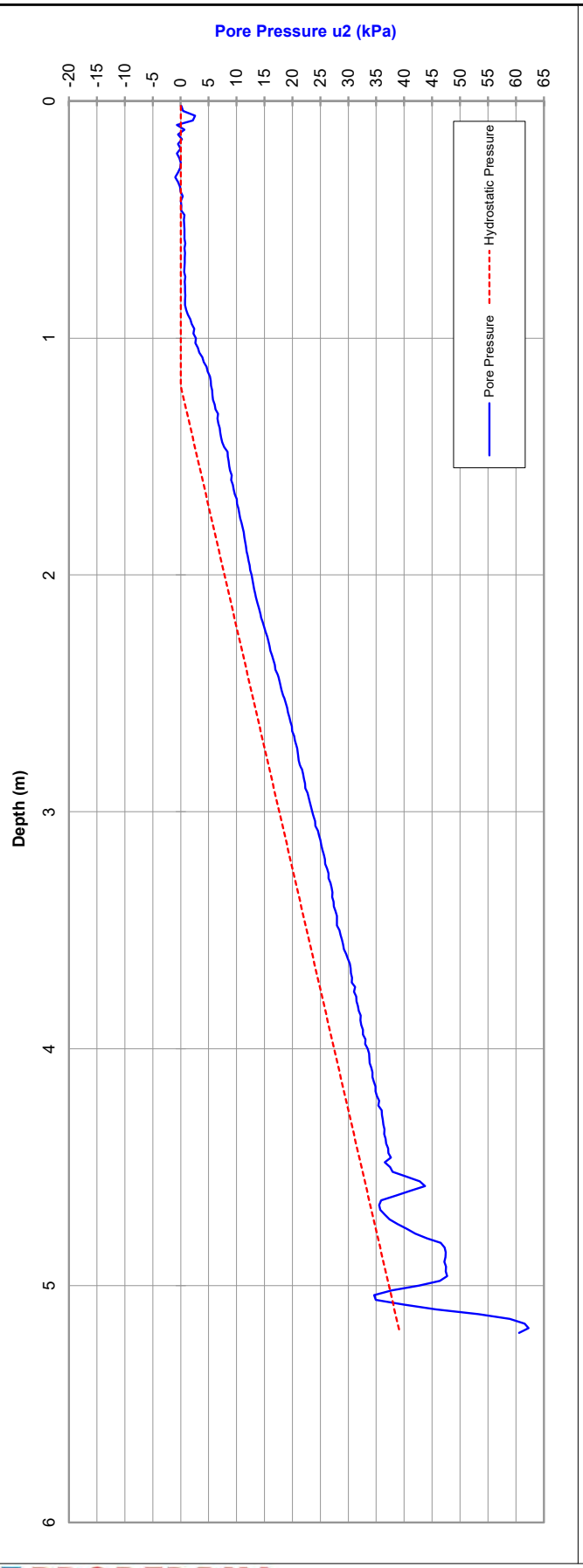
Cone I.D.: EC28

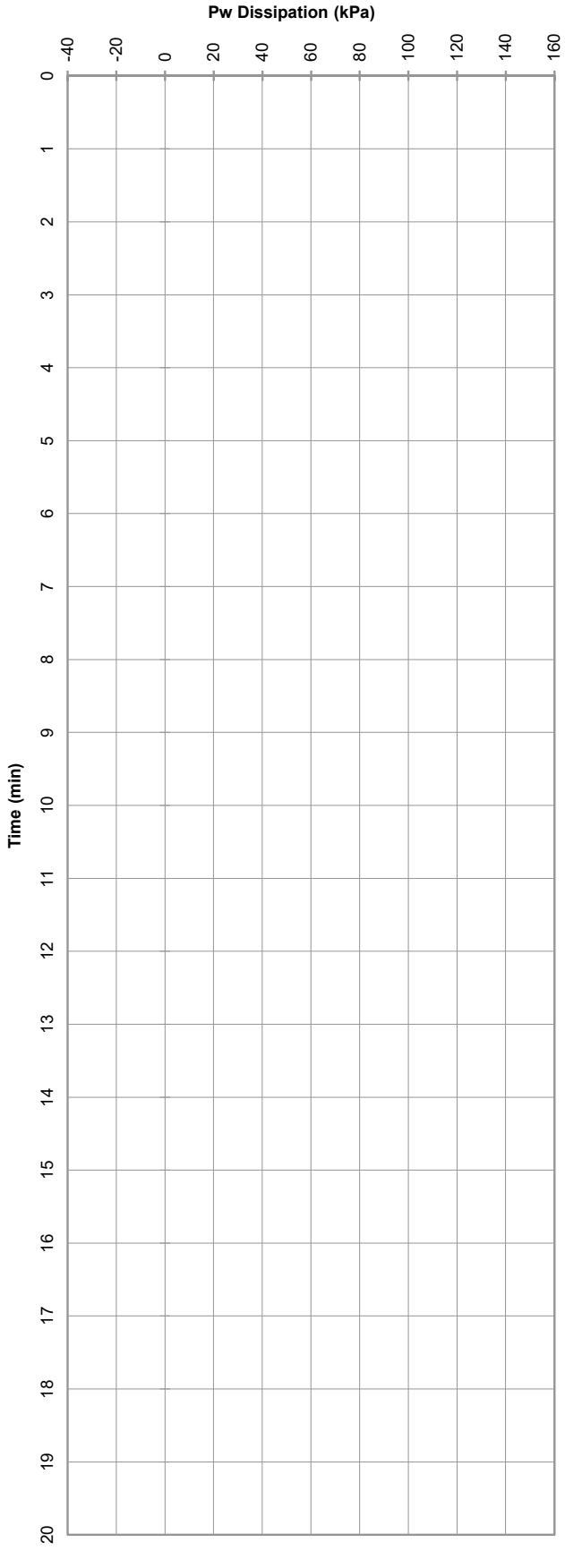
File: GG0052T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 06**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

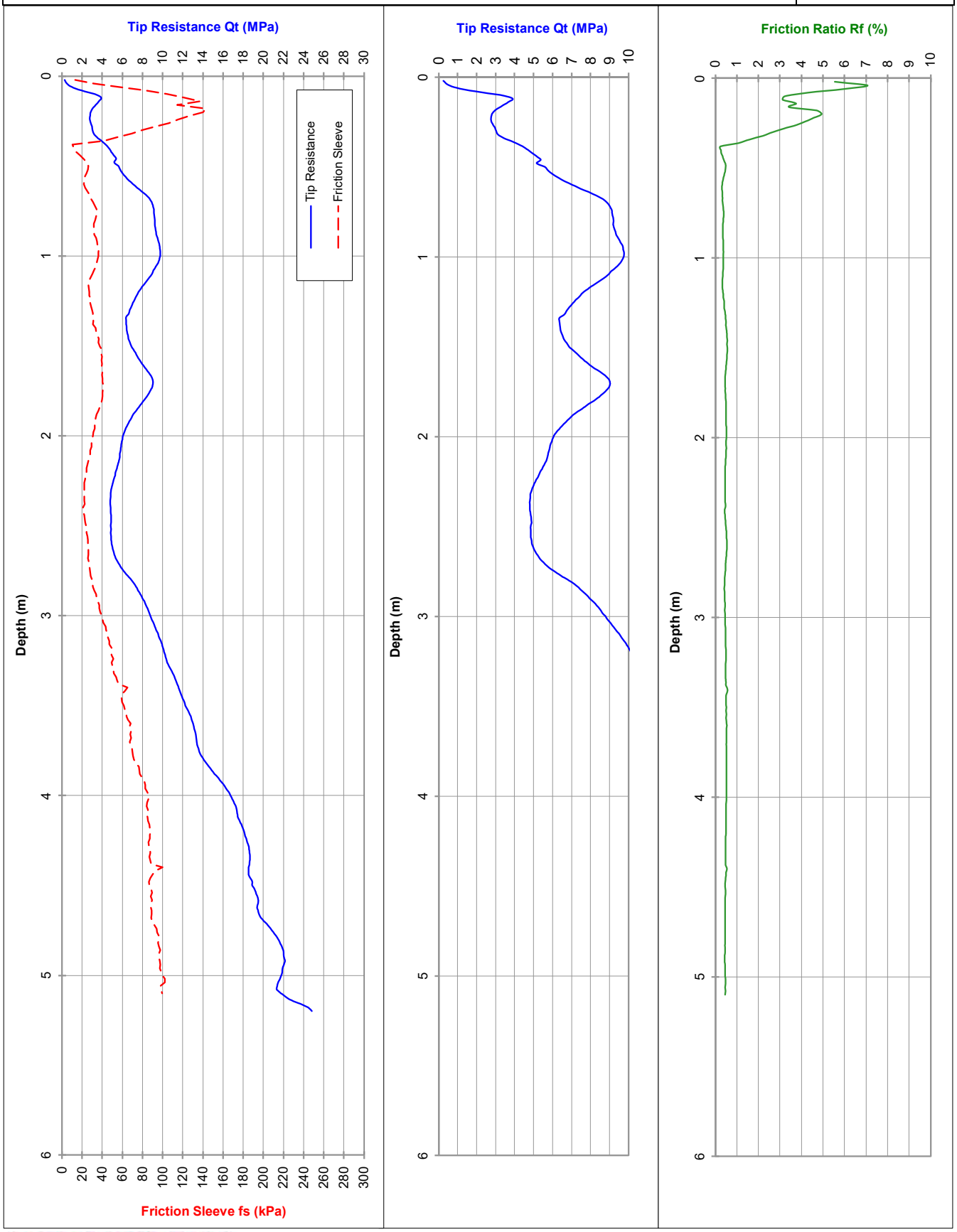
Approx. Water (m): 1.2

File: GG0052T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 07**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.30

Dummy probe to (m):

Refusal:

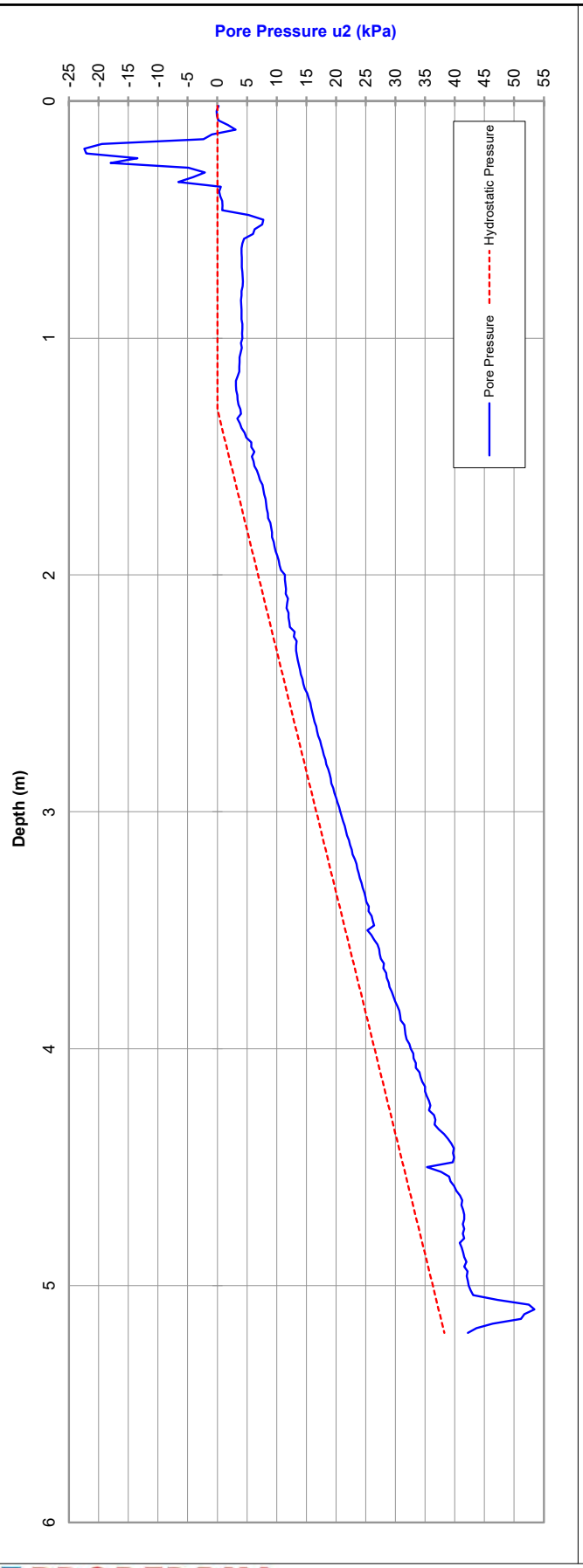
Cone I.D.: EC28

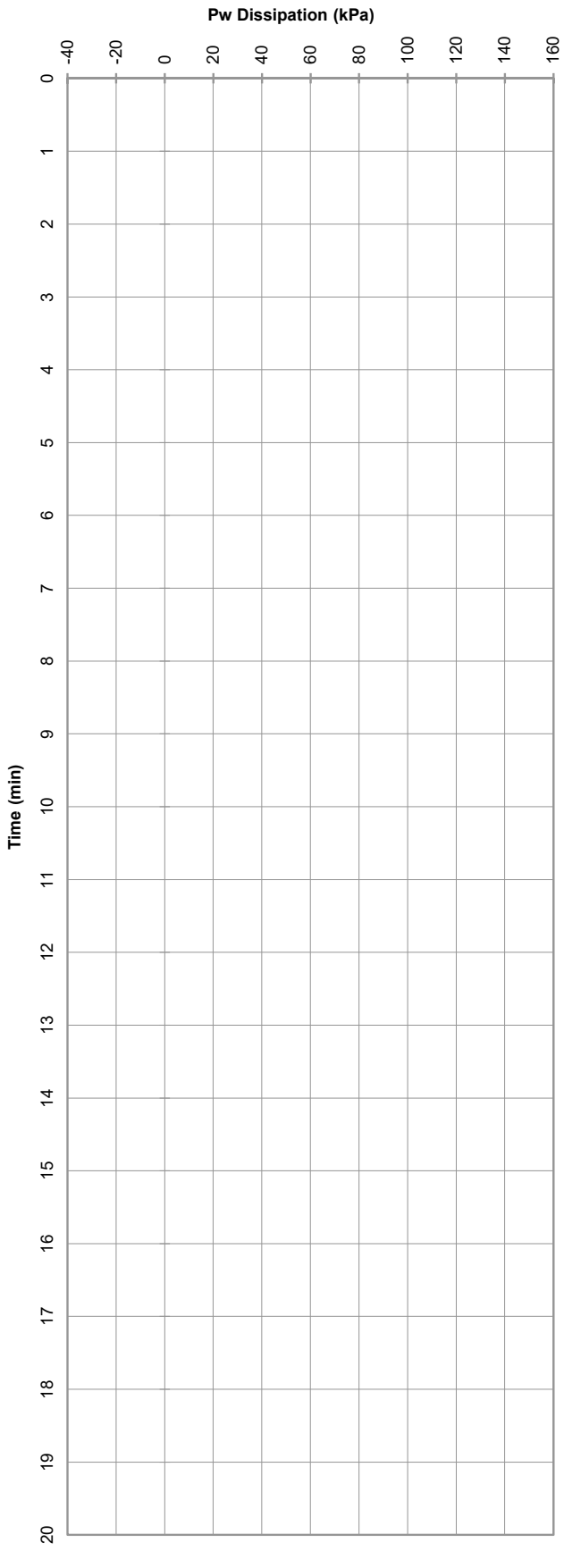
File: GG0053T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 07**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

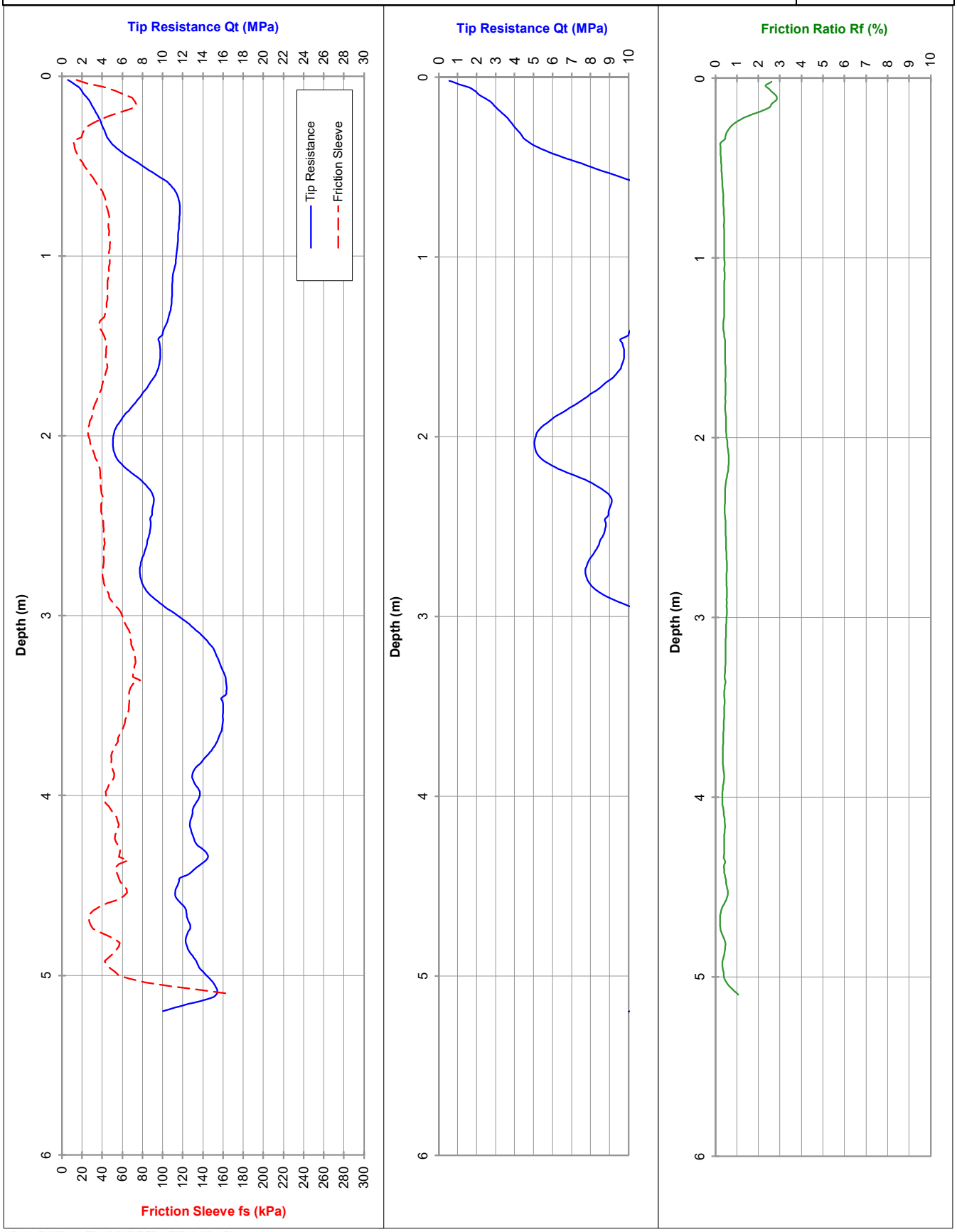
Approx. Water (m): 1.3

File: GG0053T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 08**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.90

Dummy probe to (m):

Refusal:

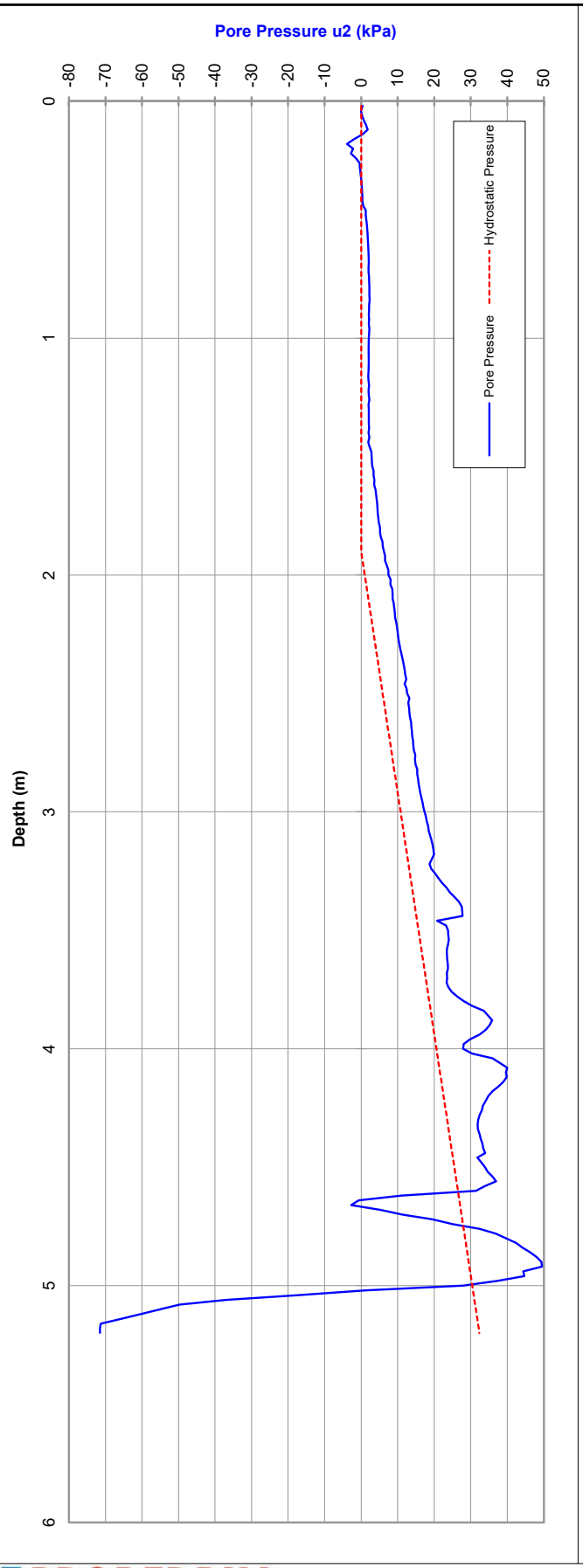
Cone I.D.: EC28

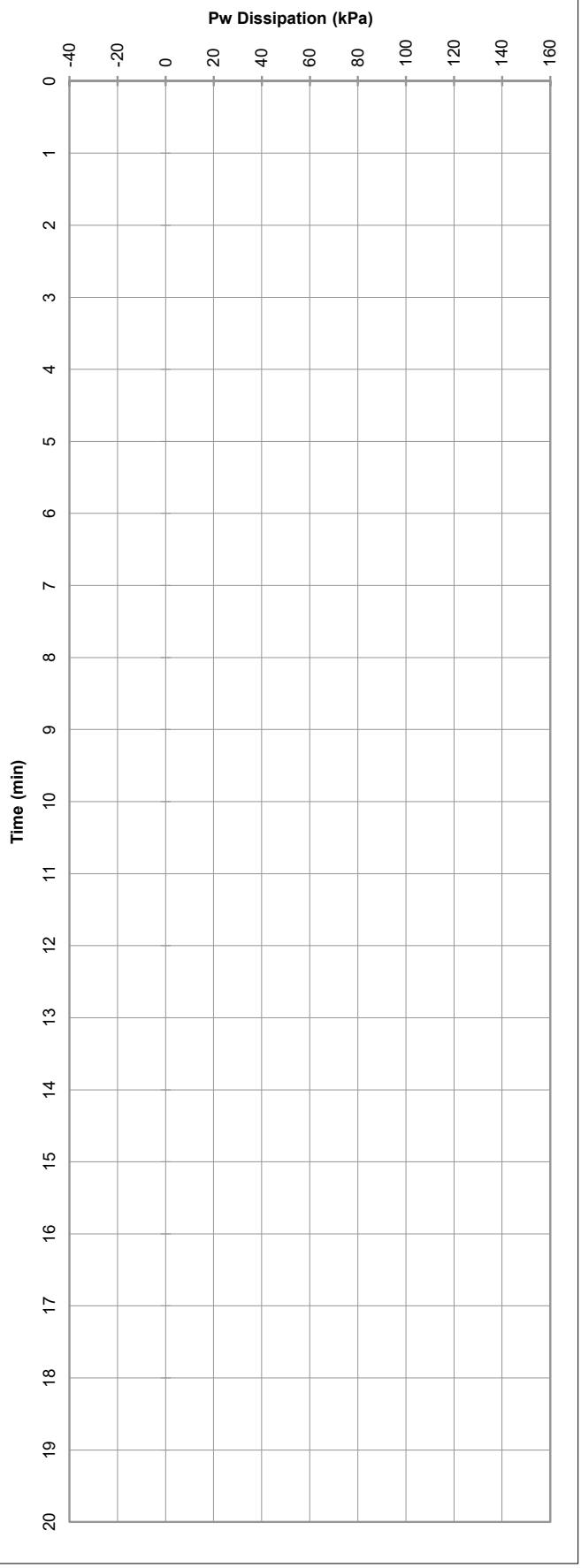
File: GG0054T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 08**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

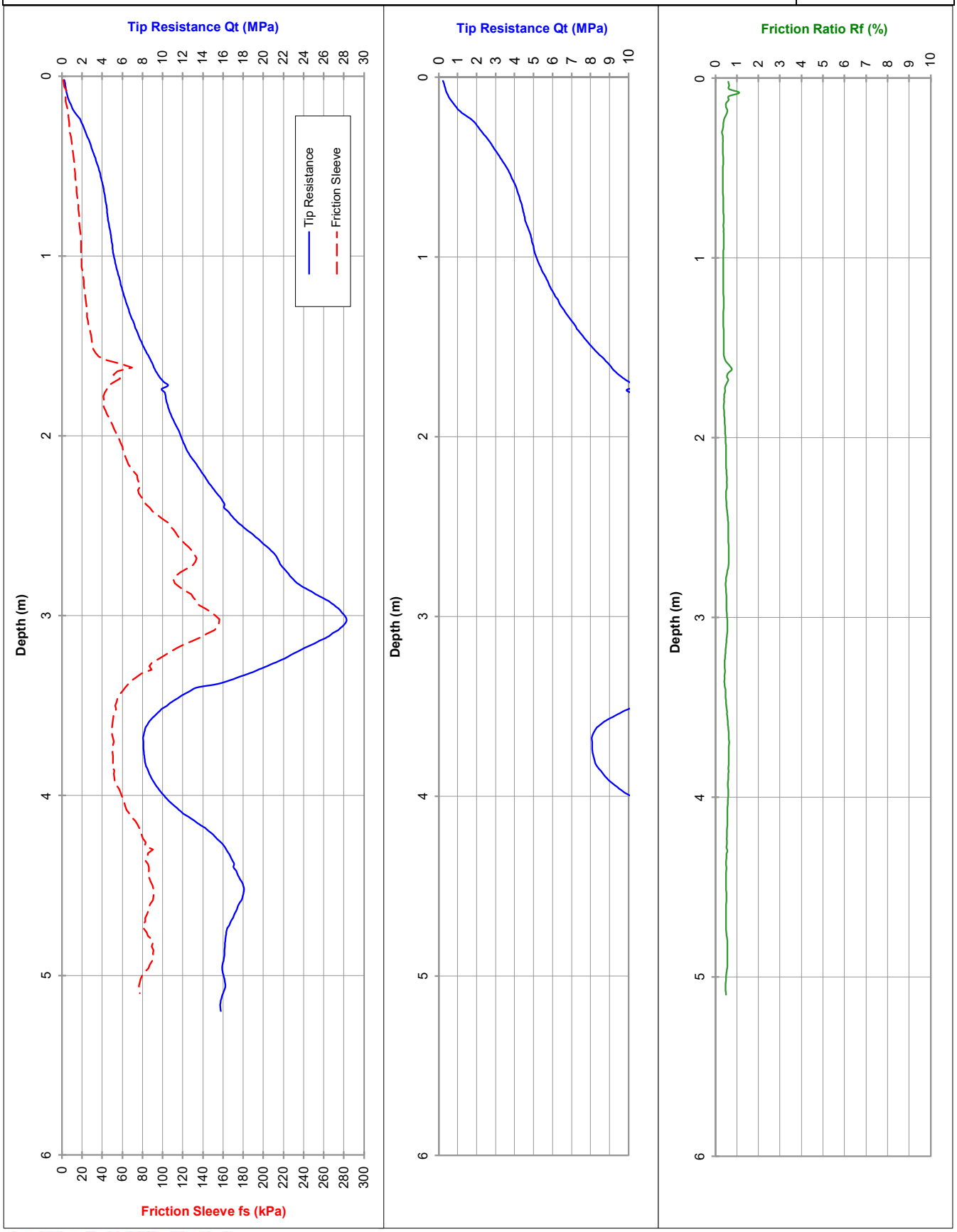
Approx. Water (m): 1.9

File: GG0054T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 09**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.30

Dummy probe to (m):

Refusal:

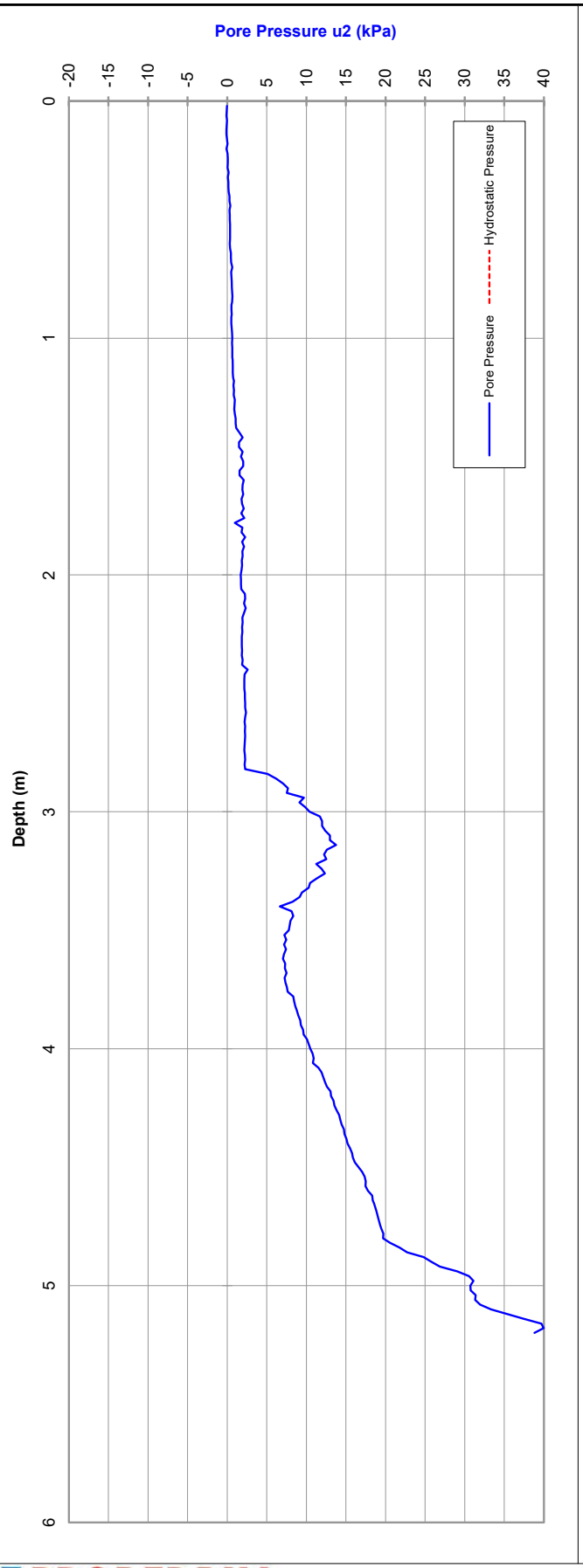
Cone I.D.: EC28

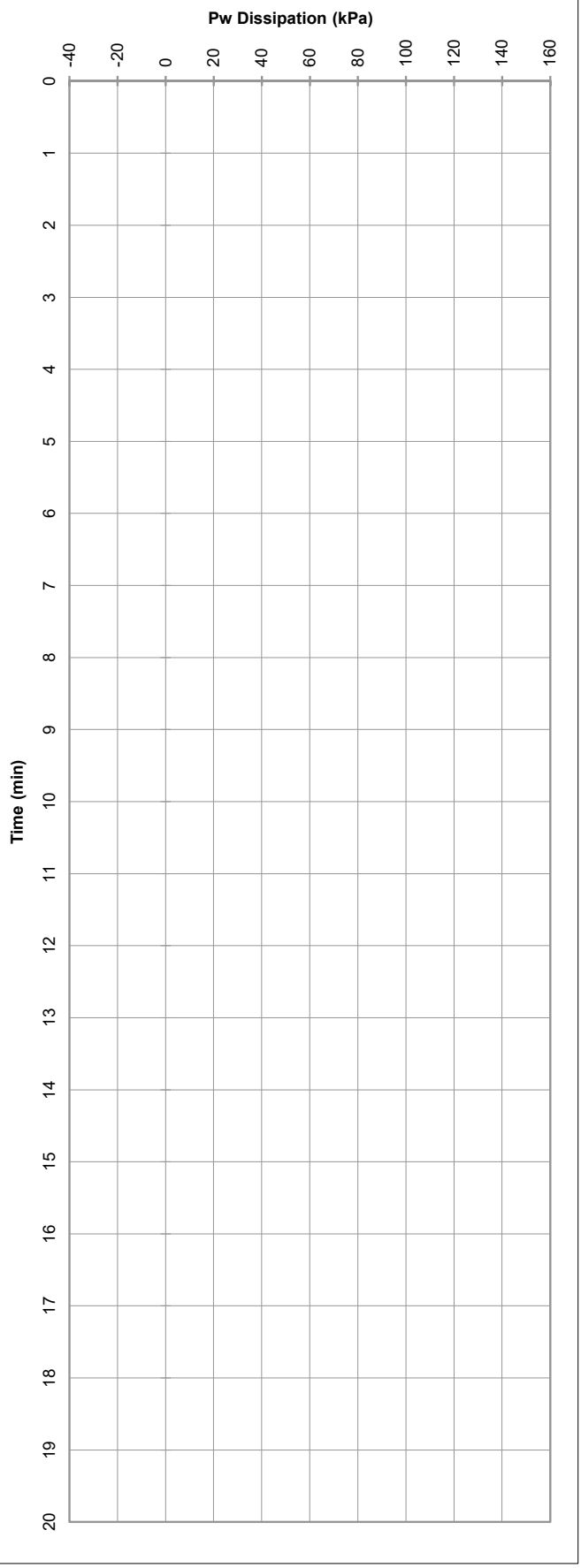
File: GG0055T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 09**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

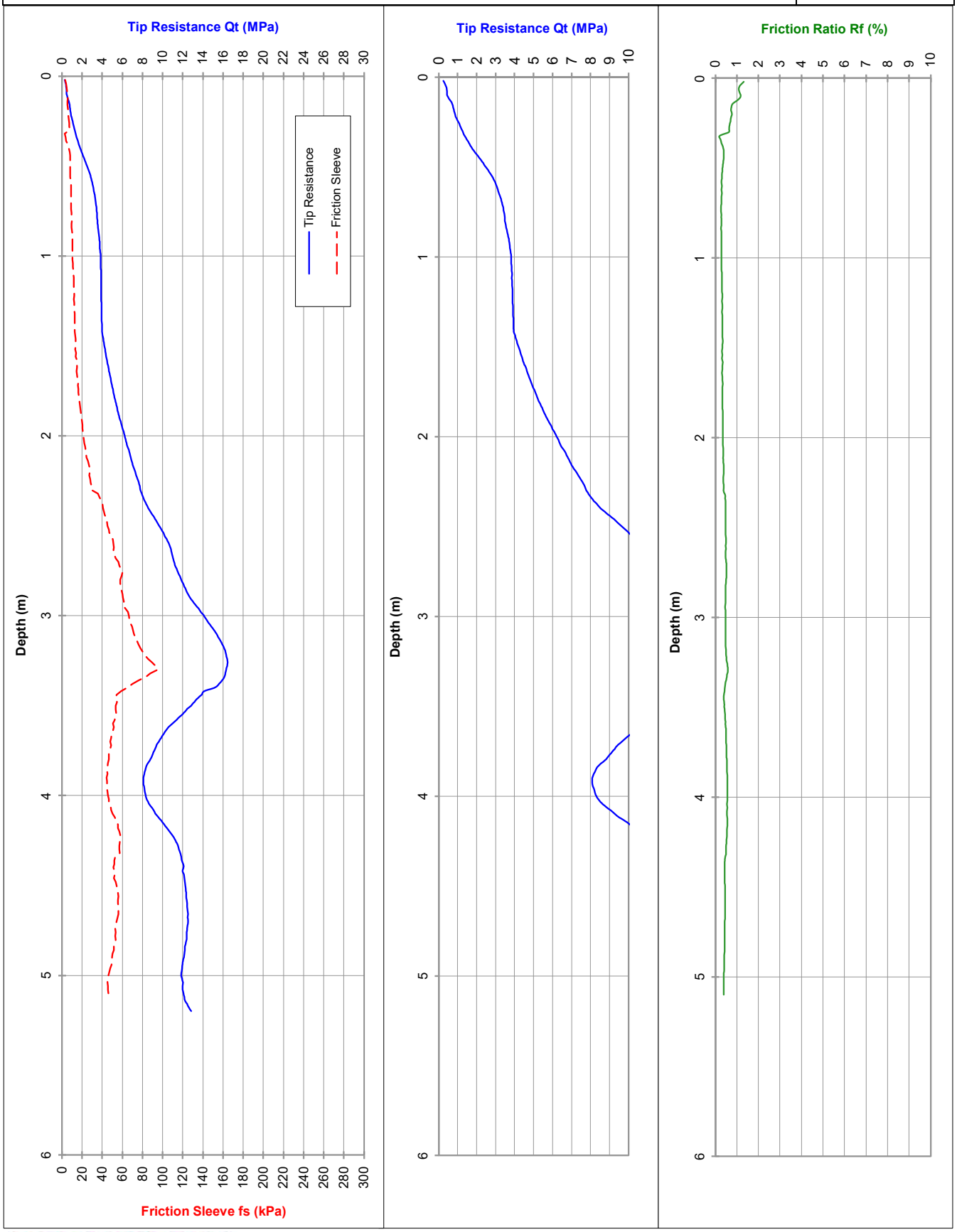
Approx. Water (m): Dry to 3.30

File: GG0055T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 10**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.50

Dummy probe to (m):

Refusal:

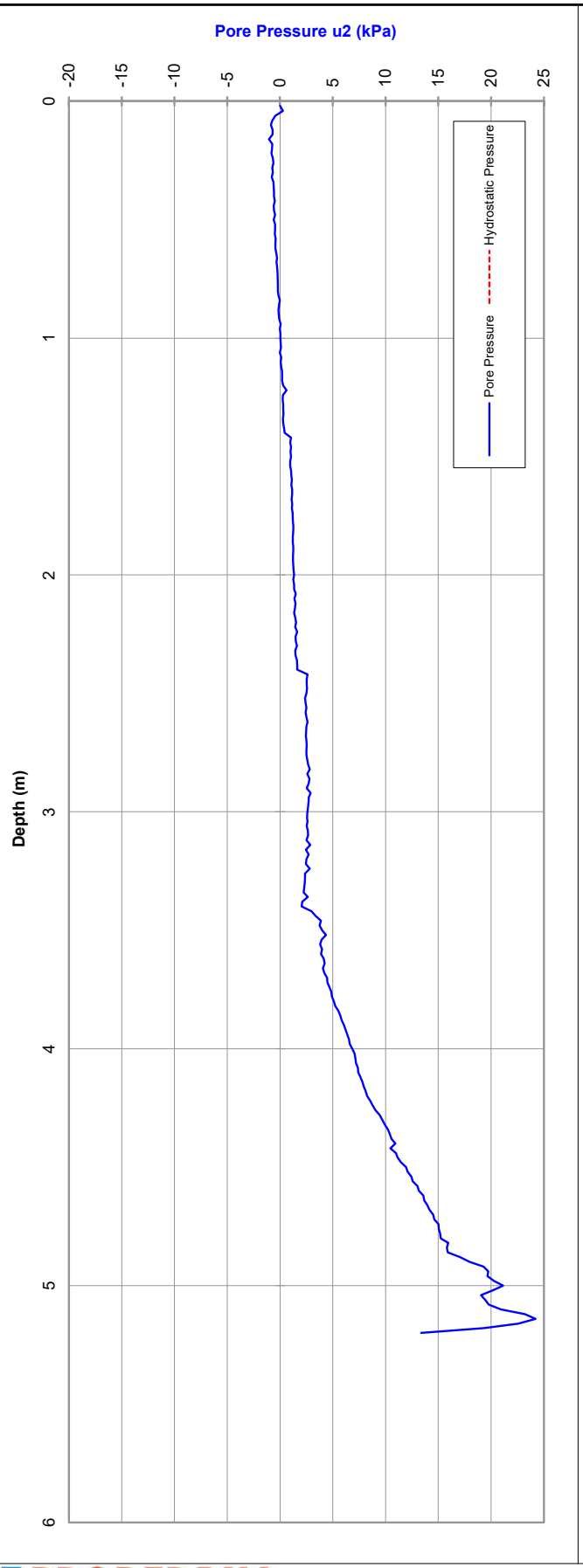
Cone I.D.: EC28

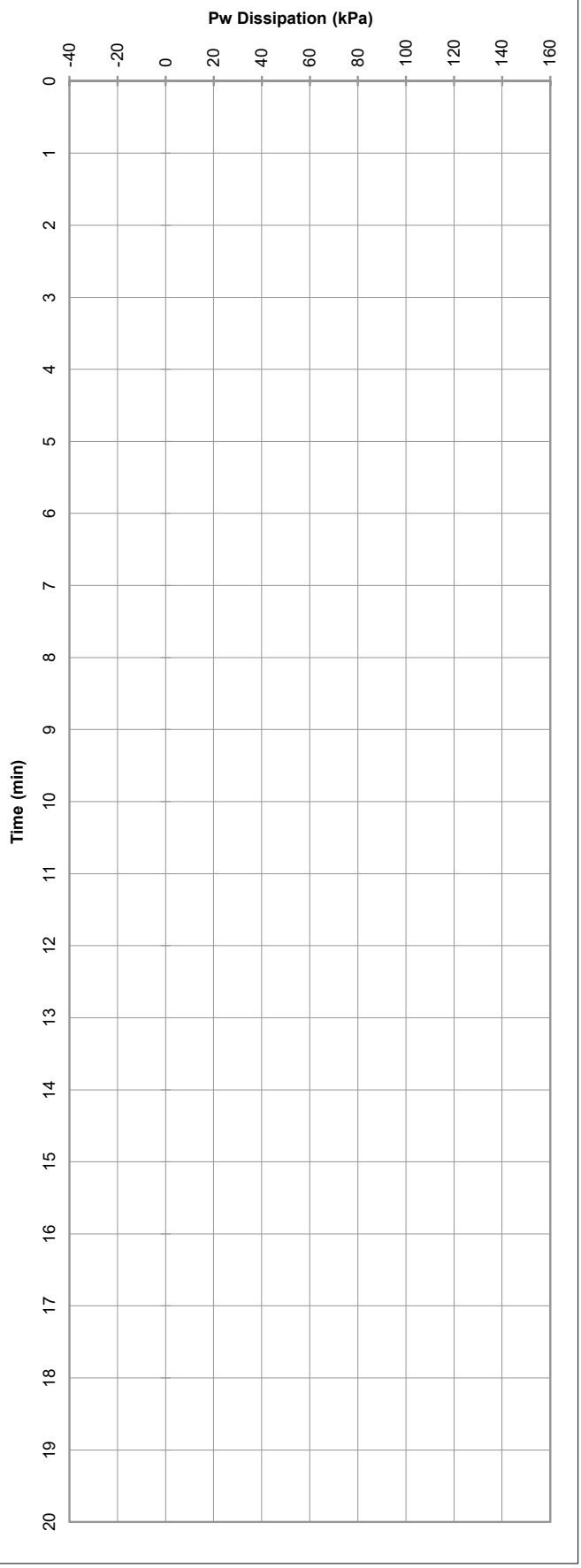
File: GG0056T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 10**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

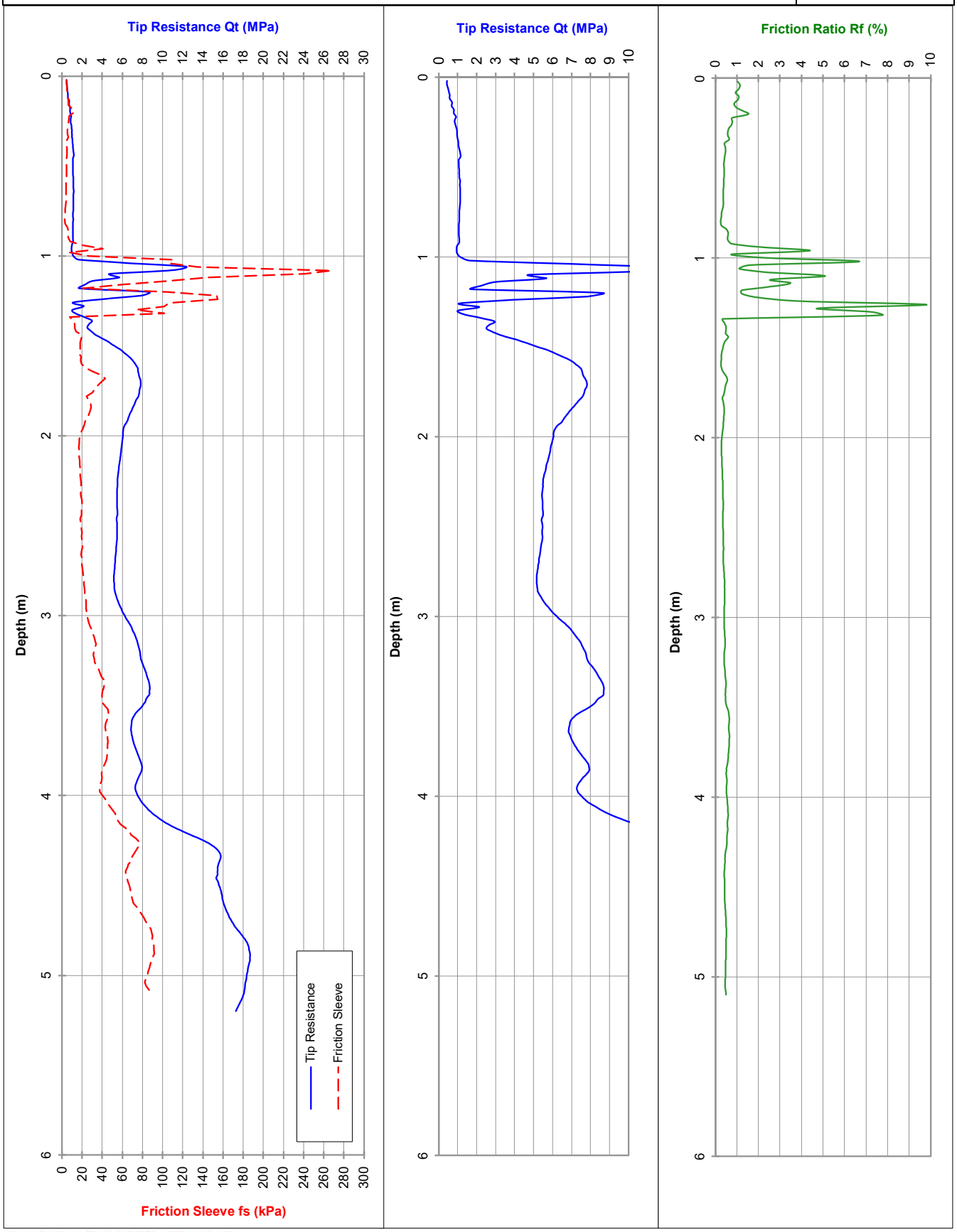
Approx. Water (m): Dry to 3.50

File: GG0056T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 11**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.50

Dummy probe to (m):

Refusal:

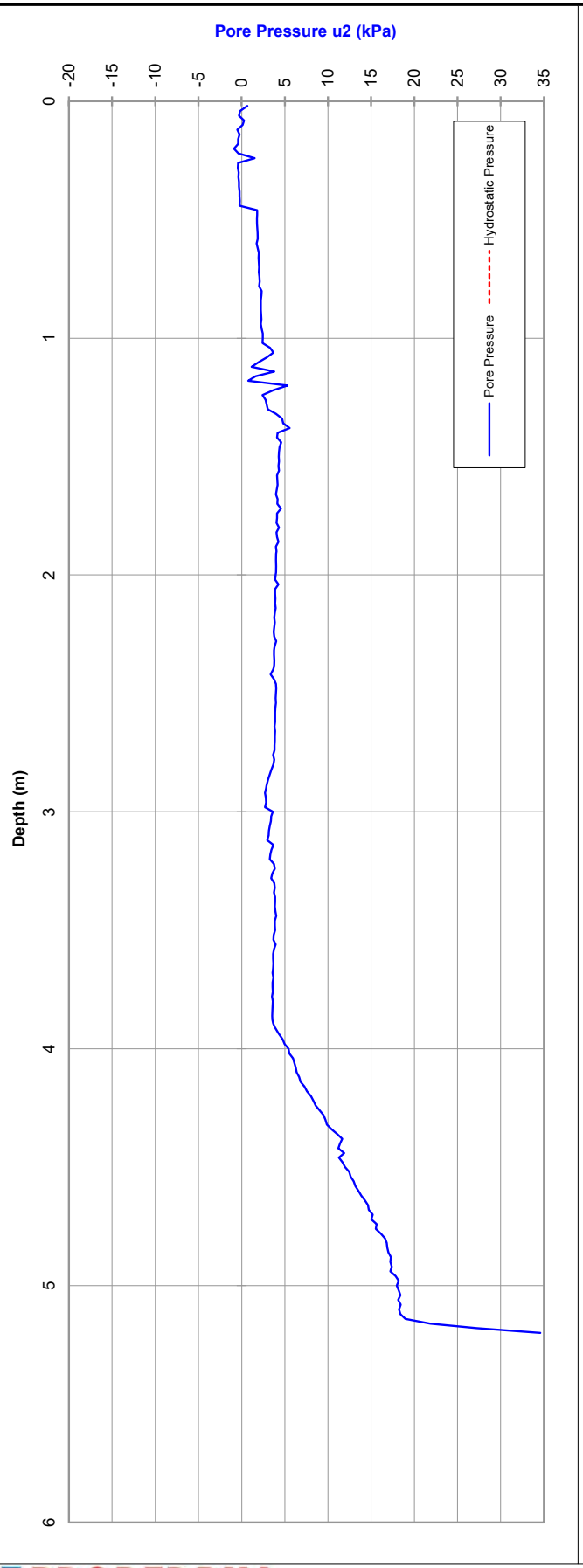
Cone I.D.: EC28

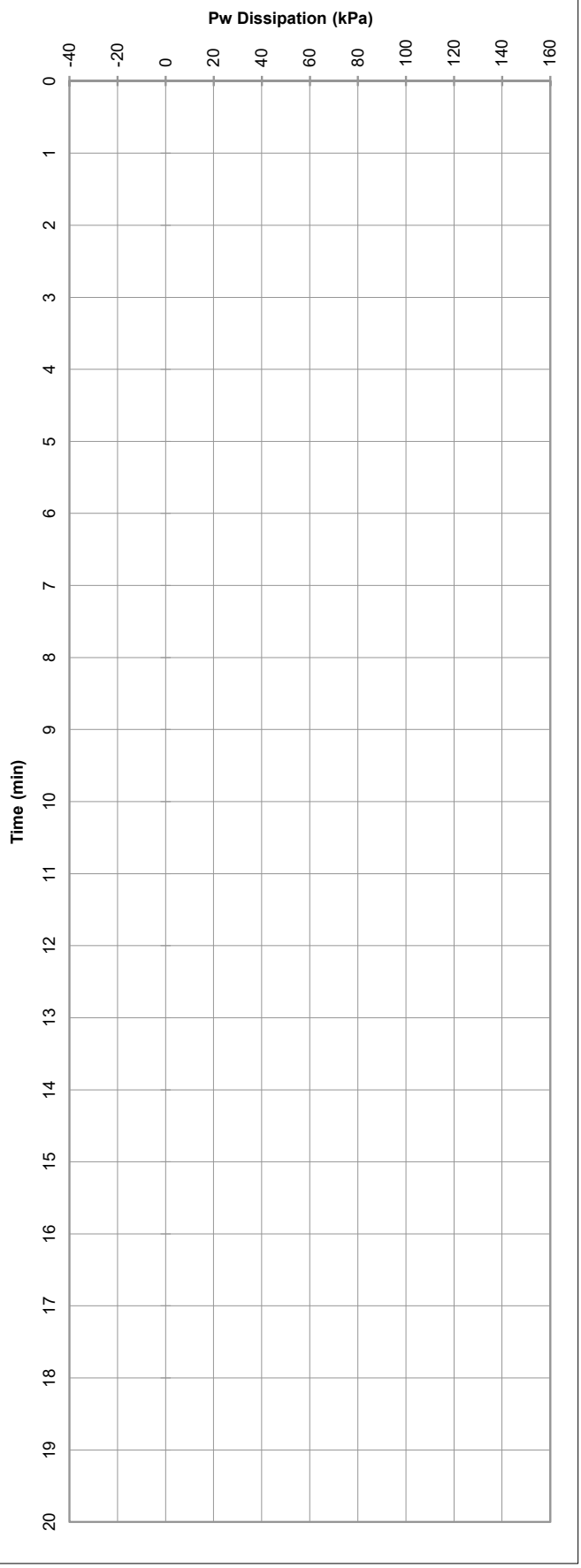
File: GG0057T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 11**
LOCATION:	Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

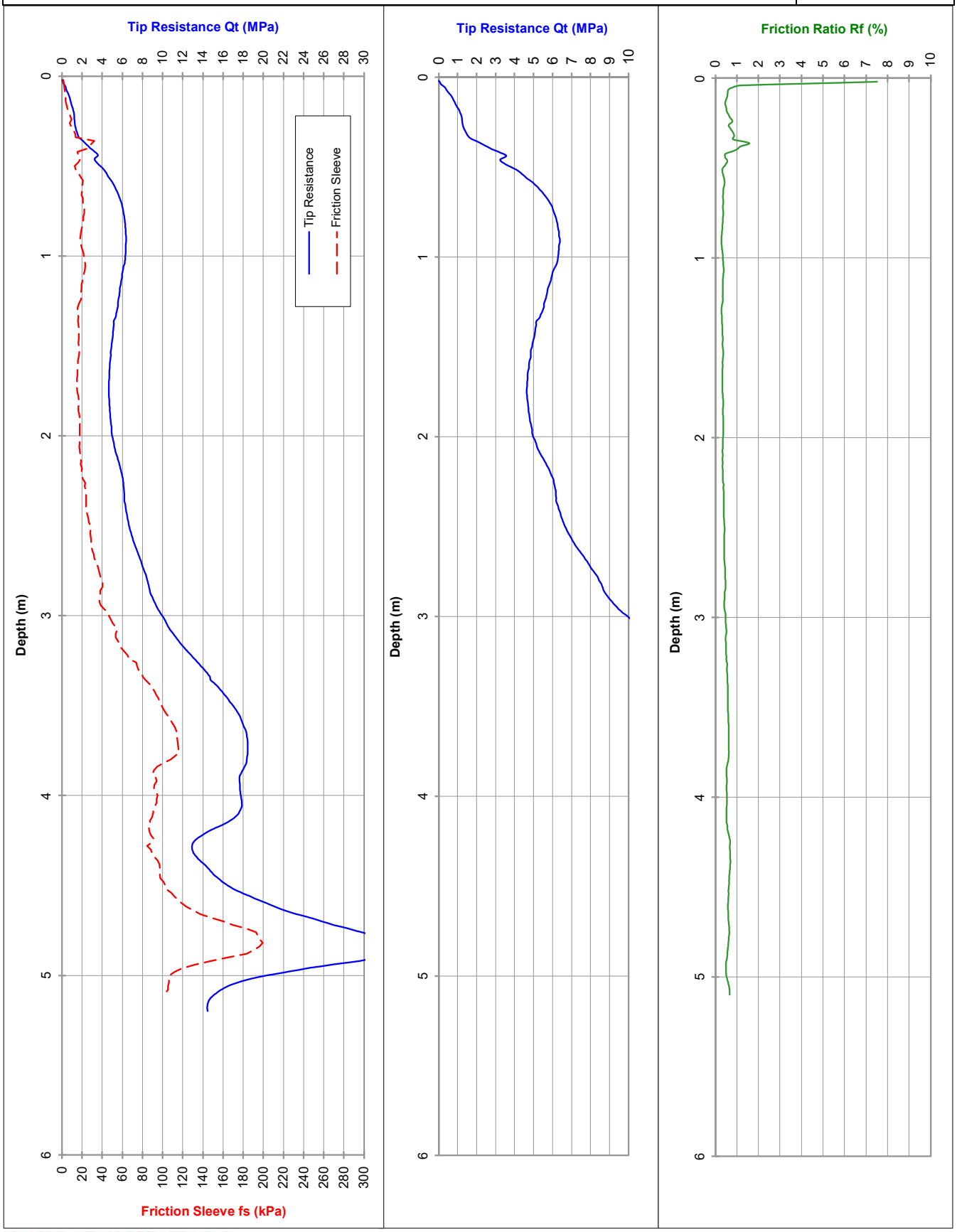
Approx. Water (m): Dry to 3.50

File: GG0057T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 12**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 4.0

Dummy probe to (m):

Refusal:

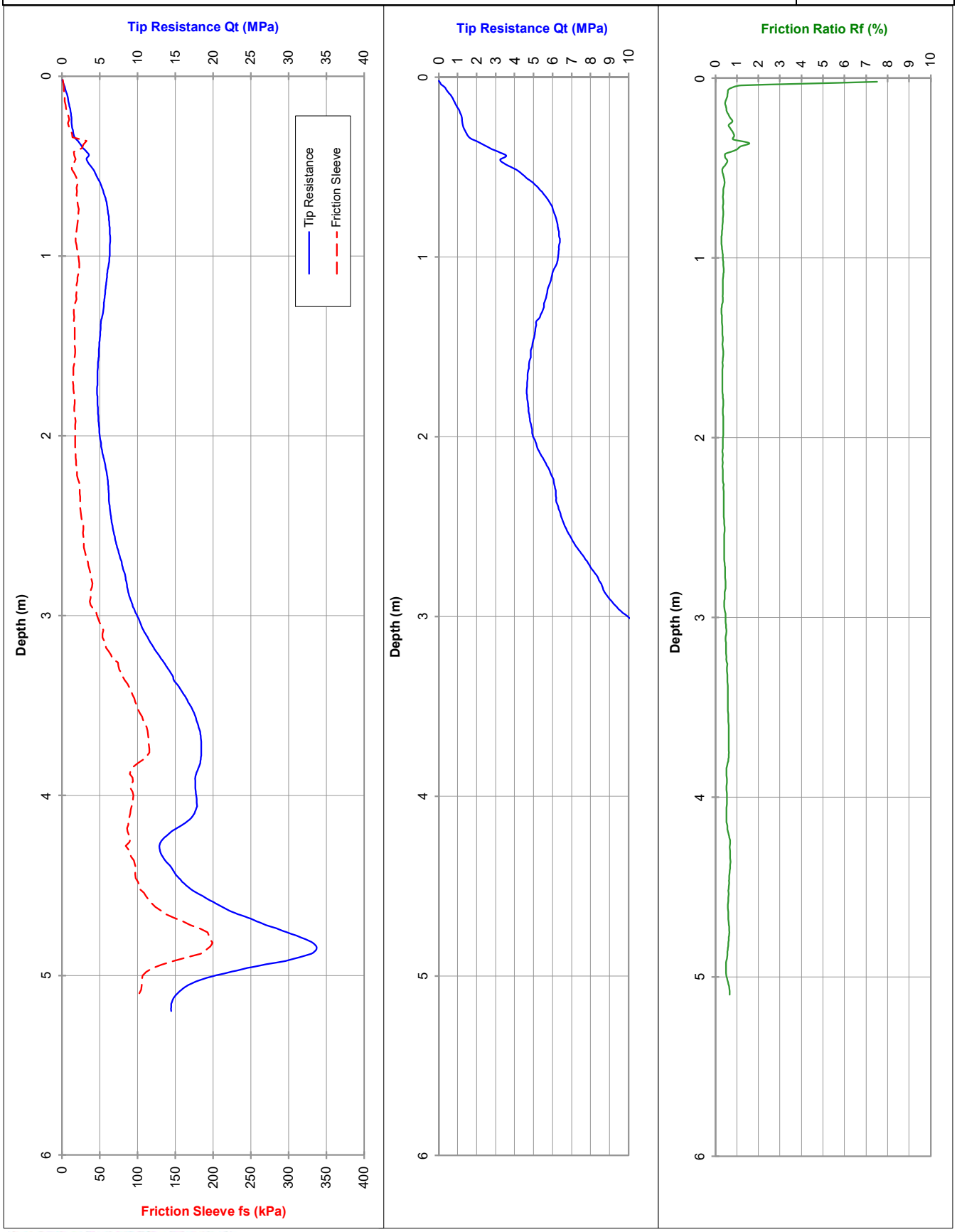
Cone I.D.: EC28

File: GG0058T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 12**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 4.0

Dummy probe to (m):

Refusal:

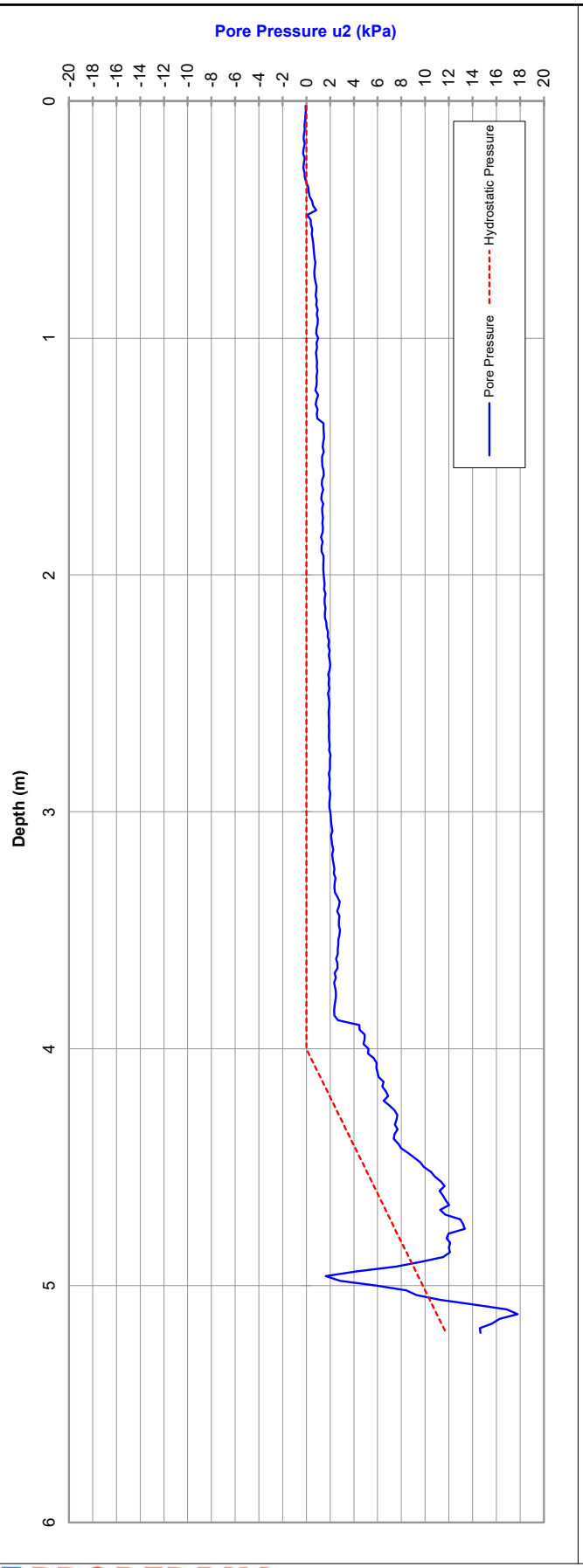
Cone I.D.: EC28

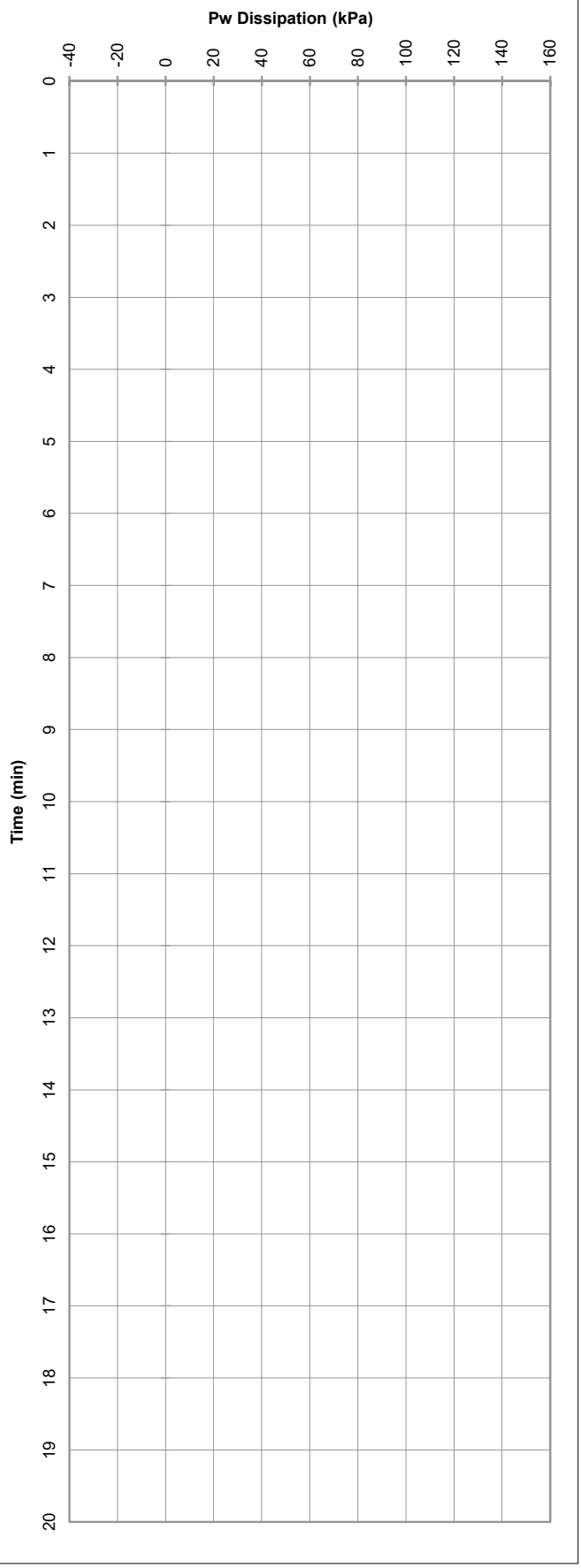
File: GG0058T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 12**
LOCATION:	Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

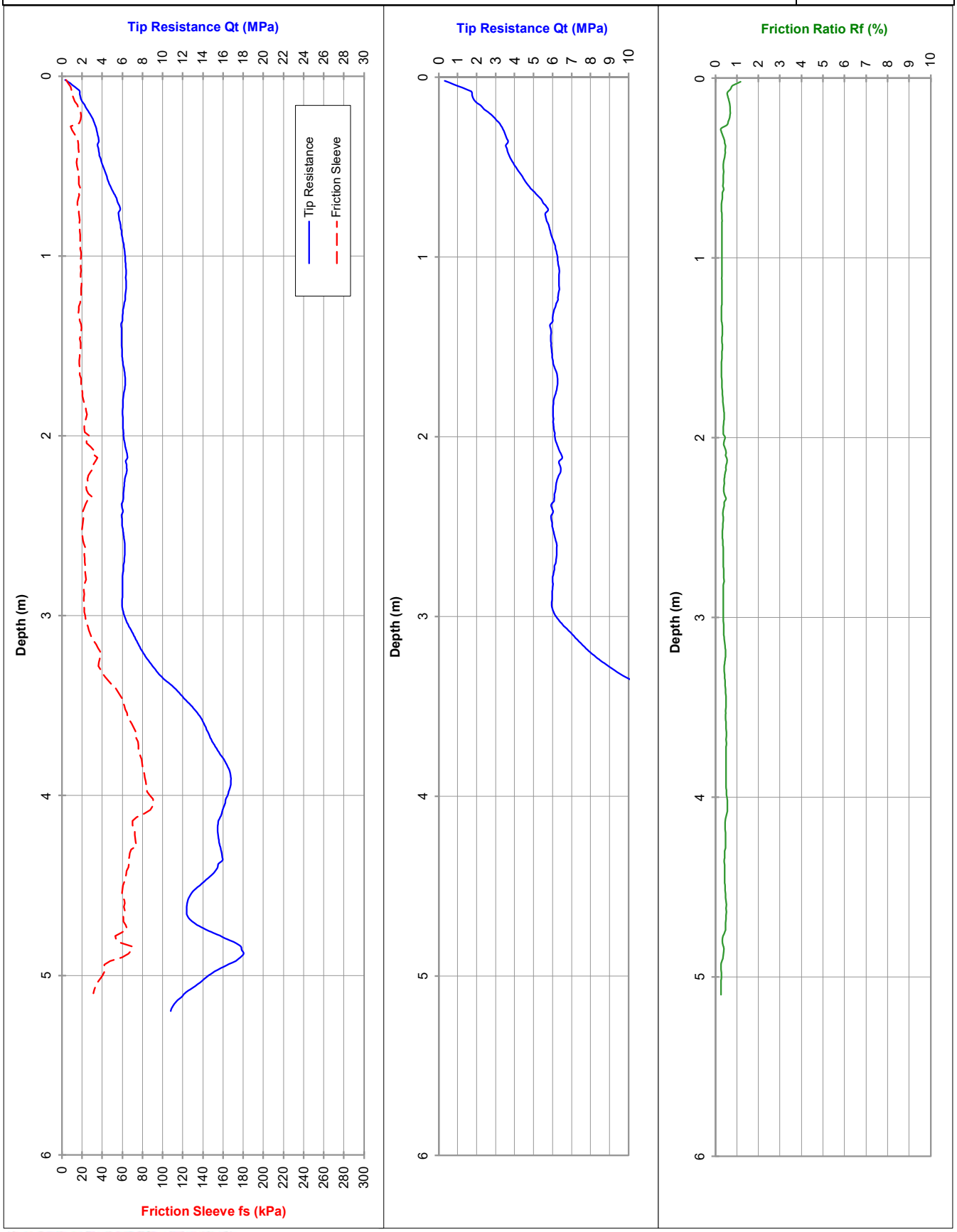
Approx. Water (m): 4

File: GG0058T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 13**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 2.0

Dummy probe to (m):

Refusal:

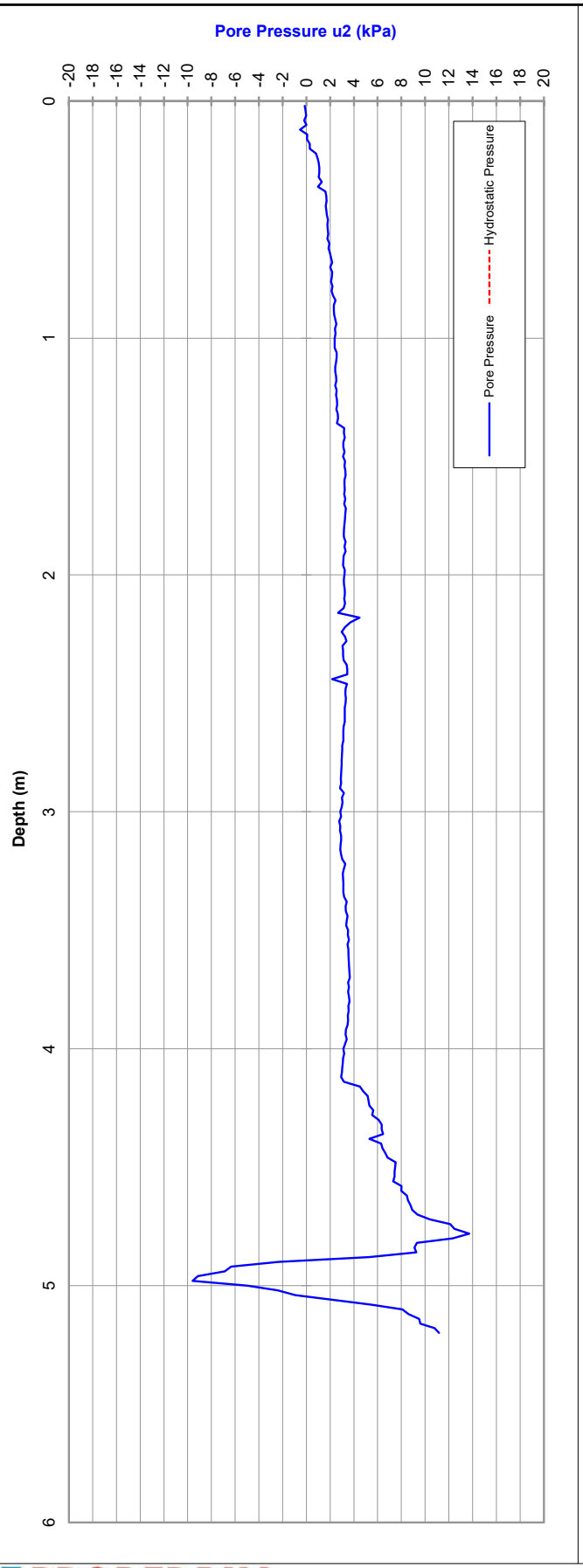
Cone I.D.: EC28

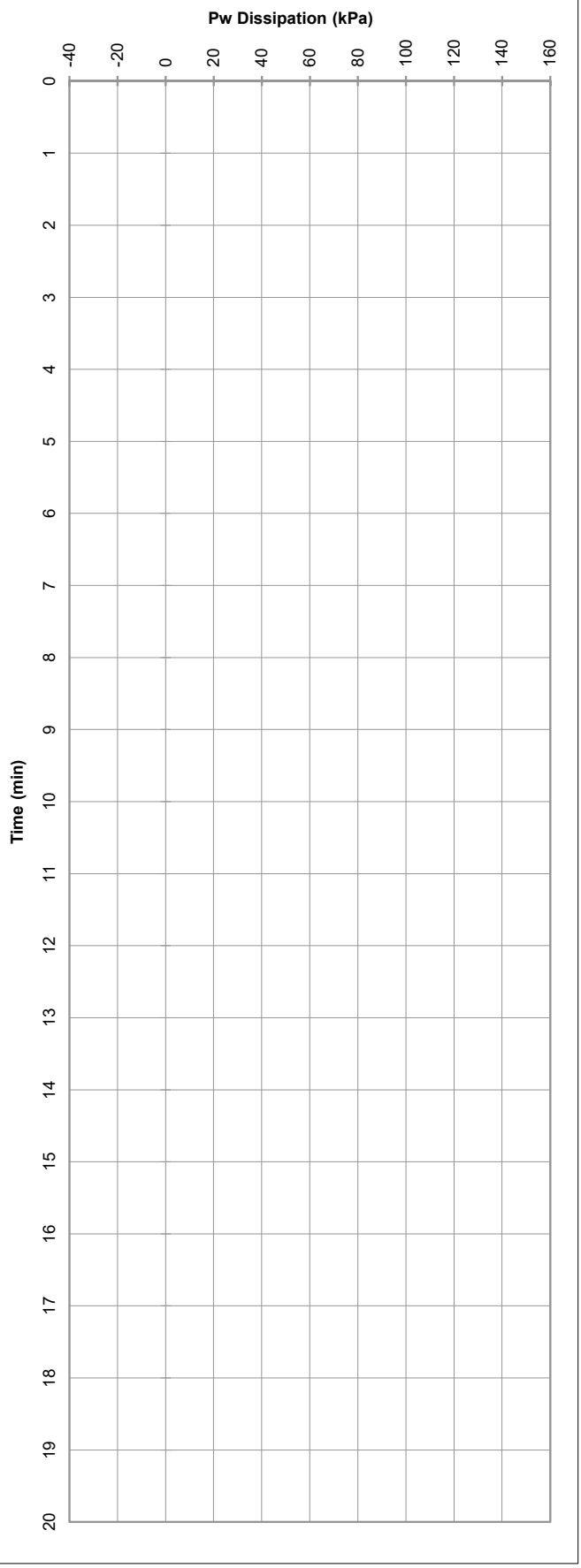
File: GG0059T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 13**
LOCATION: Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

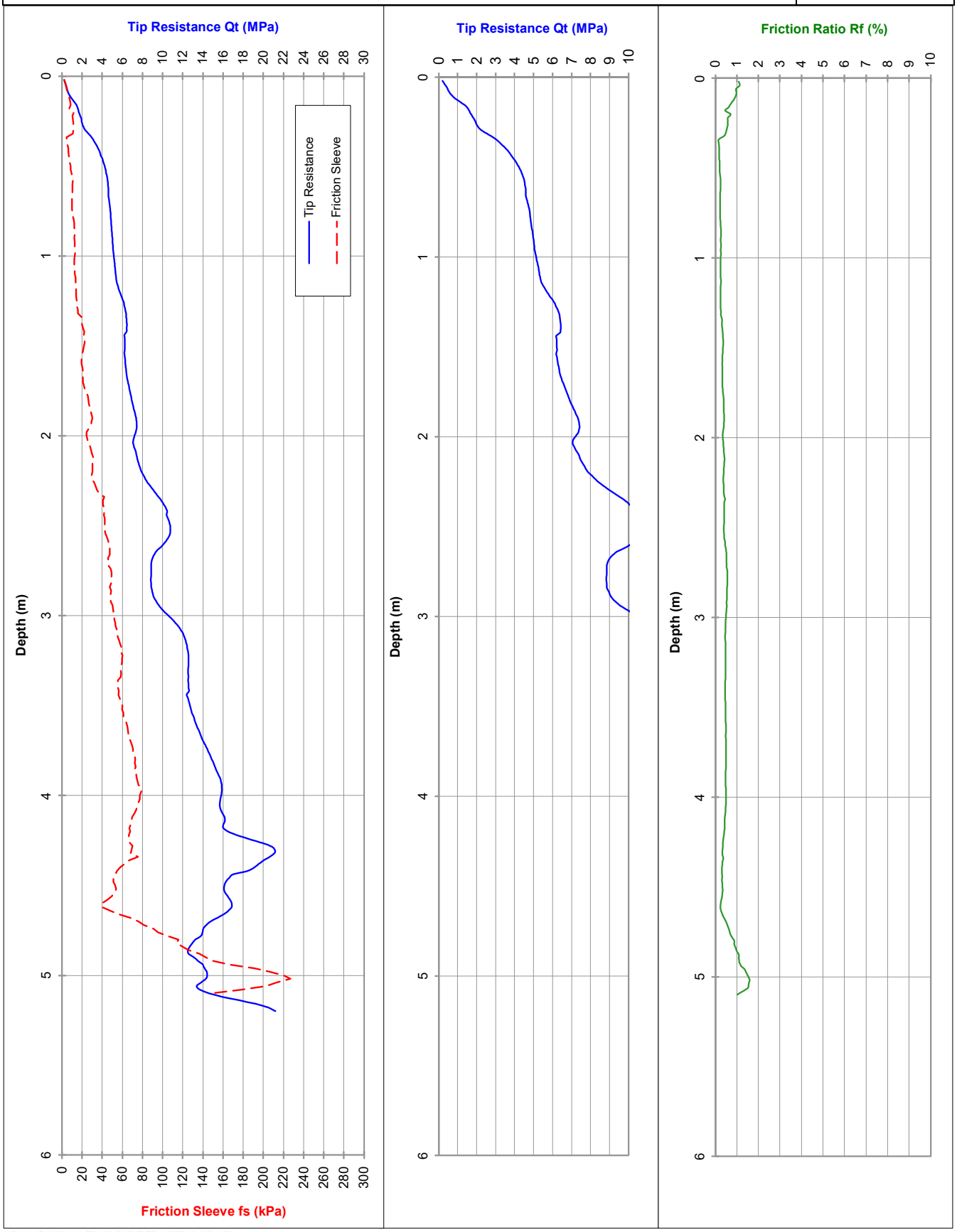
Approx. Water (m): Dry to 2.0

File: GG0059T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 14**
LOCATION: Wellard	Co-ords:	28-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 2.20

Dummy probe to (m):

Refusal:

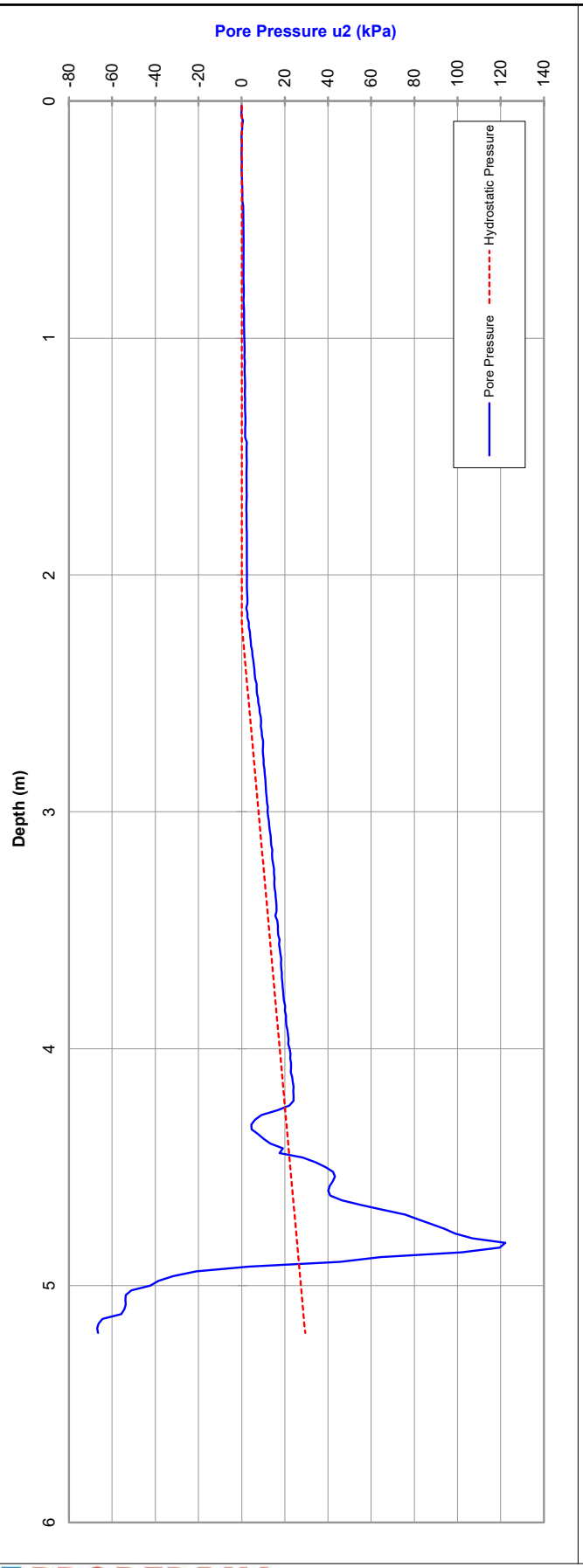
Cone I.D.: EC28

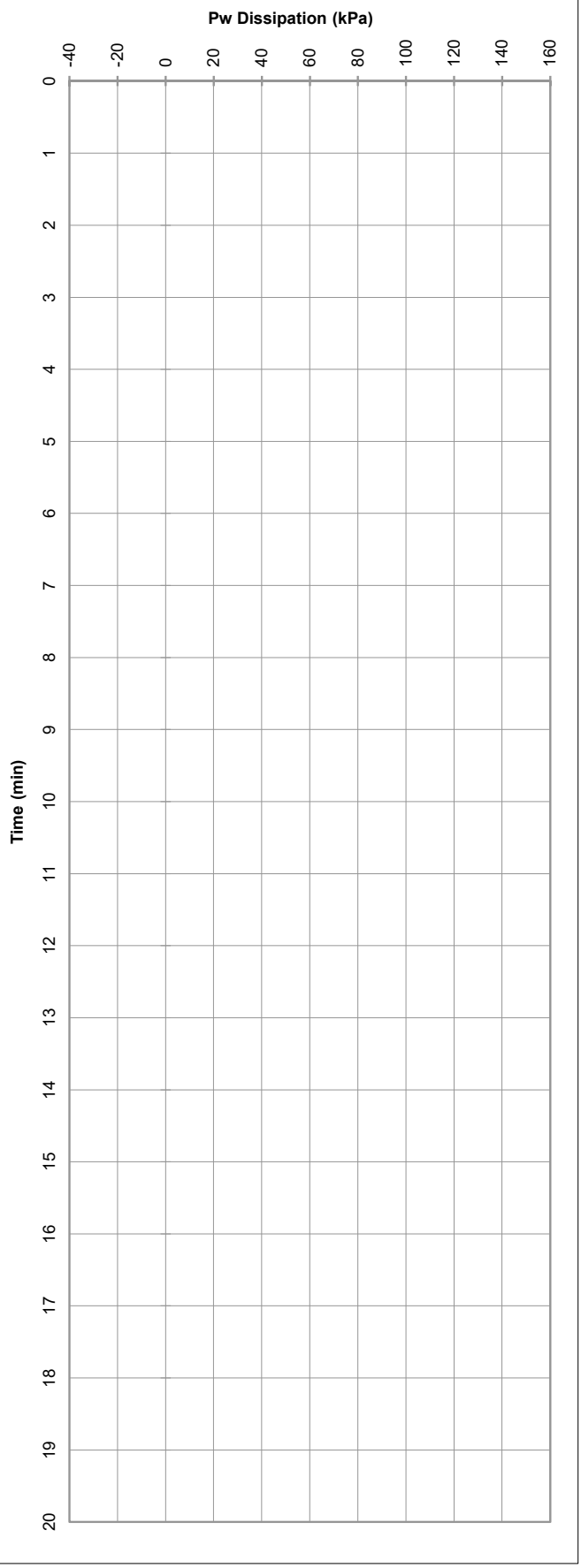
File: GG0060T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 14**
LOCATION:	Wellard	Co-ords:	28-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

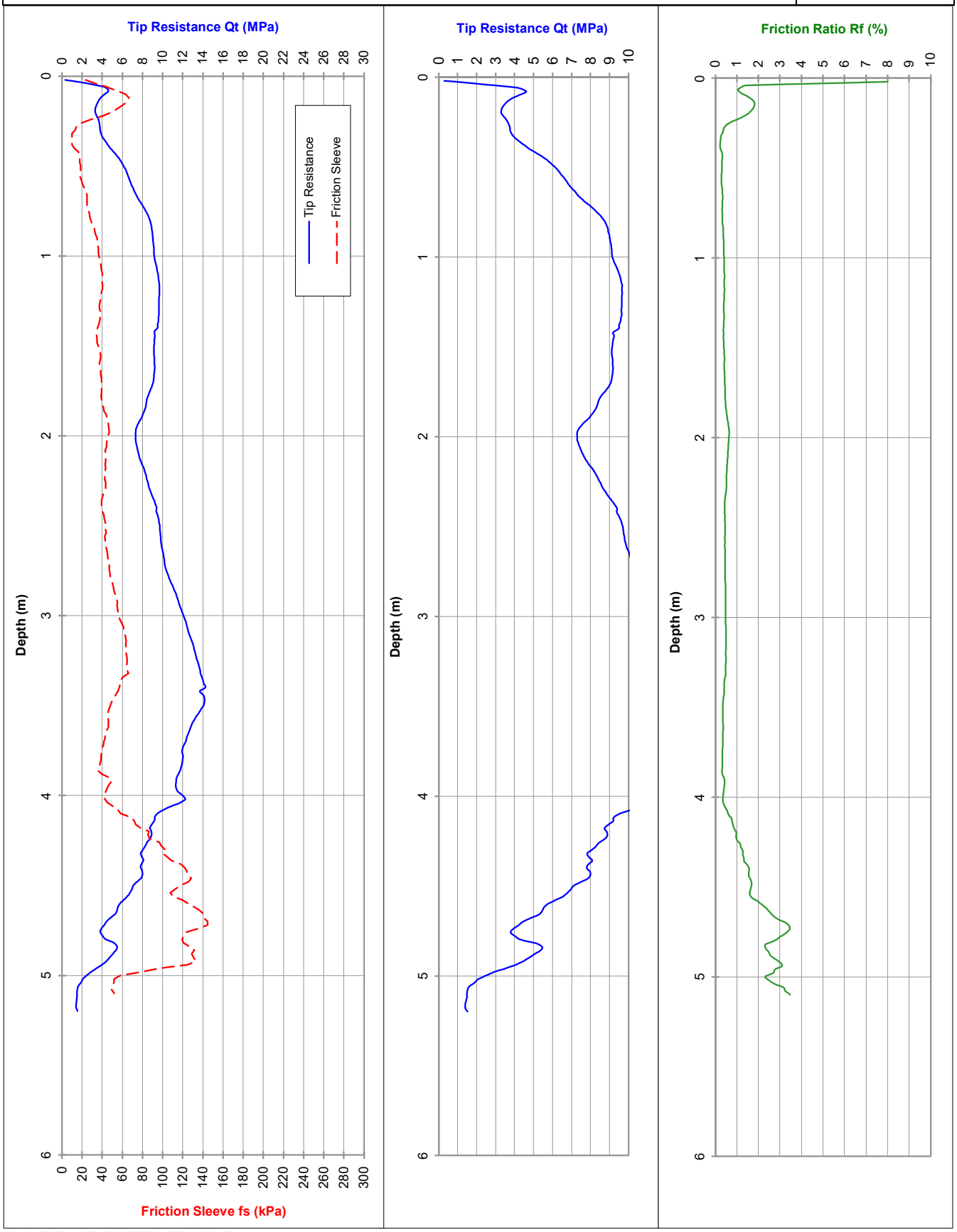
Approx. Water (m): 2.2

File: GG0060T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 15**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.7

Dummy probe to (m):

Refusal:

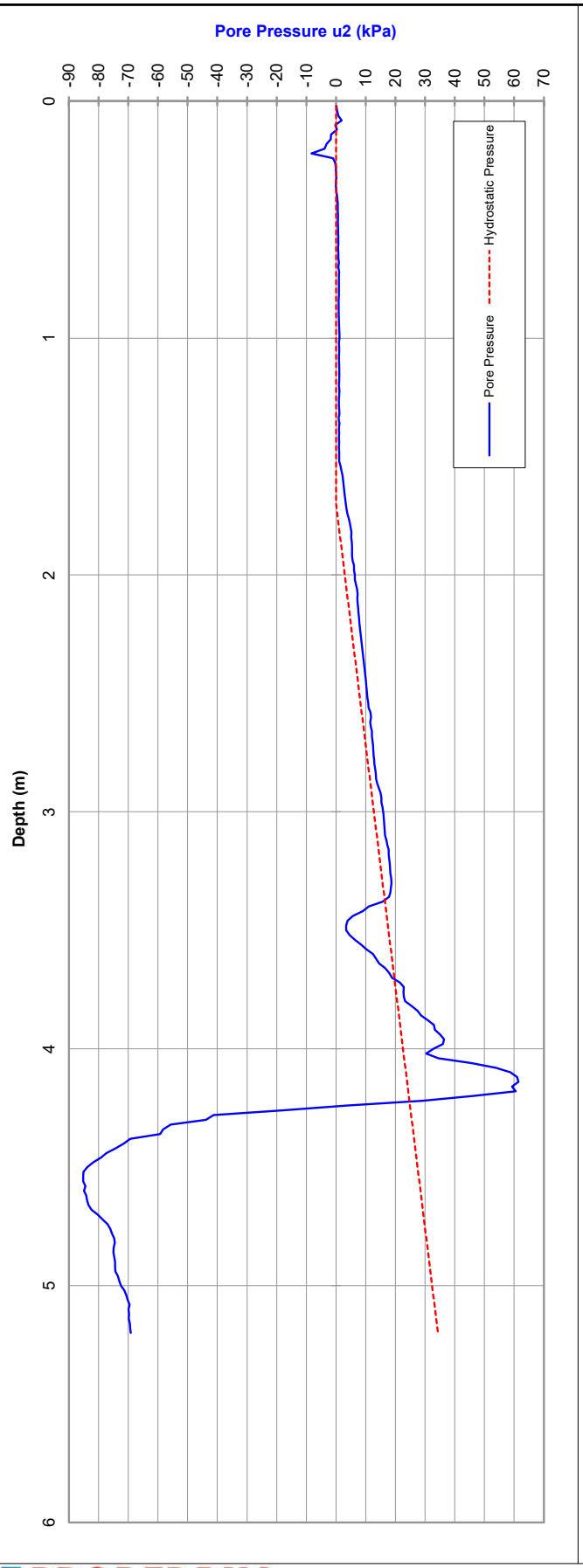
Cone I.D.: EC28

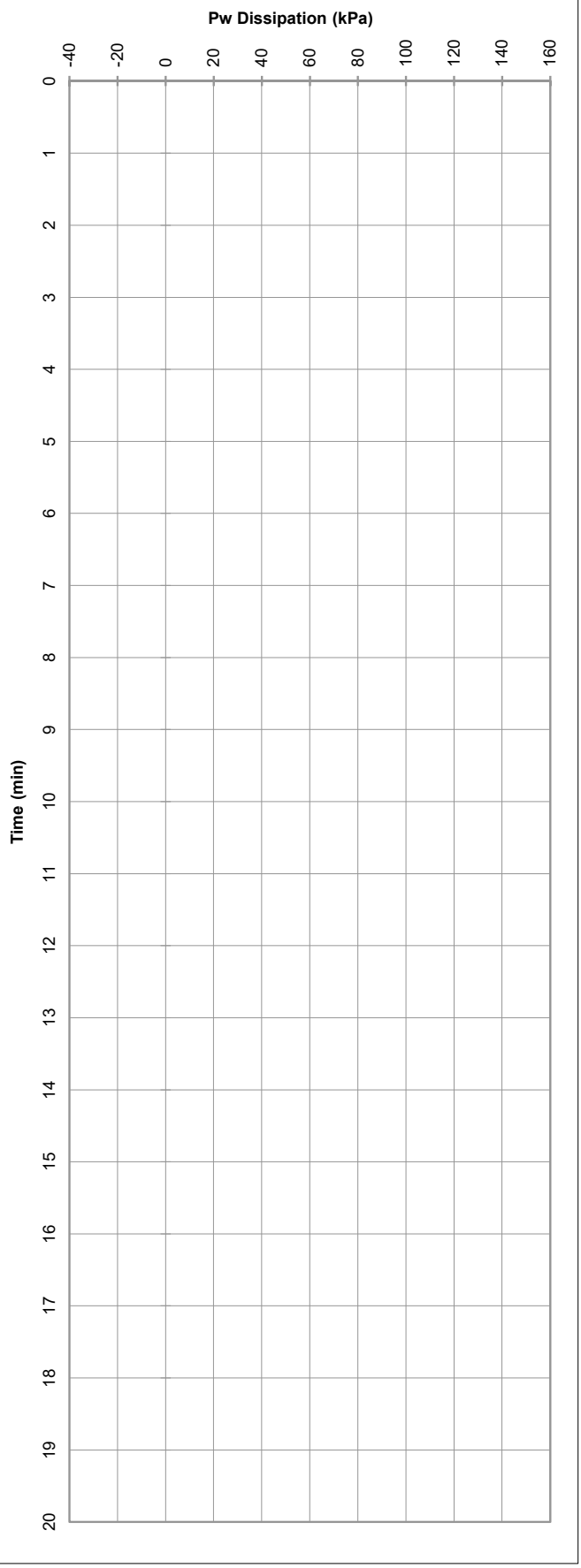
File: GG0061T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 15**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

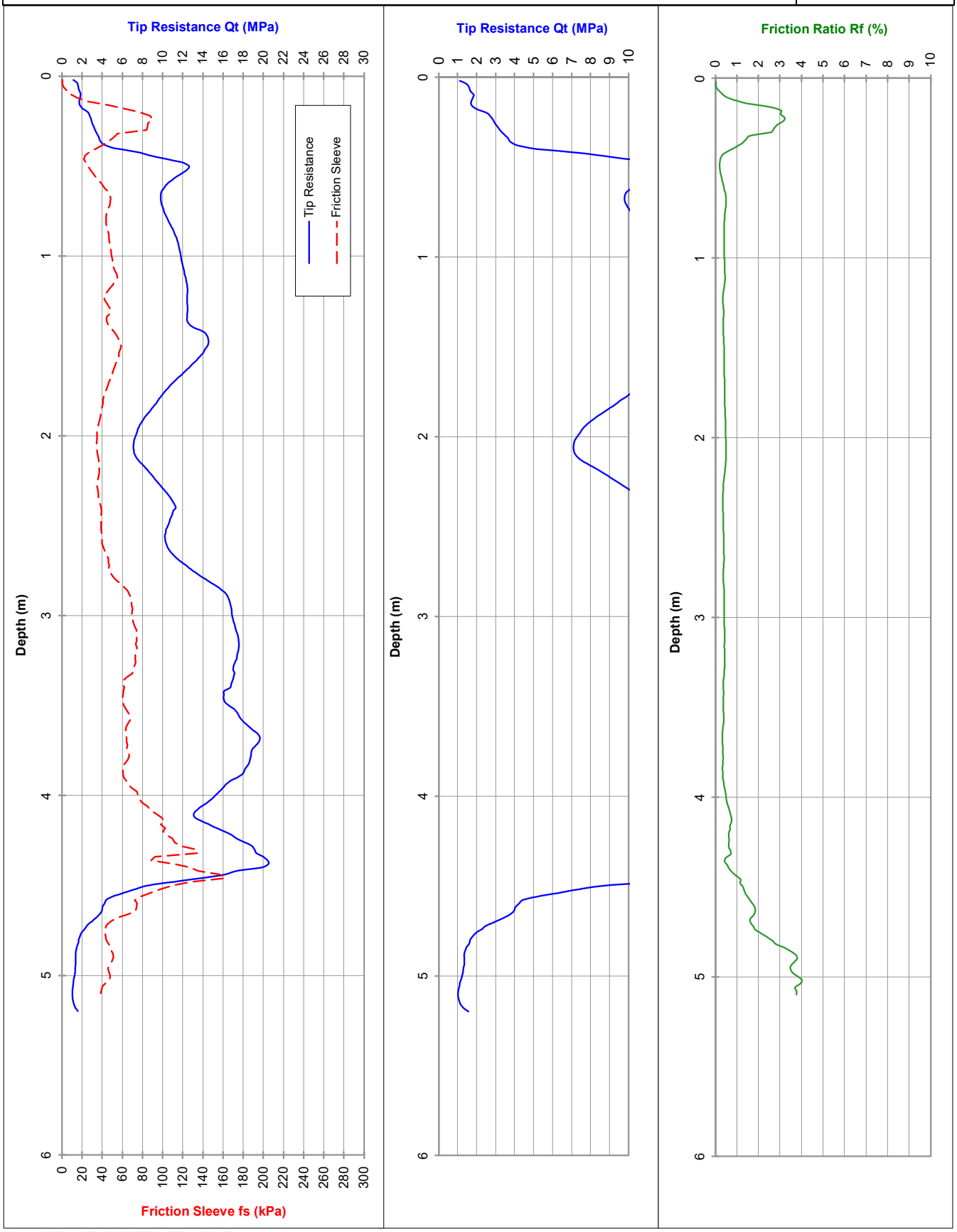
Approx. Water (m): 1.7

File: GG0061T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 16**
LOCATION:	Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.60

Dummy probe to (m):

Refusal:

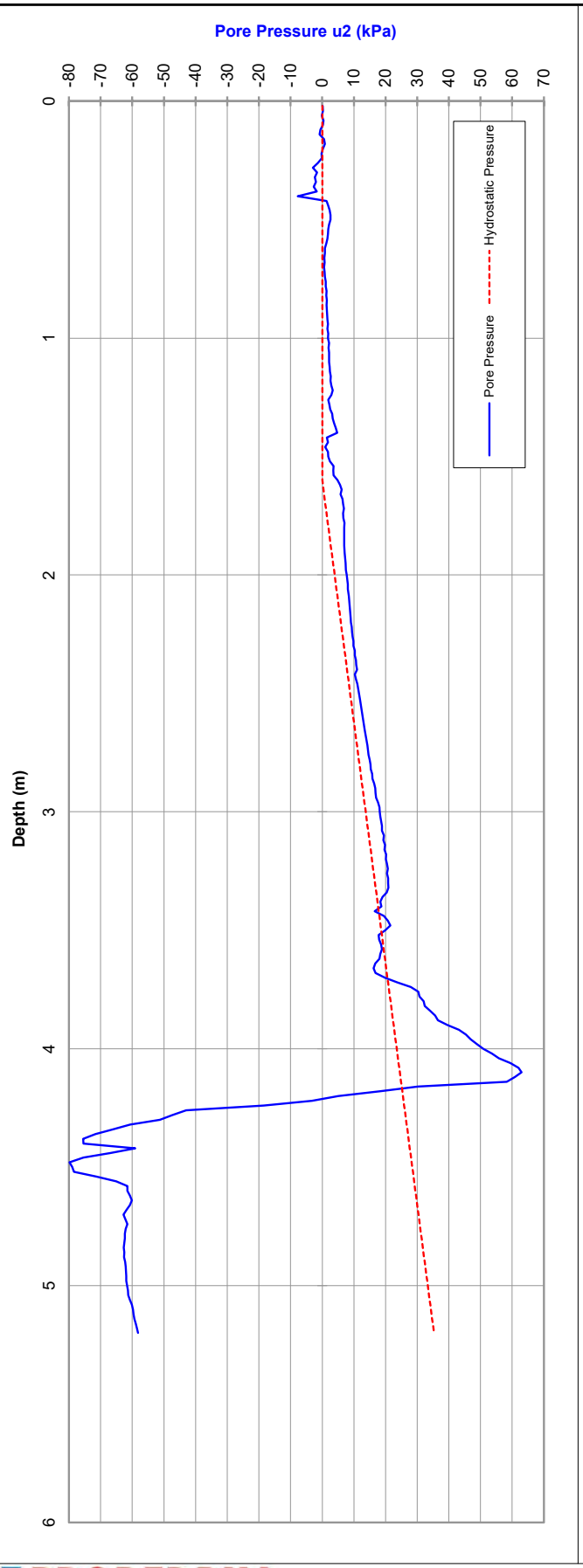
Cone I.D.: EC28

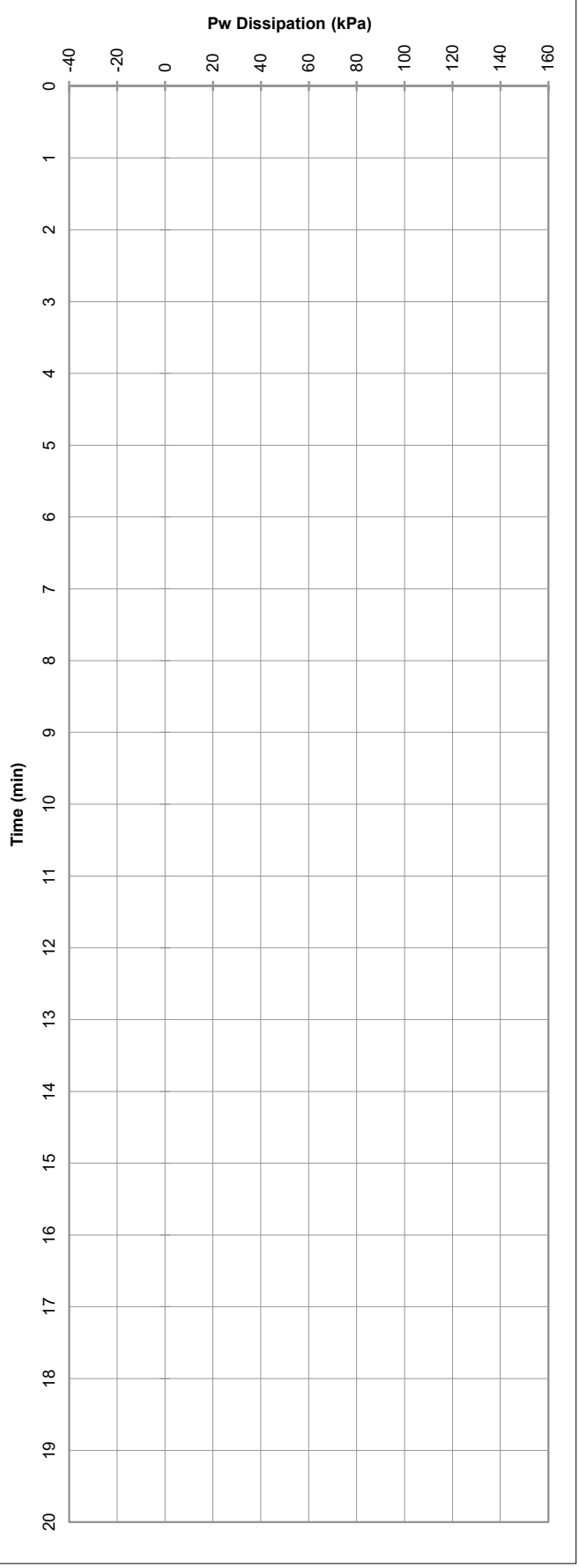
File: GG0062T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 16**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

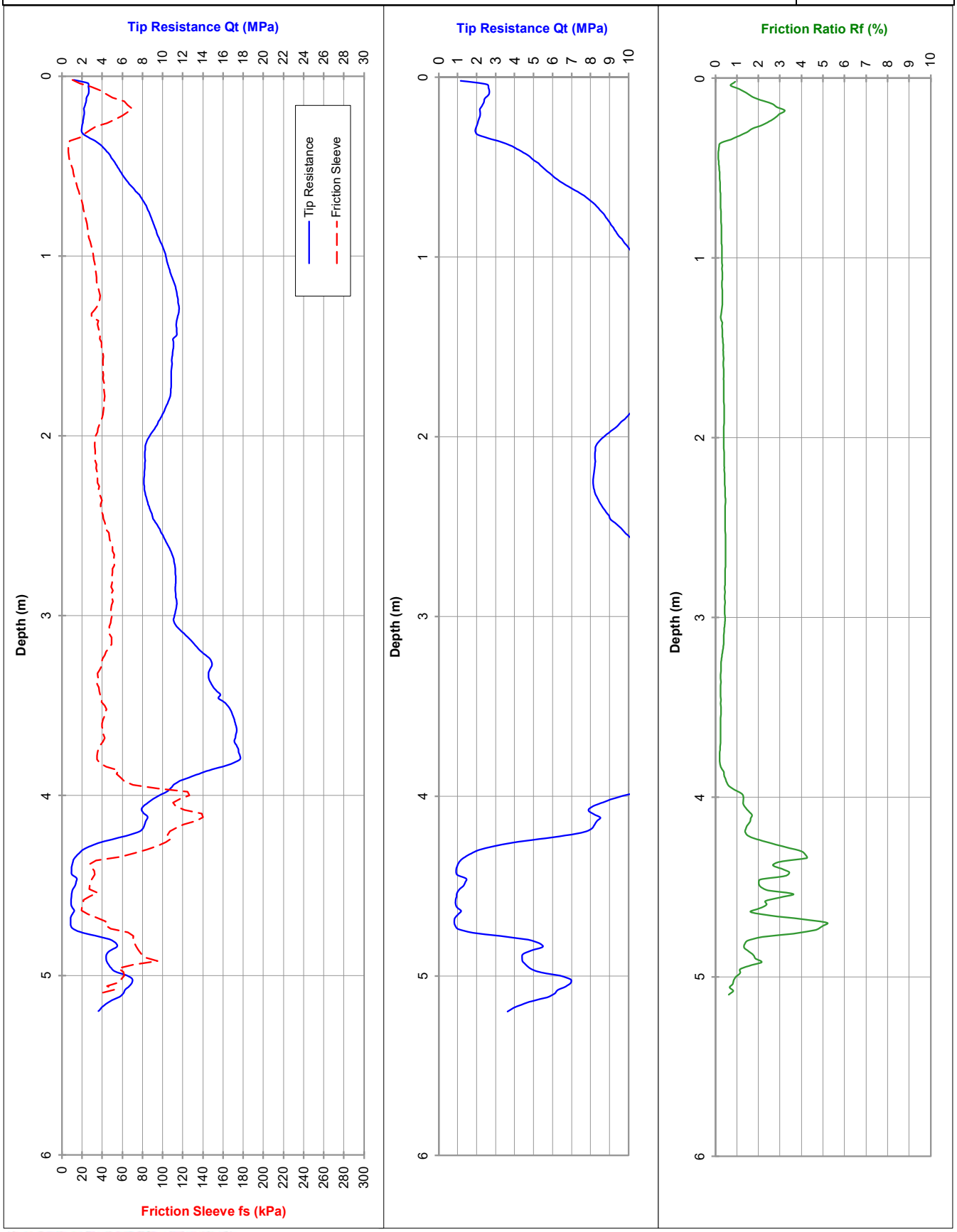
Approx. Water (m): 1.6

File: GG0062T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 17**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.50

Dummy probe to (m):

Refusal:

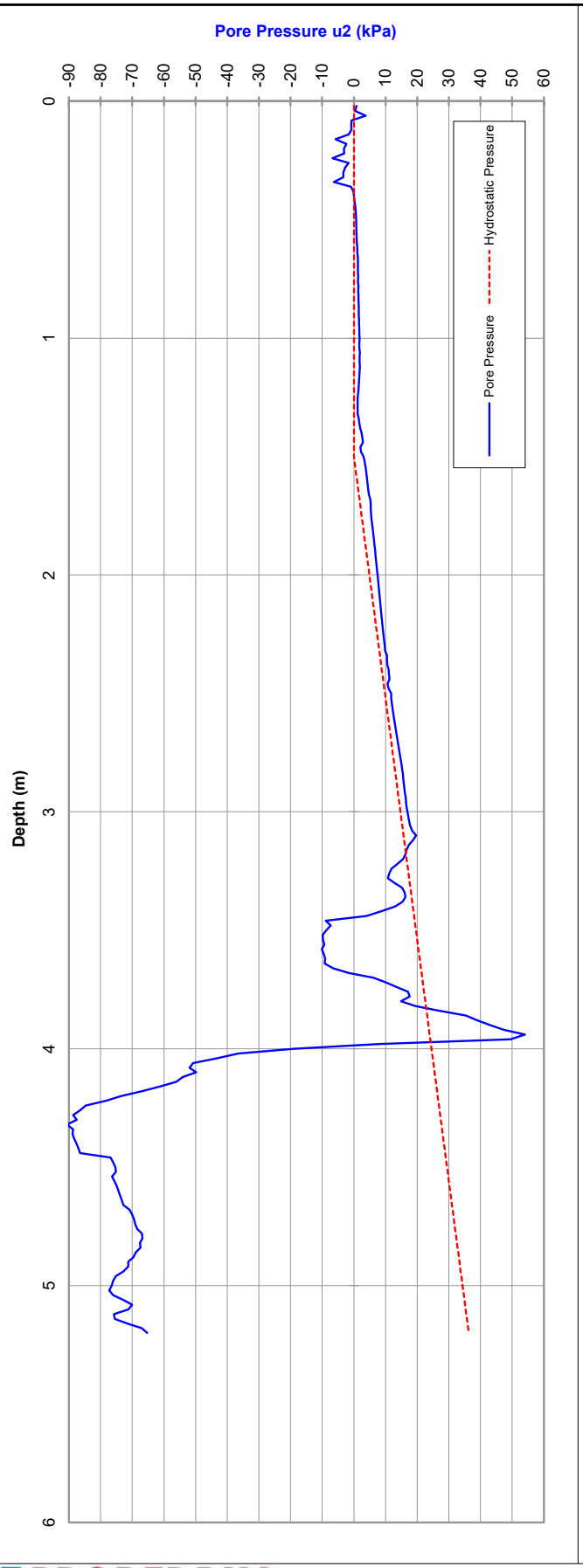
Cone I.D.: EC28

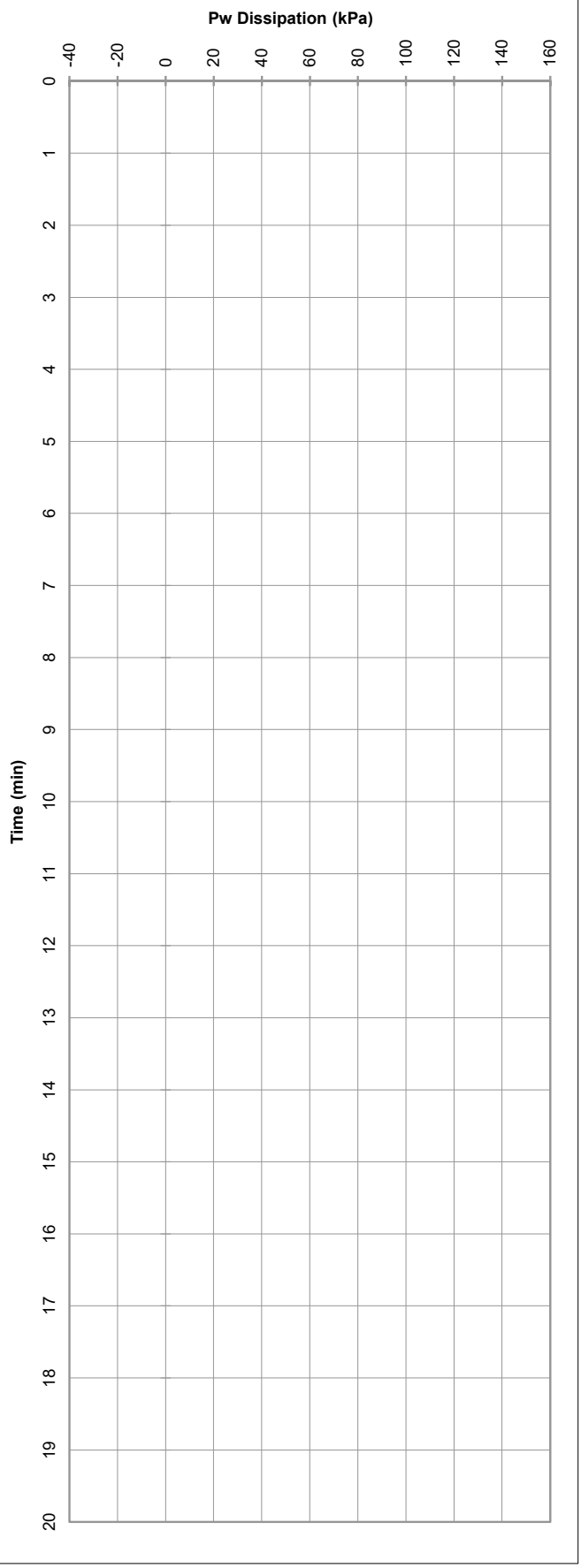
File: GG0063T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 17**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

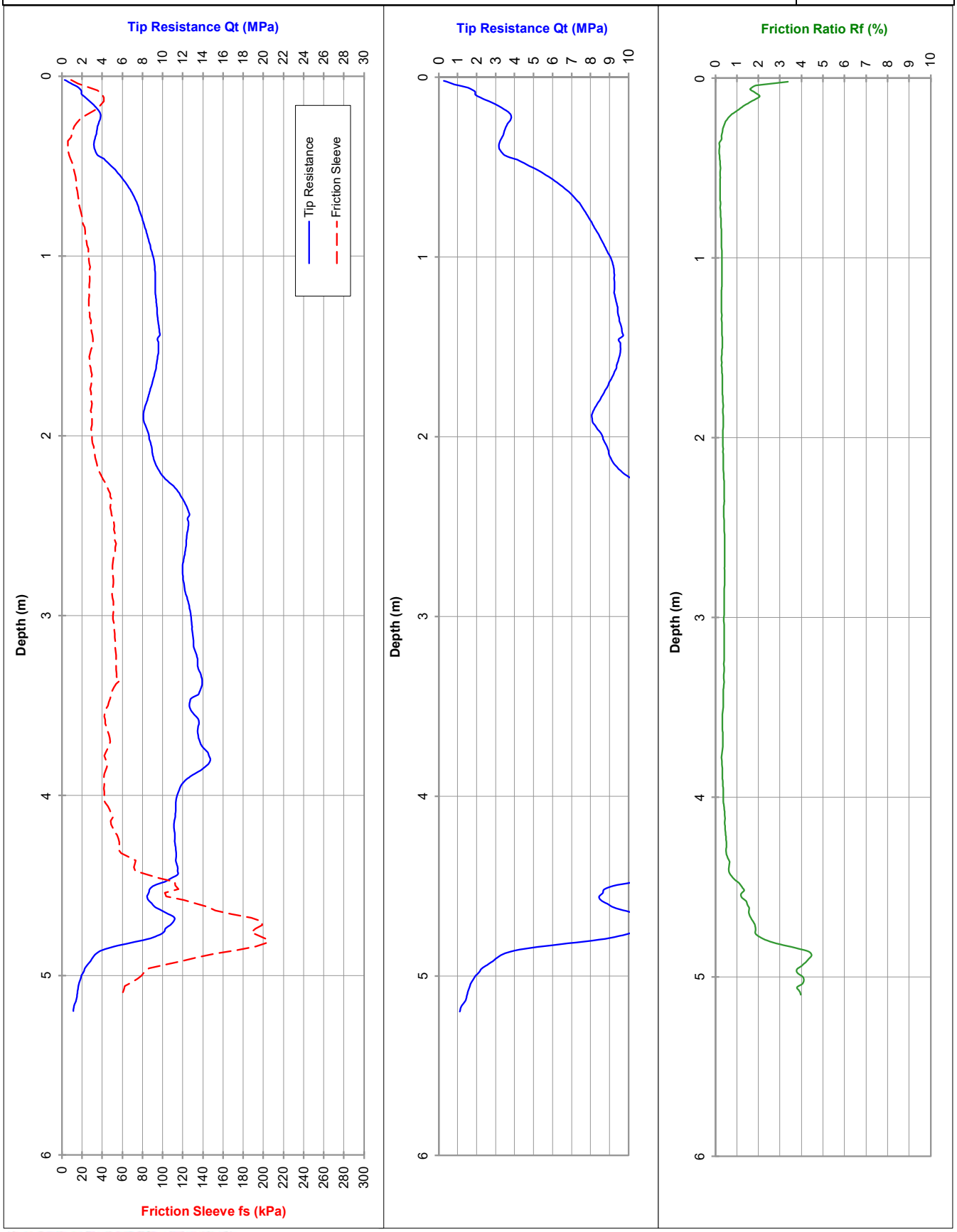
Approx. Water (m): 1.5

File: GG0063T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 18**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.70

Dummy probe to (m):

Refusal:

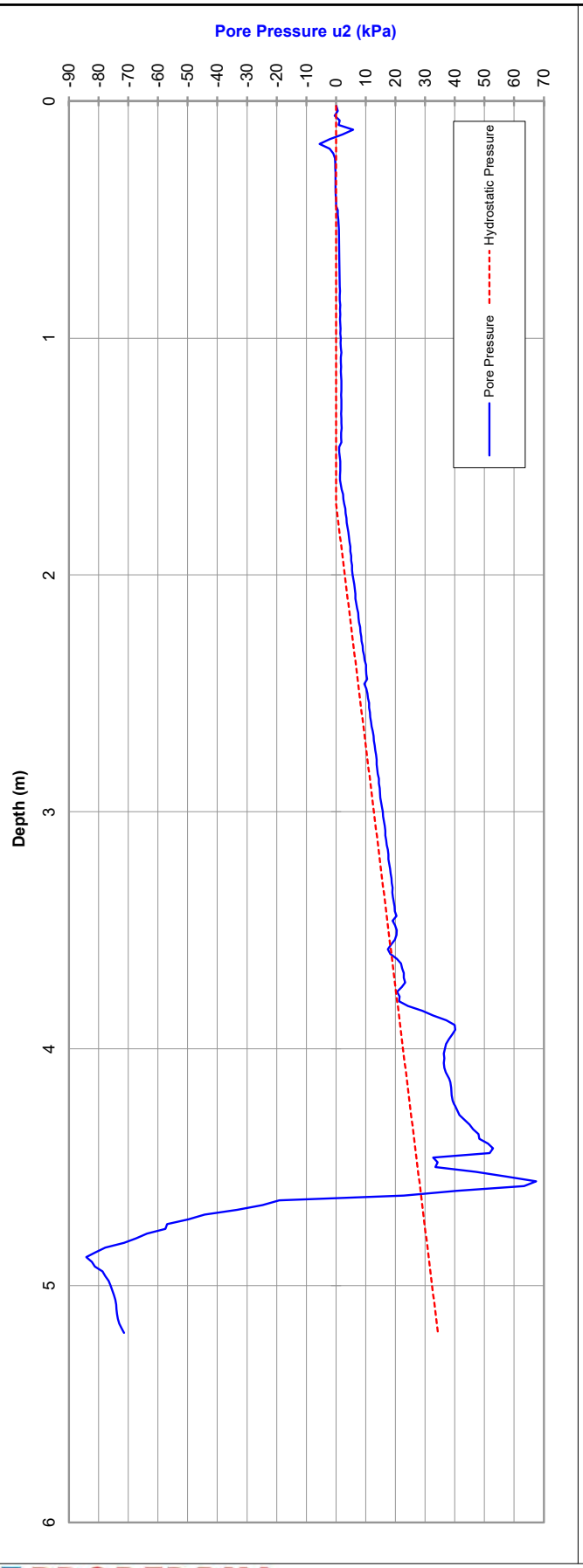
Cone I.D.: EC28

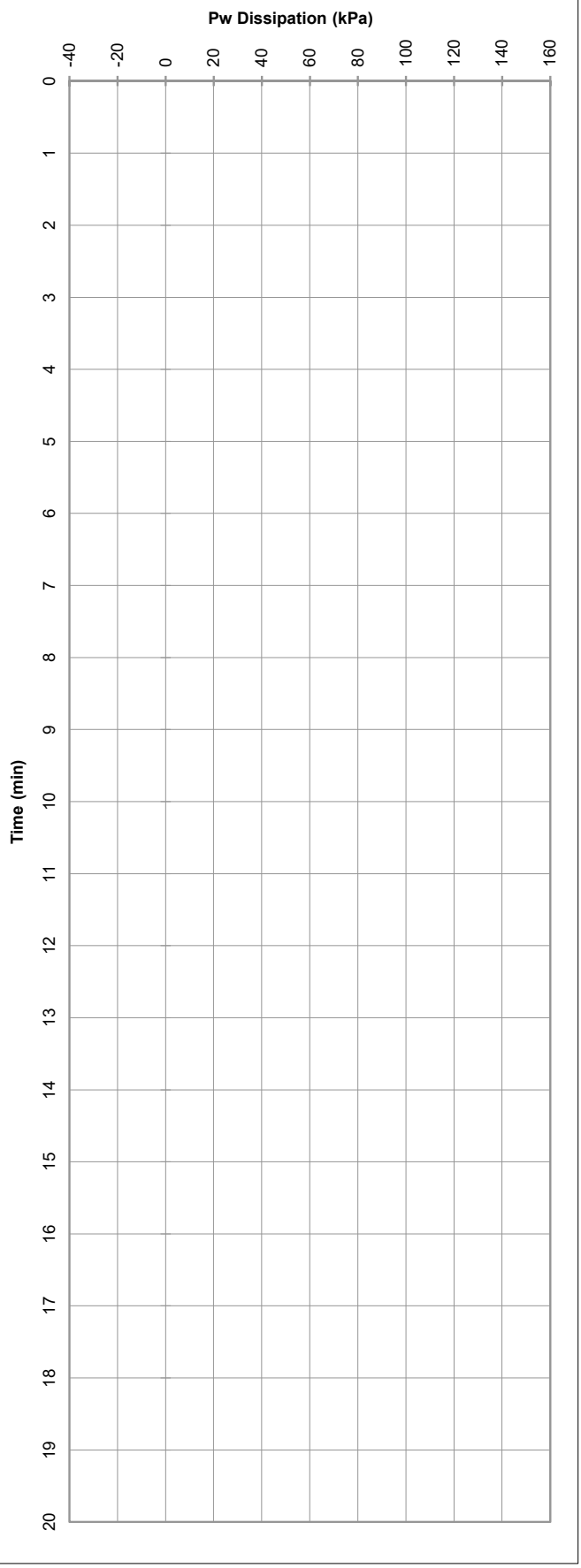
File: GG0064T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 18**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

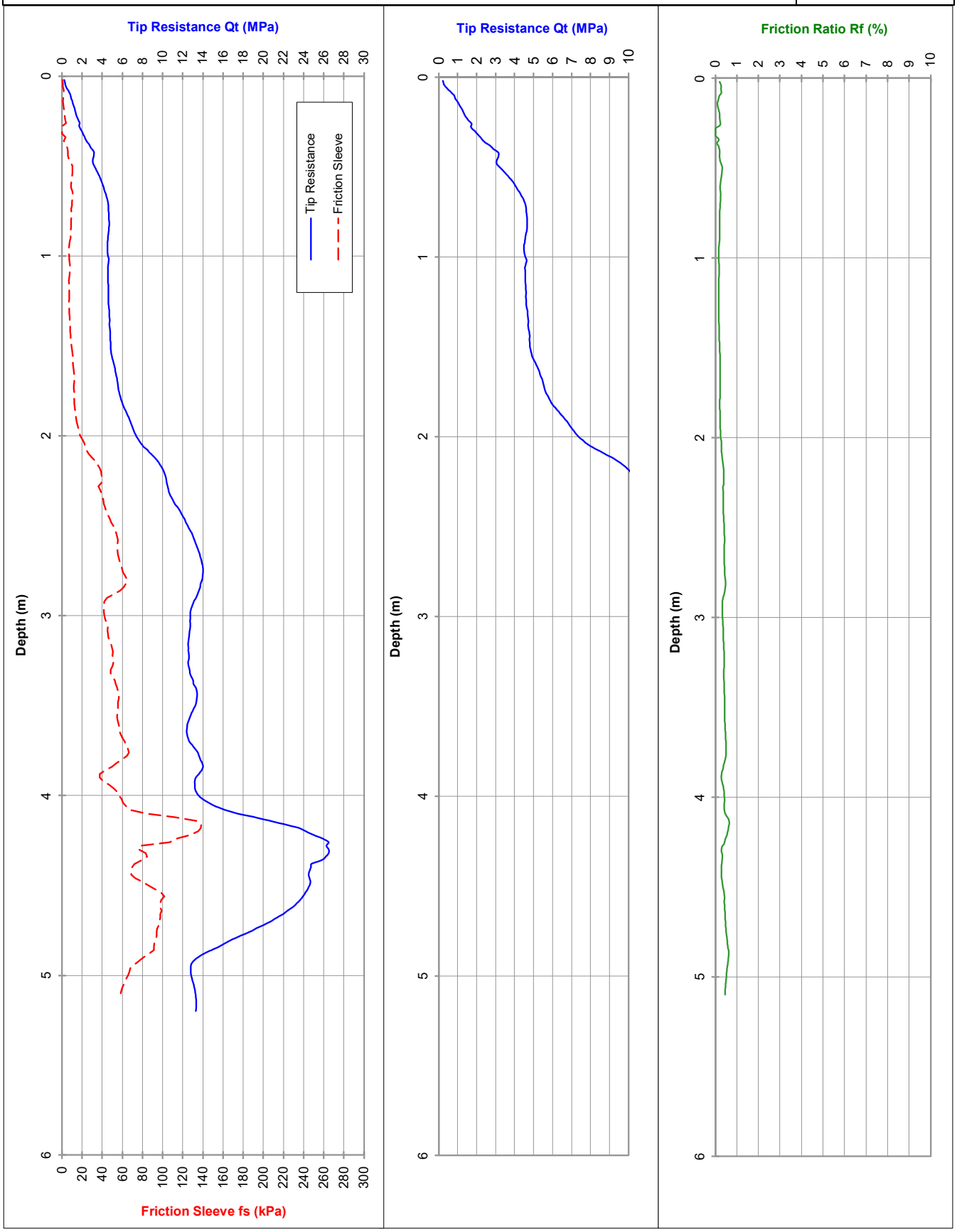
Approx. Water (m): 1.7

File: GG0064T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT:	Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT:	Providence East Estate	RL (m):	**CPTU 19**
LOCATION:	Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal:

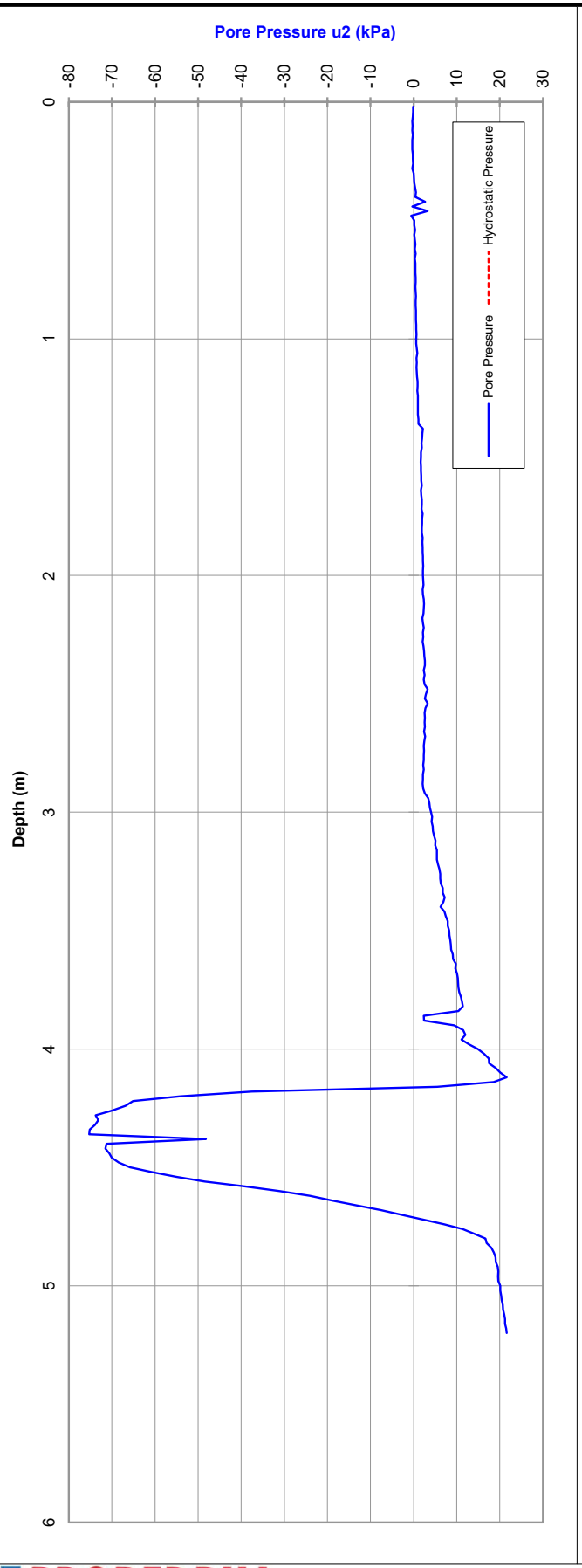
Cone I.D.: EC28

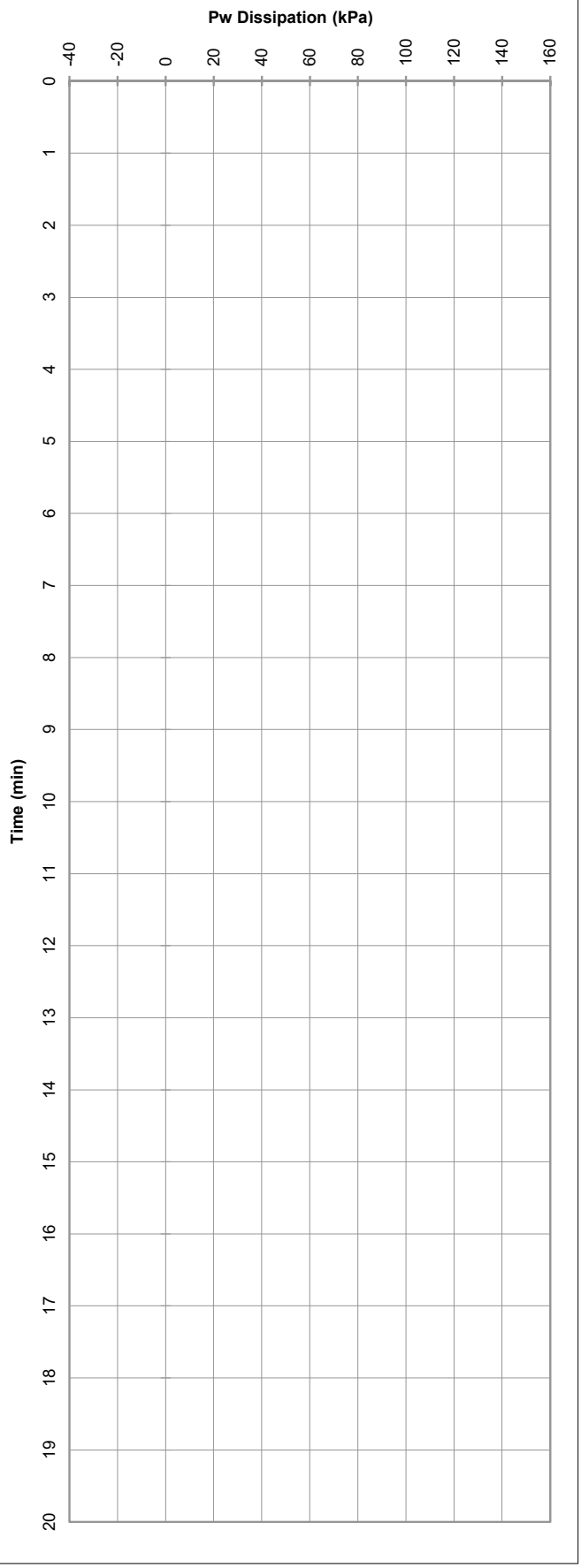
File: GG0071T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 19**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

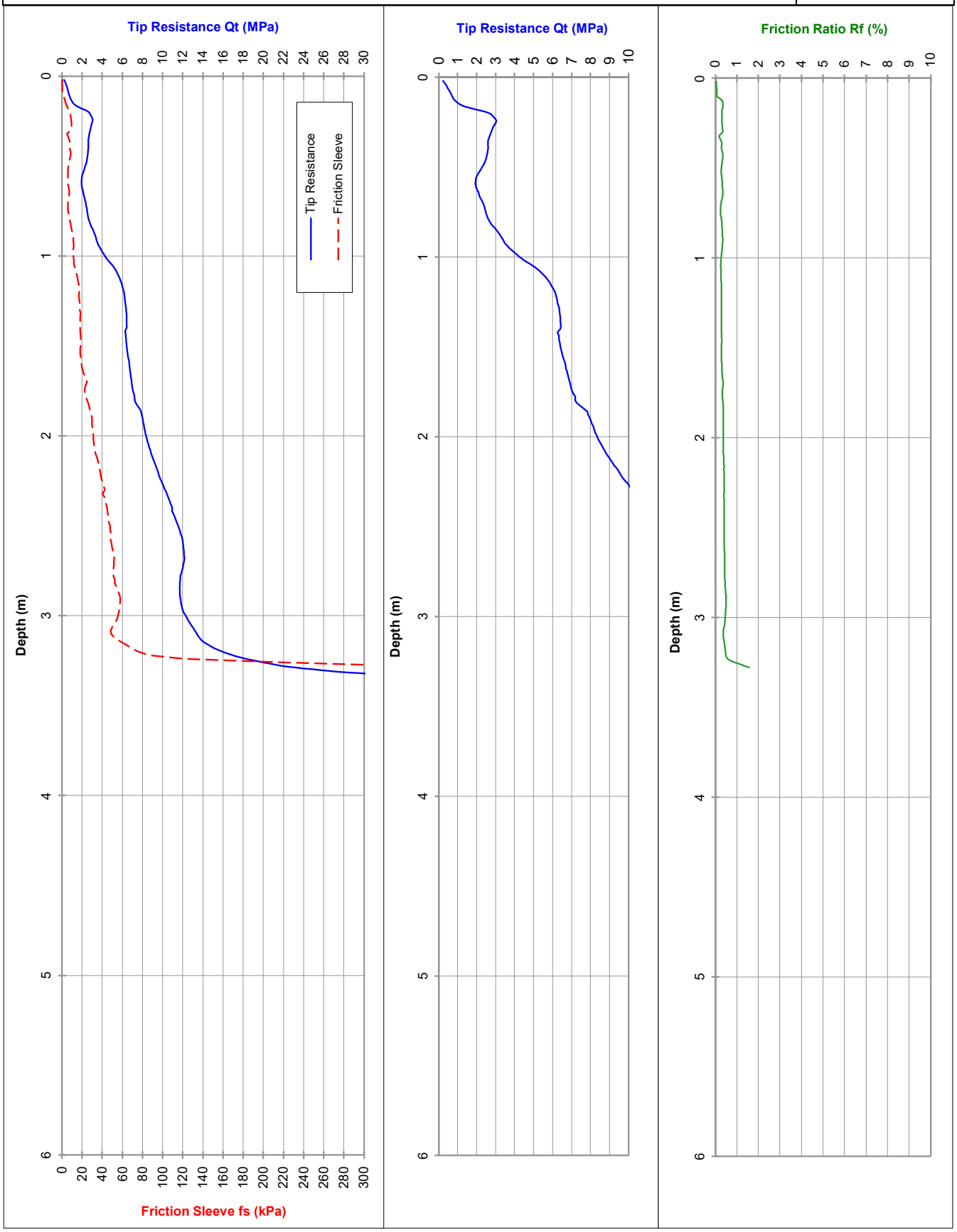
Approx. Water (m): Dry to 3.0

File: GG0071T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal: 58 MPa + Rod Friction

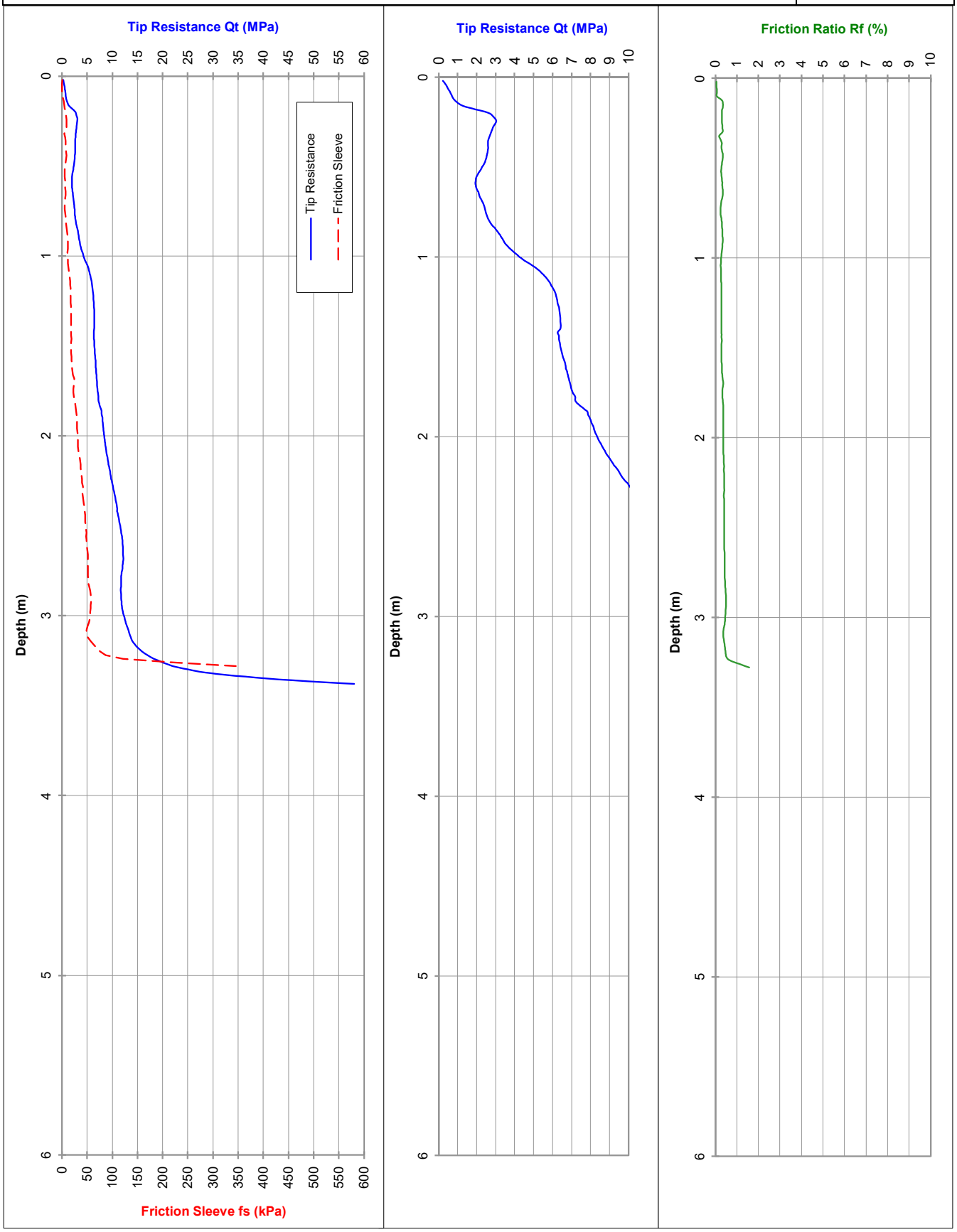
Cone I.D.: EC28

File: GG0069T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal: 58 MPa + Rod Friction

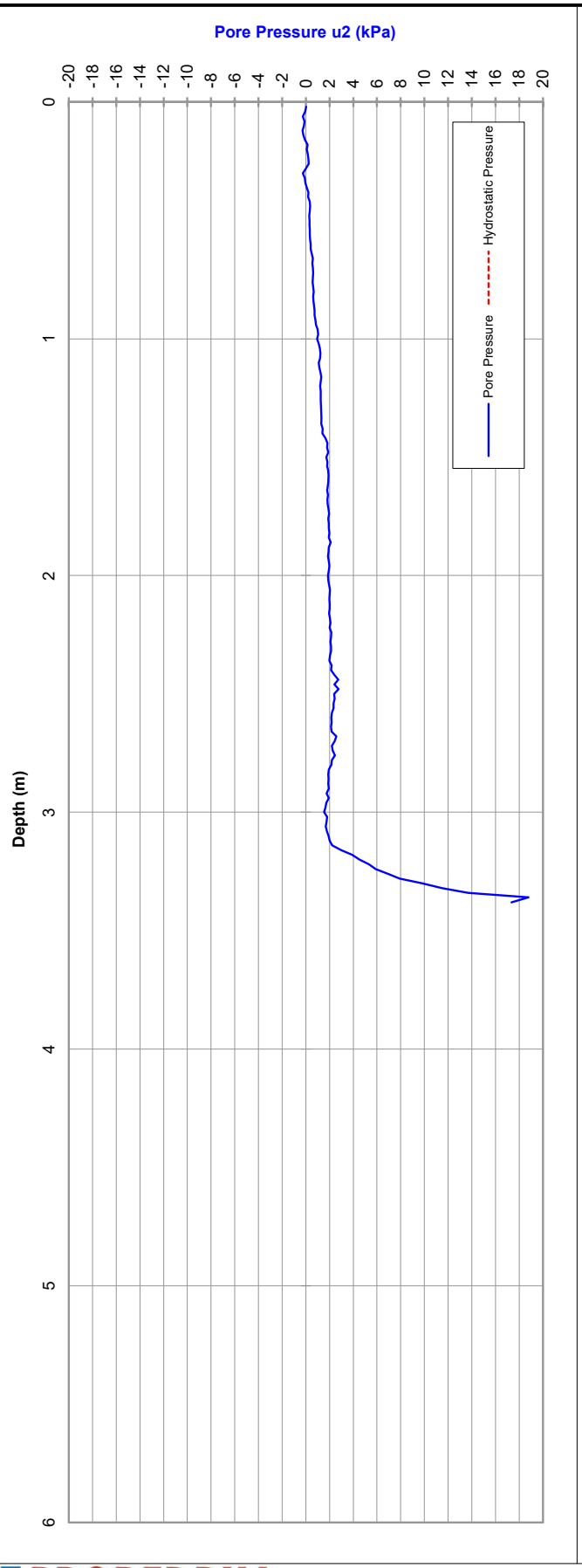
Cone I.D.: EC28

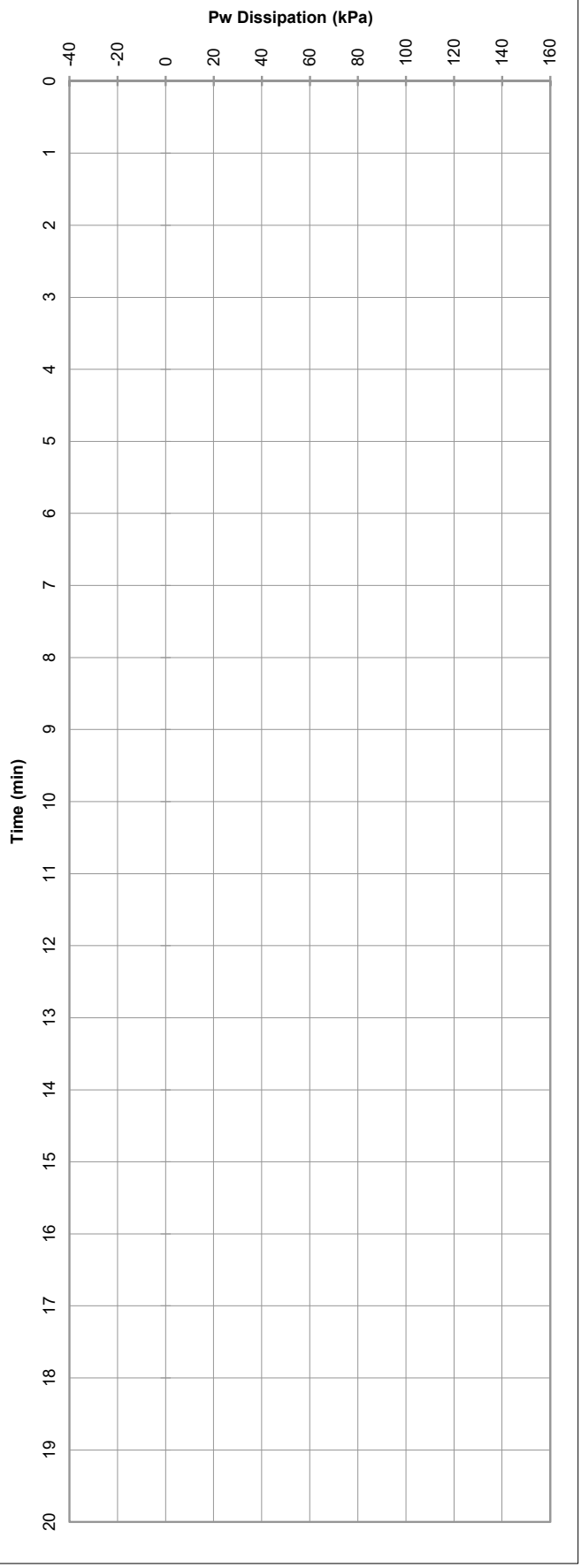
File: GG0069T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

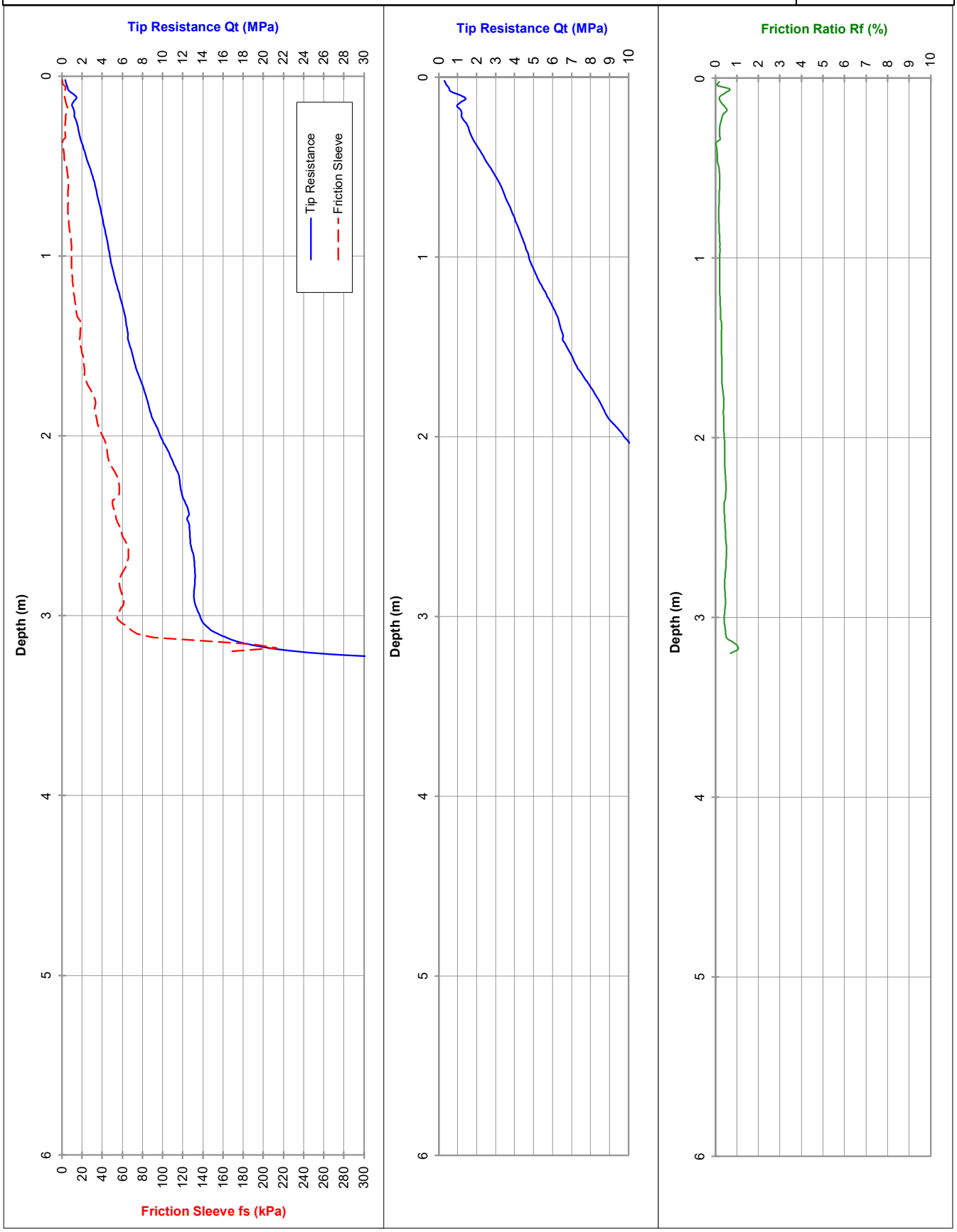
Approx. Water (m): Dry to 3.0

File: GG0069T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20A**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal: 56 MPa + Rod Friction

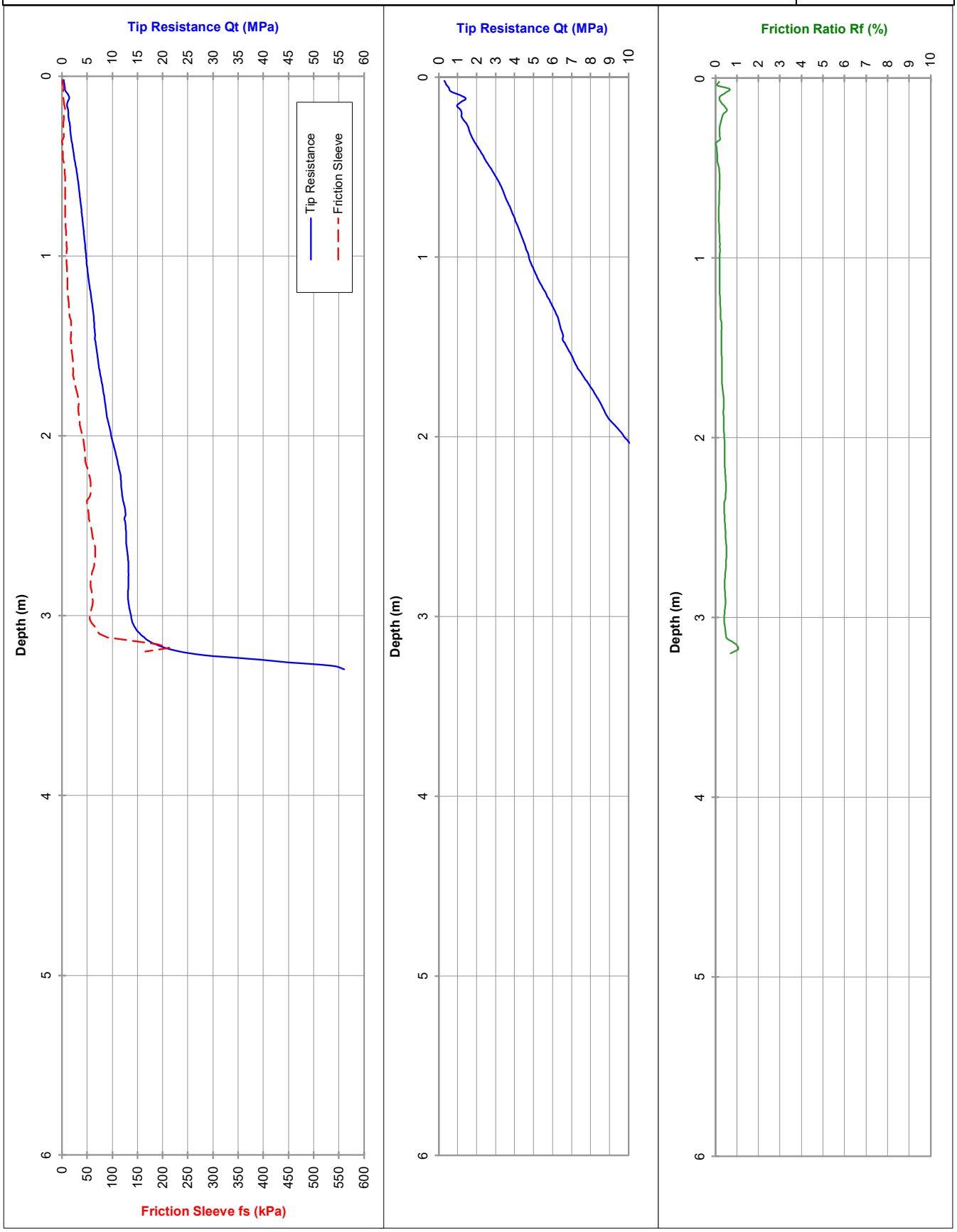
Cone I.D.: EC28

File: GG0070T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20A**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): Dry to 3.0

Dummy probe to (m):

Refusal: 56 MPa + Rod Friction

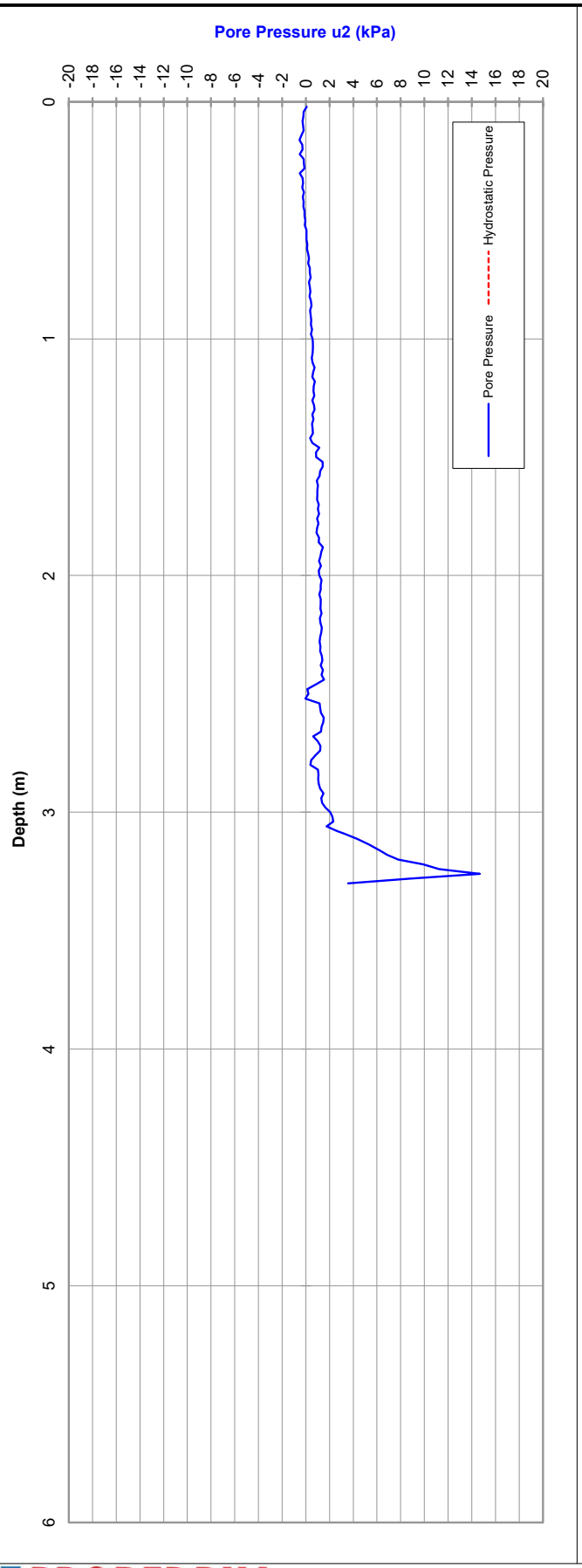
Cone I.D.: EC28

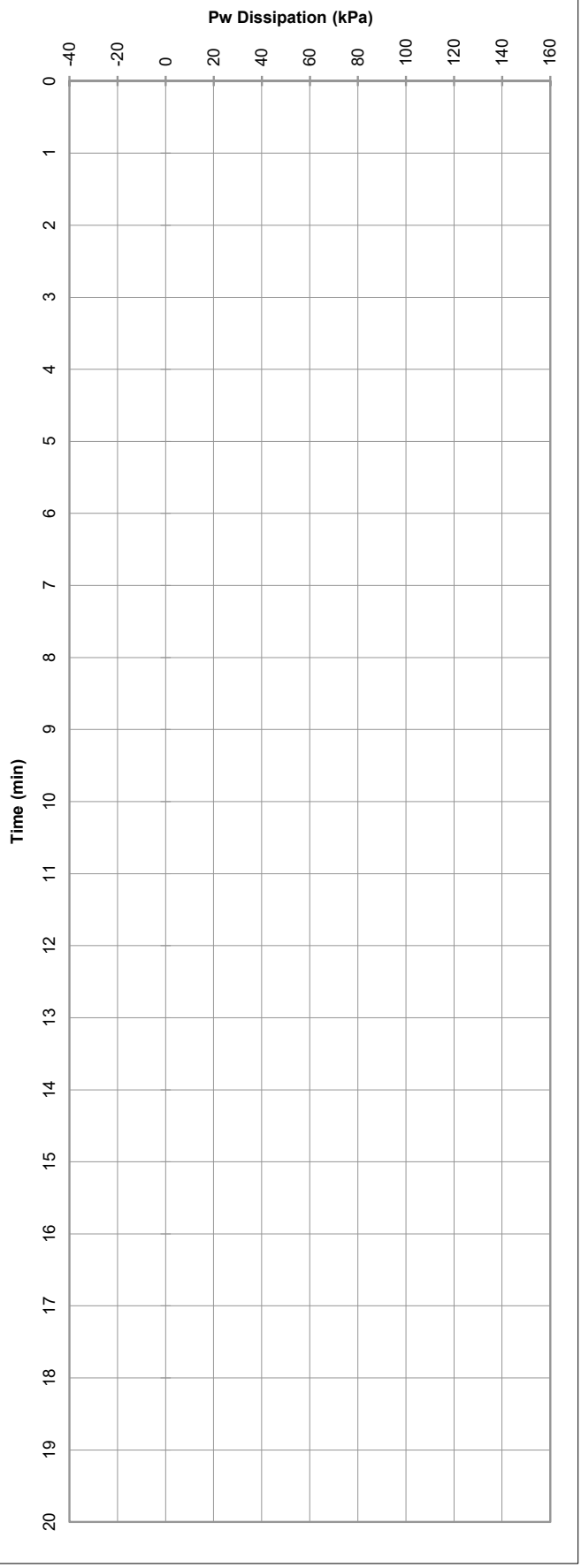
File: GG0070T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 20A**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

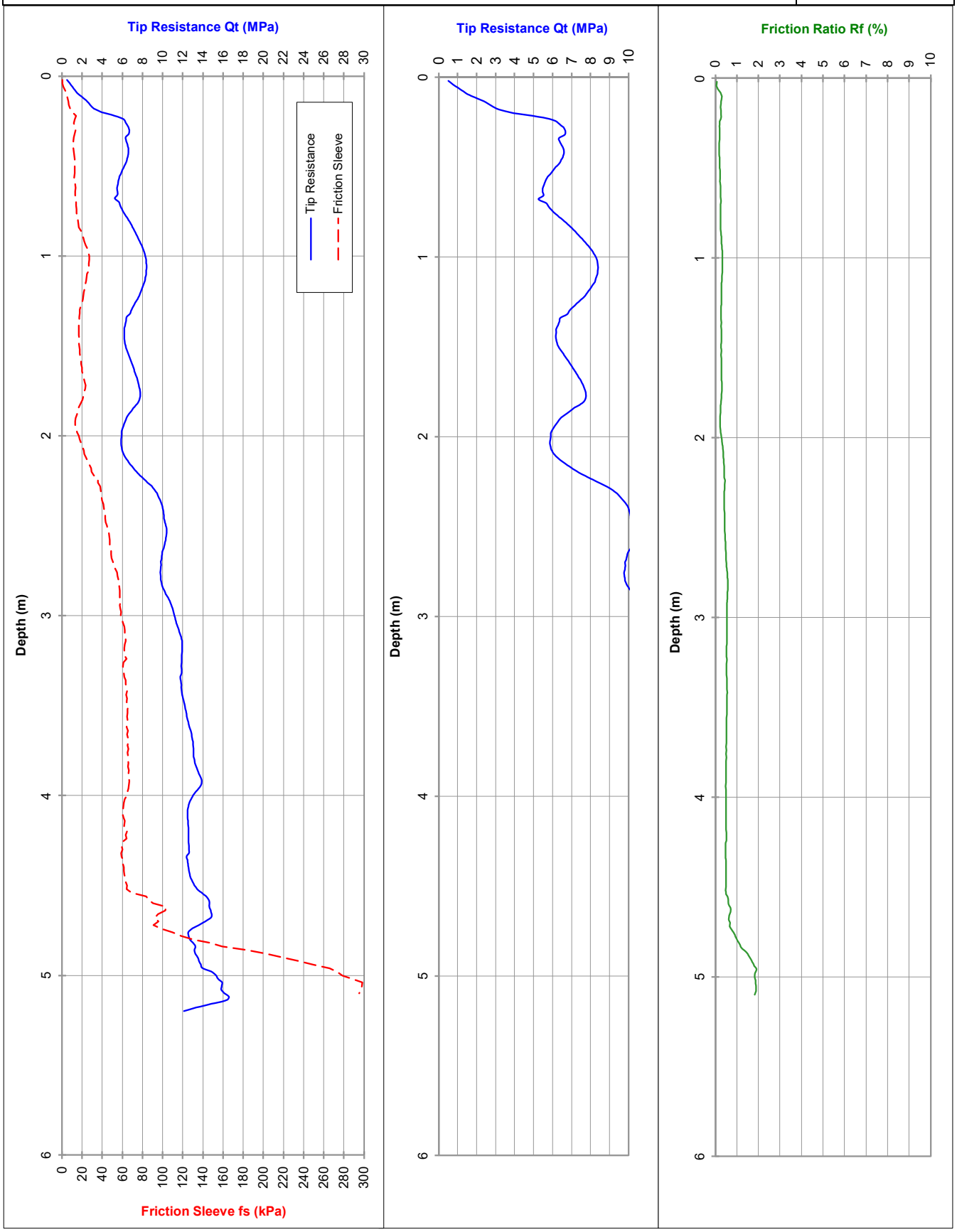
Approx. Water (m): Dry to 3.0

File: GG0070T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 21**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 2.0

Dummy probe to (m):

Refusal:

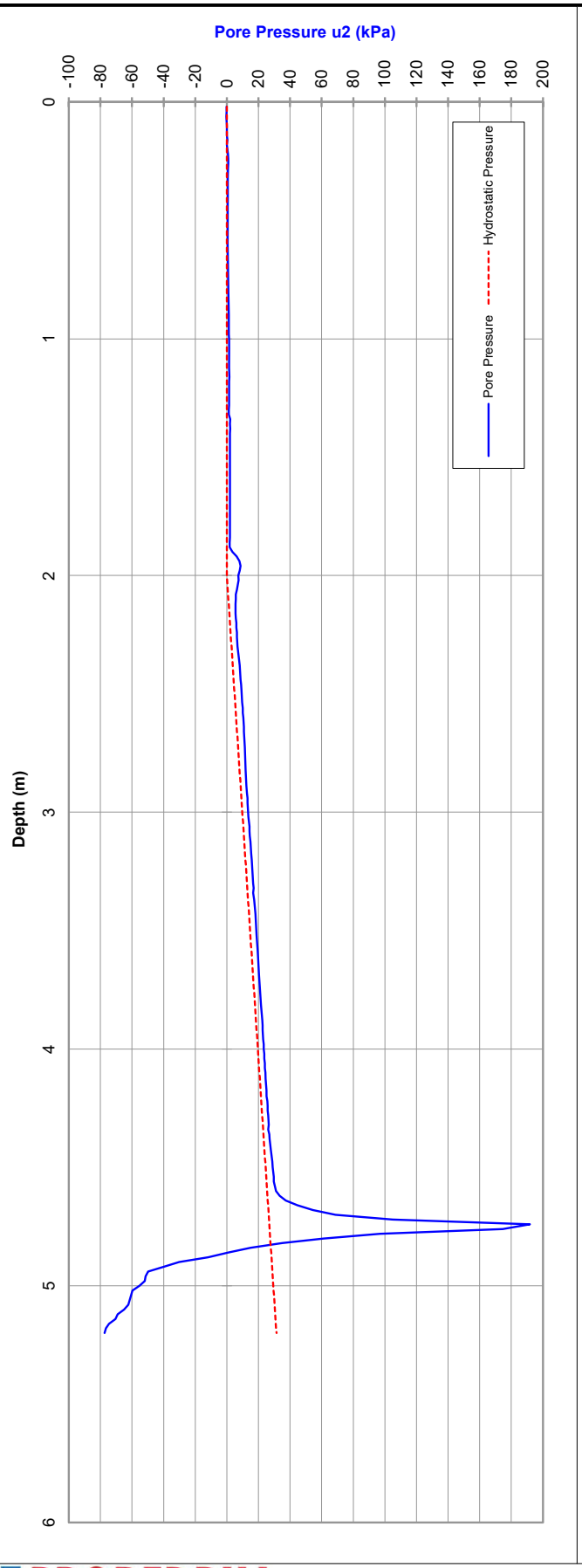
Cone I.D.: EC28

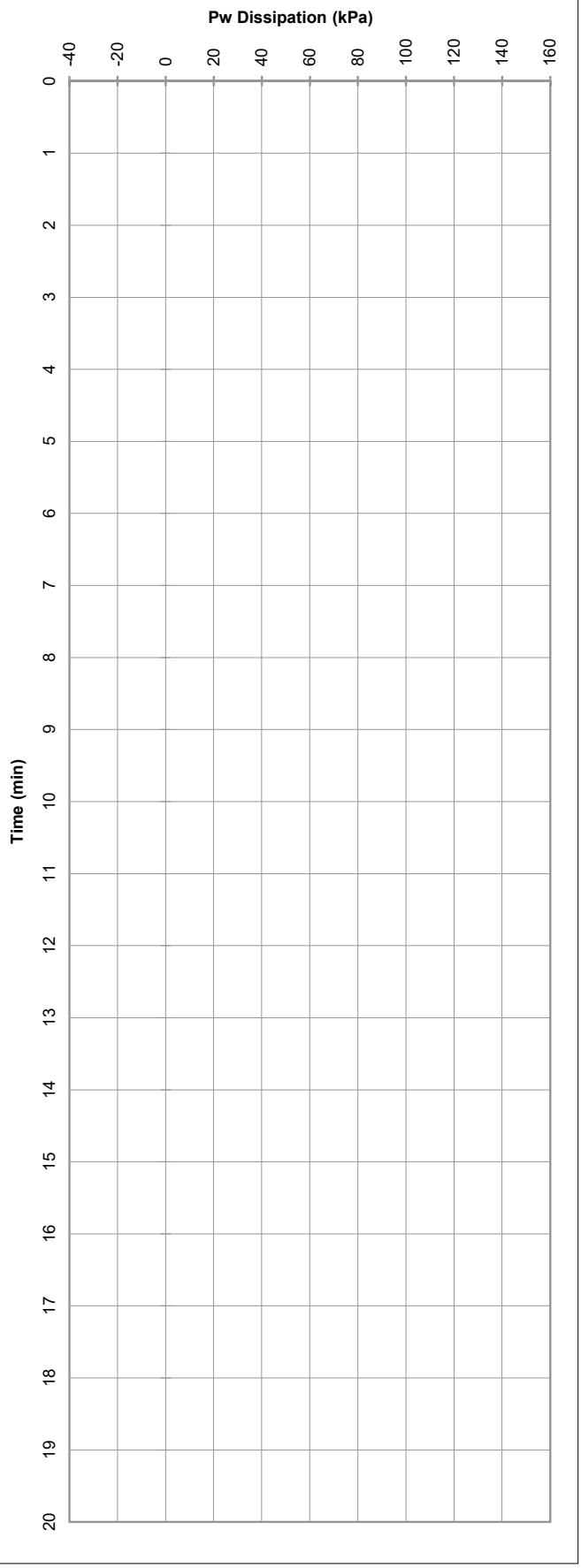
File: GG0068T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 21**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

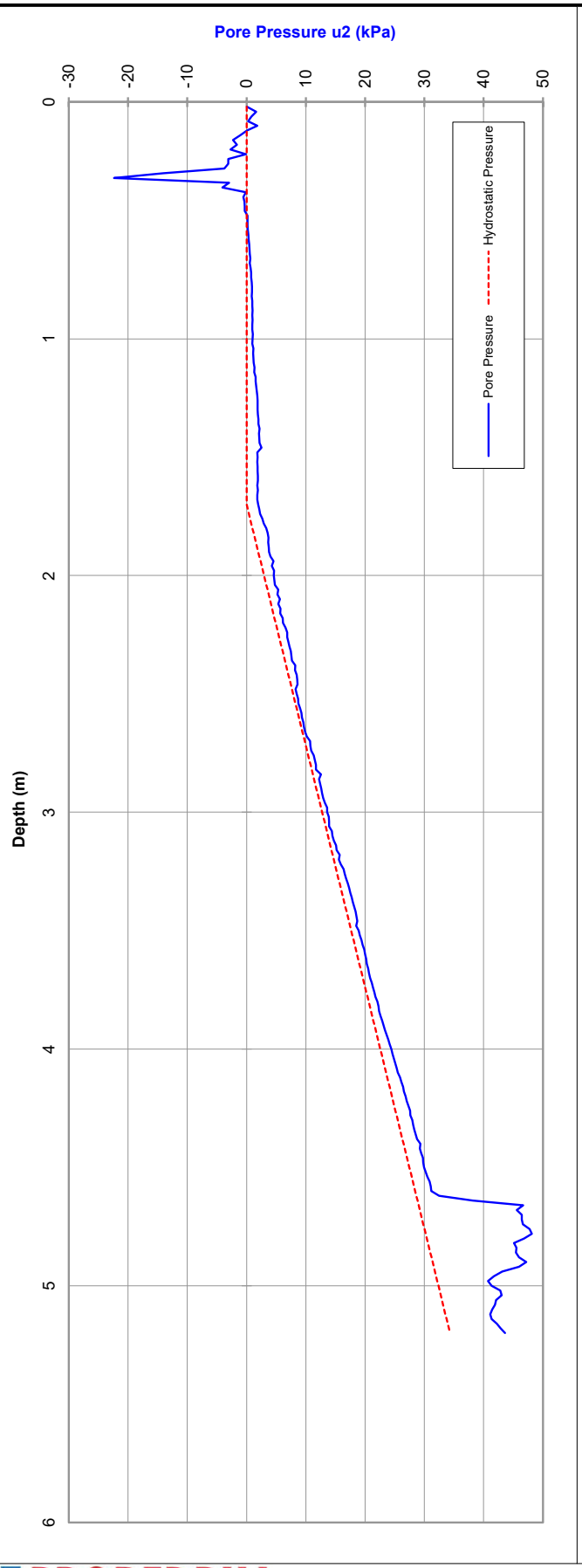
Approx. Water (m): 2

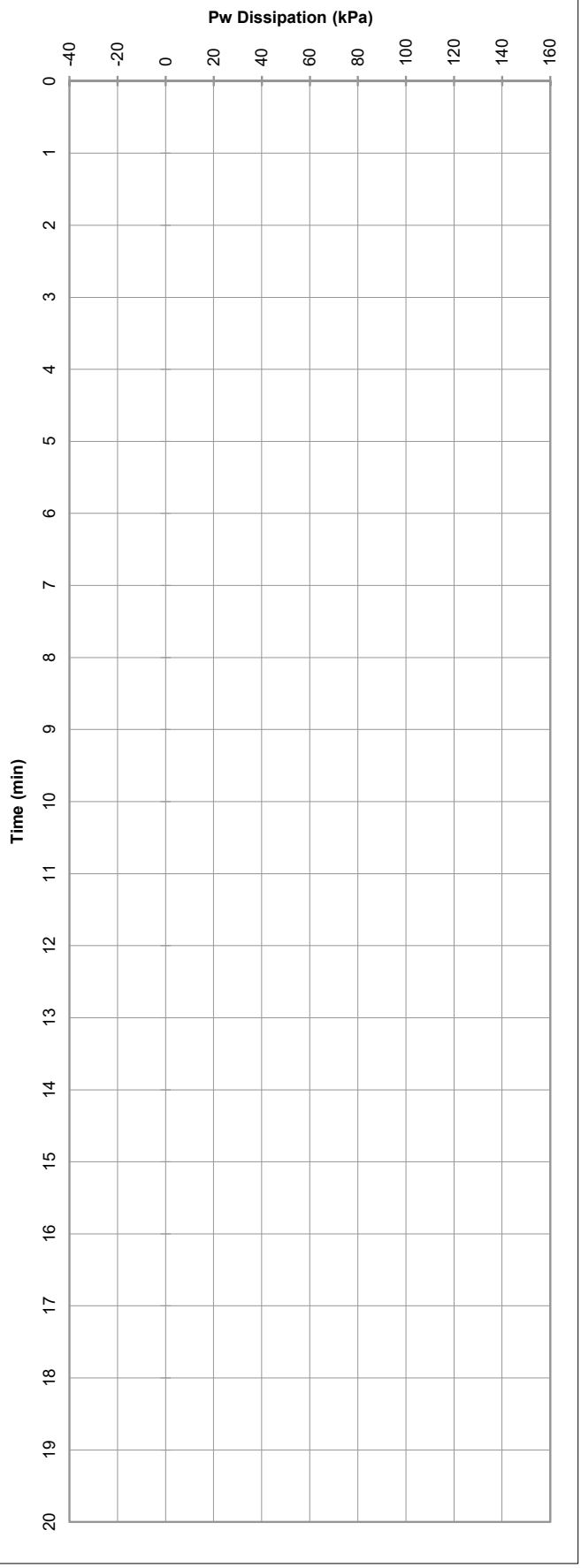
File: GG0068T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 22**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

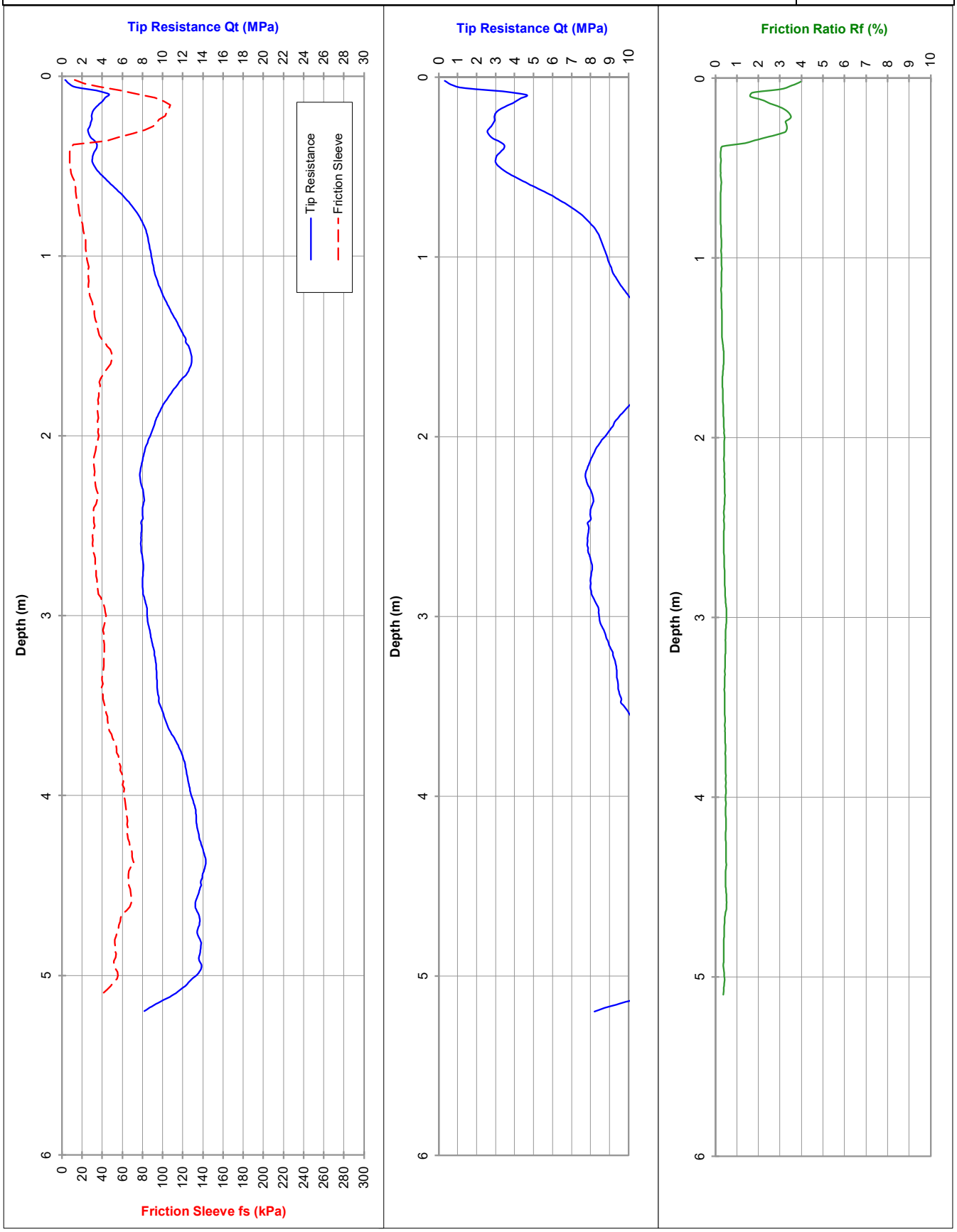
Approx. Water (m): 1.7

File: GG0067T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 22**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.7

Dummy probe to (m):

Refusal:

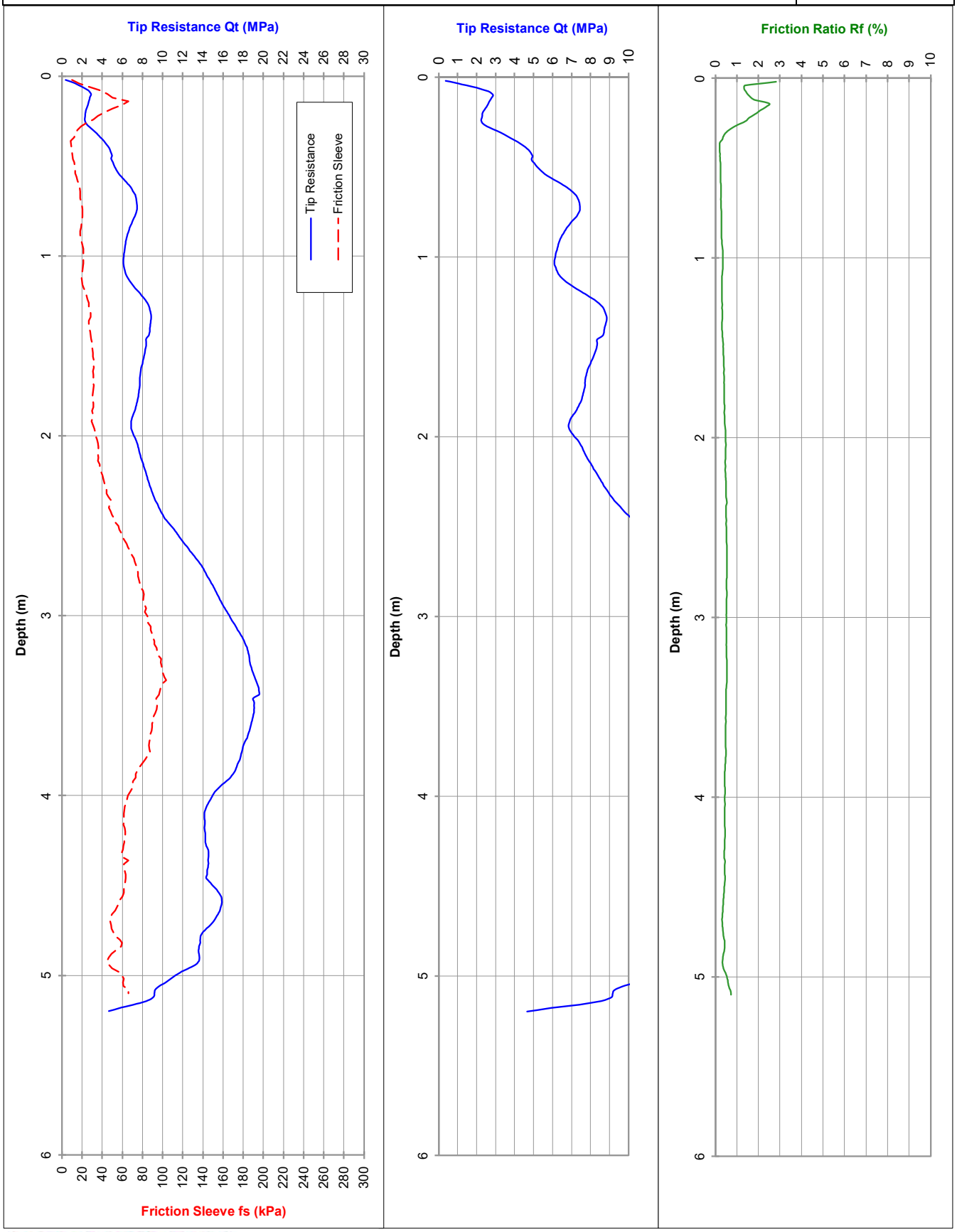
Cone I.D.: EC28

File: GG0067T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 23**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.50

Dummy probe to (m):

Refusal:

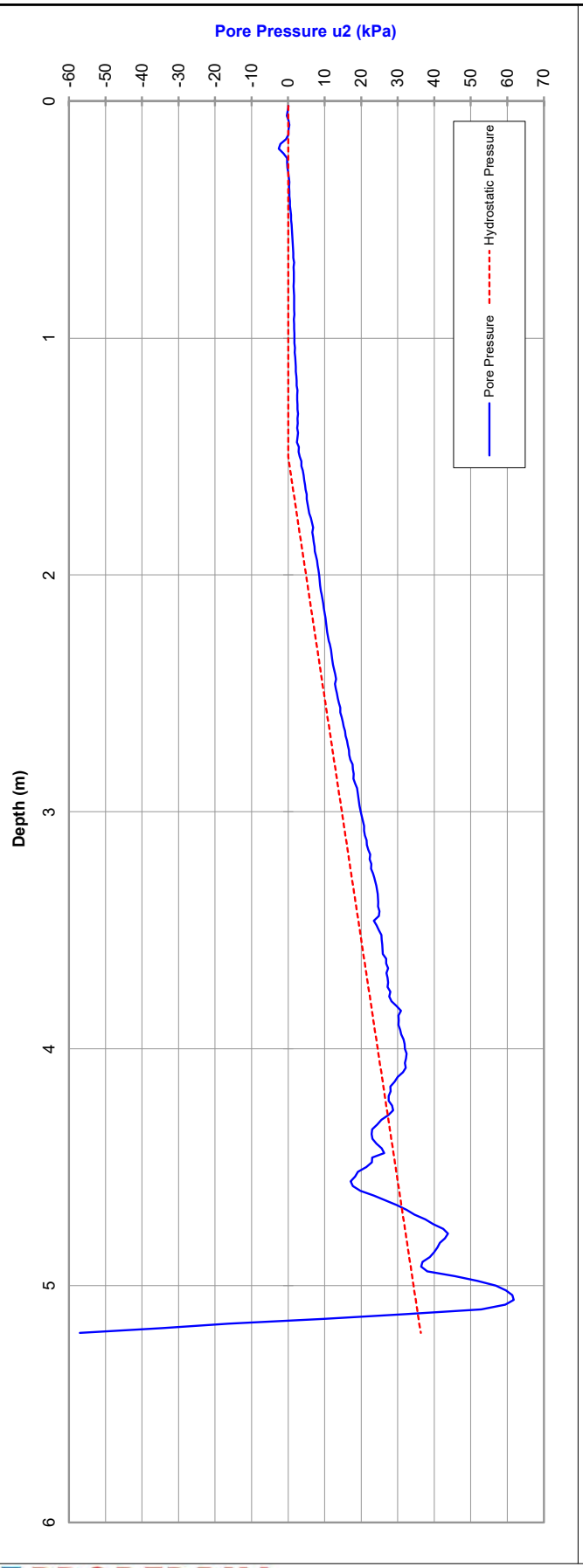
Cone I.D.: EC28

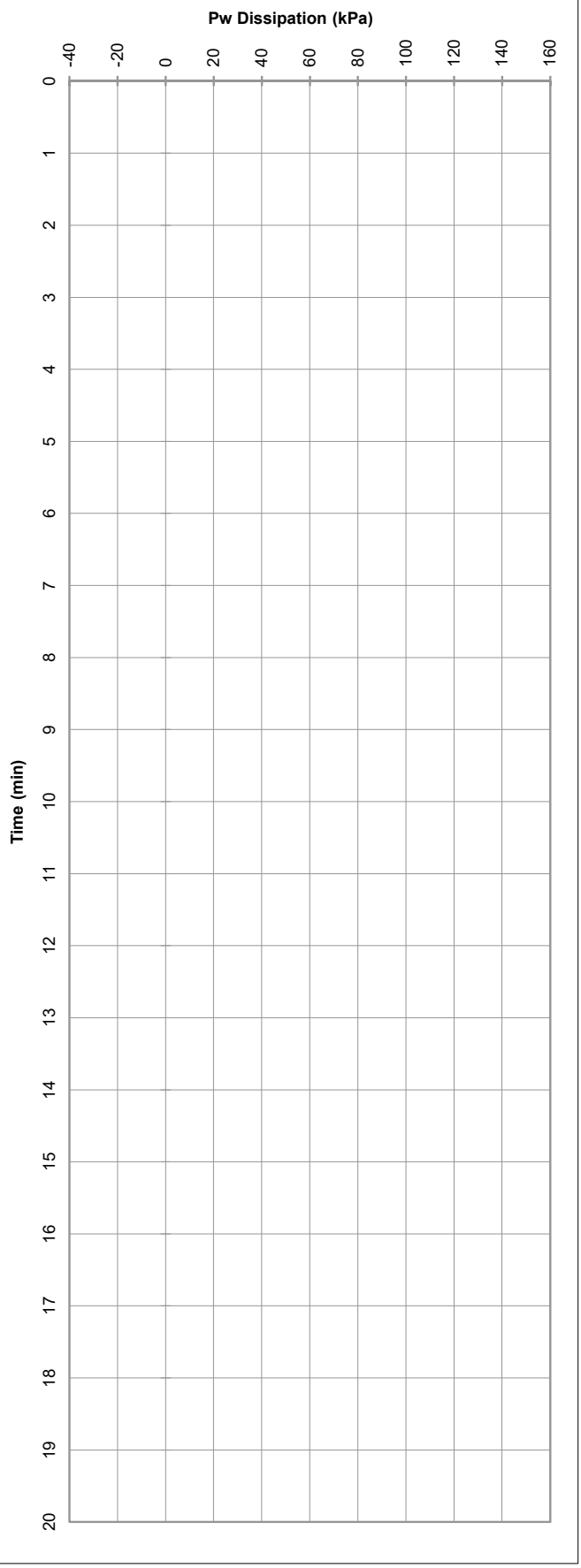
File: GG0066T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 23**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

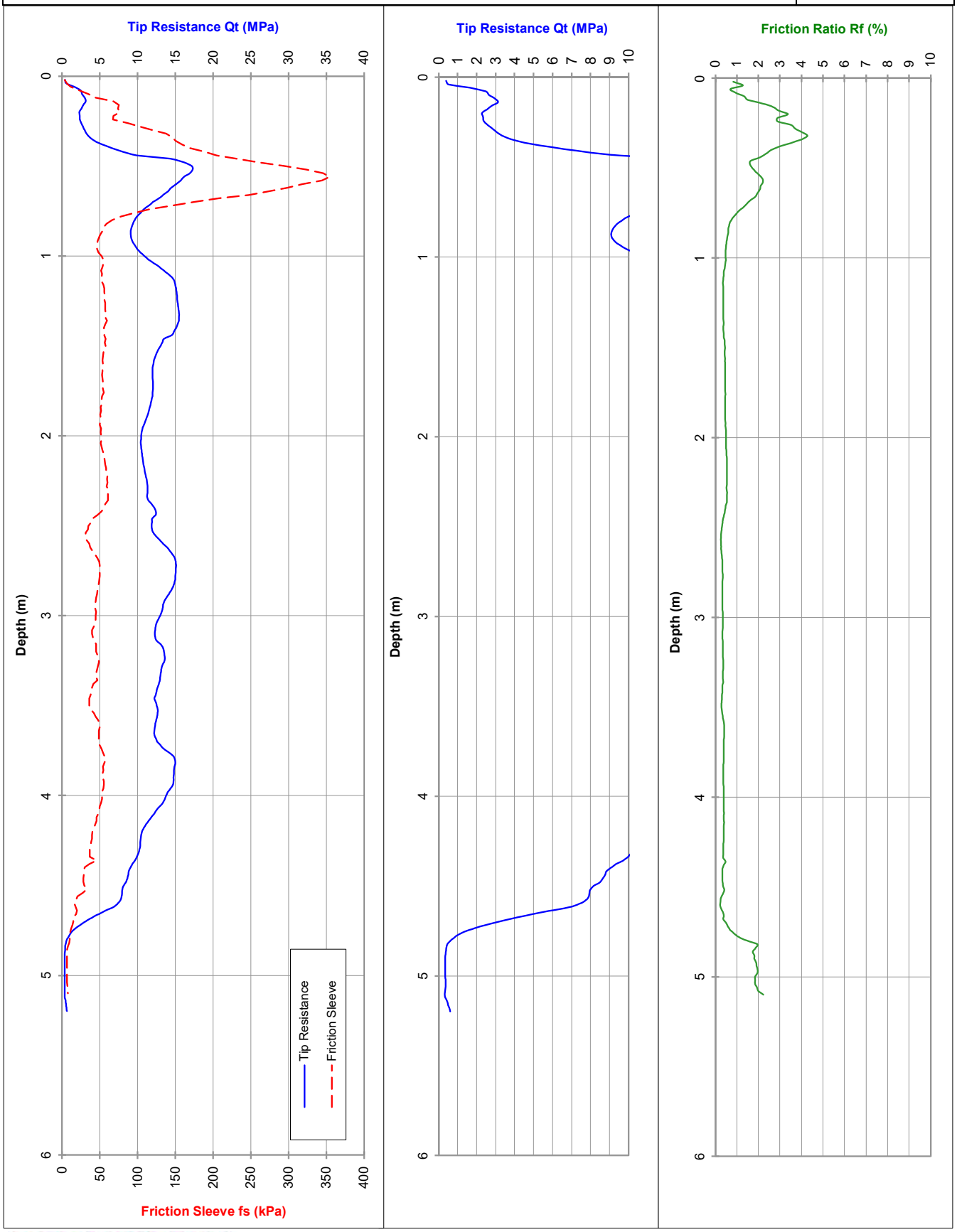
Approx. Water (m): 1.5

File: GG0066T.txt

Rig type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 24**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.40

Dummy probe to (m):

Refusal:

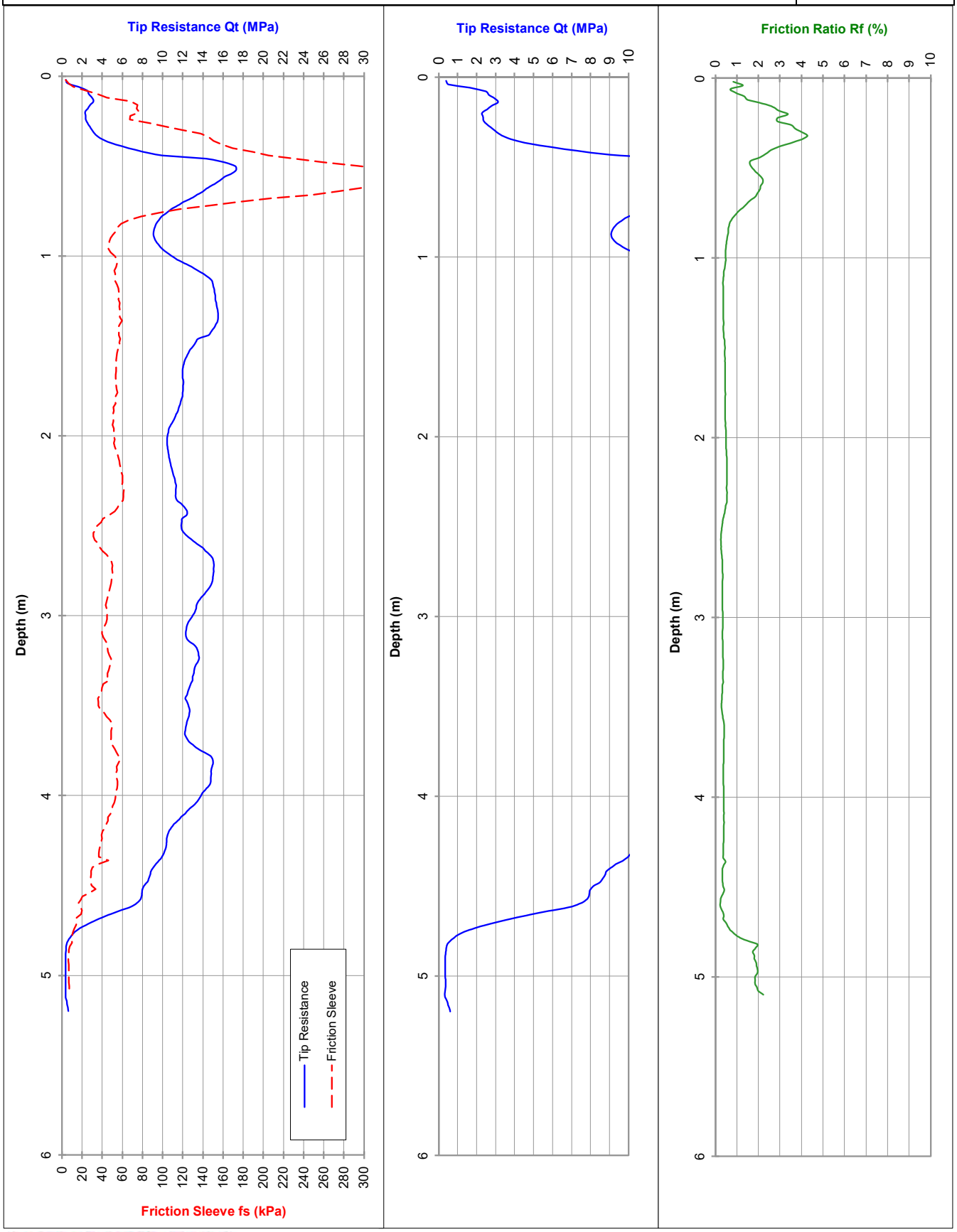
Cone I.D.: EC28

File: GG0065T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 24**
LOCATION: Wellard	Co-ords:	29-Jun-22



PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Approx. water (m): 1.40

Dummy probe to (m):

Refusal:

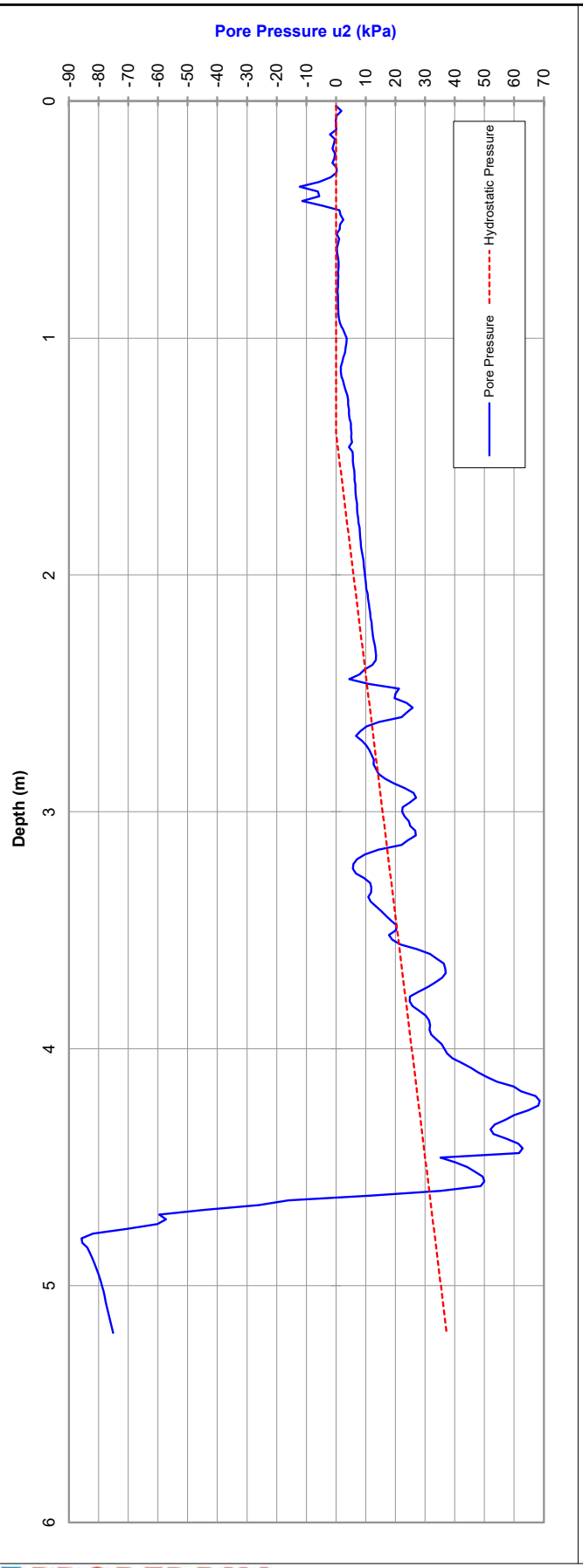
Cone I.D.: EC28

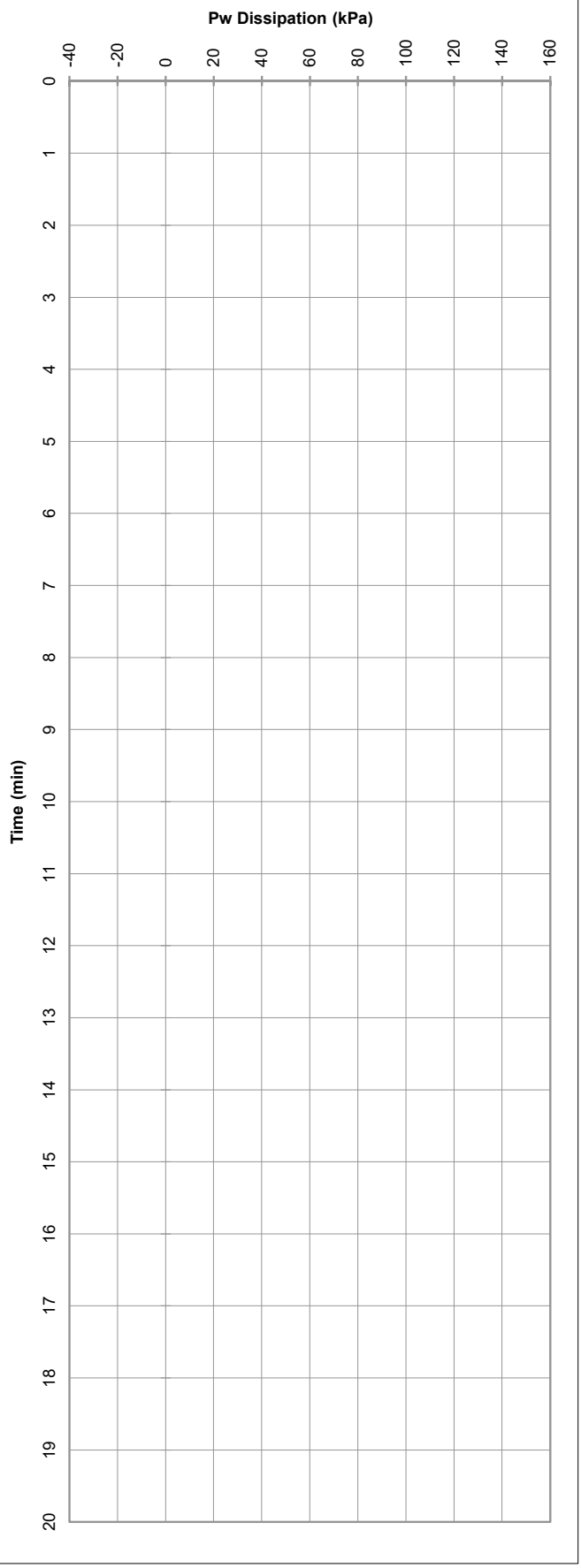
File: GG0065T

Rig Type: 7t track

ELECTRIC FRICTION-CONE PENETROMETER

CLIENT: Eastcourt Property Group	Job No.: GGC221986	Probe I.D
PROJECT: Providence East Estate	RL (m):	**CPTU 24**
LOCATION: Wellard	Co-ords:	29-Jun-22





PROBEDRILL GEOTECHNICAL SURVEY

Tested in accordance with AS 1289.6.5.1-1999 and IRTP 2001 for friction reducer

Please note: Hydrostatic Line is taken from the water level manually dipped by the CPT Operator following completion of the probe and, as such, should be used as a guide only.

Approx. Water (m): 1.4

File: GG0065T.txt

Rig type: 7t track

APPENDIX D:
Laboratory test results

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S03
Preliminary Report Issued - Issue:1 **Issue No: 2**
This report replaces all previous issues of report no 'MAT:MC22-01871-S03'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 2/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S03
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Silty Sand
Specification	AS 1289.3.6.1
Client ID	3
Sample Location	TP02
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	3.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		Yes	
Liquid Limit (%)	AS 1289.3.1.1	59	
Plastic Limit (%)	AS 1289.3.2.1	52	
Plasticity Index (%)	AS 1289.3.3.1	7	
Date Tested		1/08/2022	
Organic Matter (%)	AS 1289.4.1.1	6.2	
Date Tested		21/07/2022	

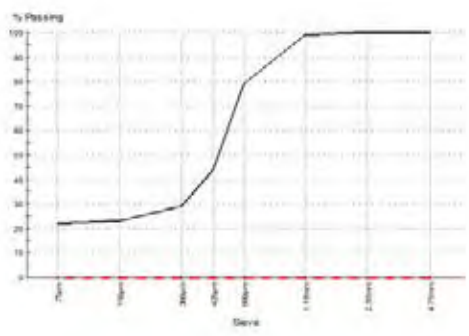
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	99	–
600µm	79	–
425µm	44	–
300µm	29	–
150µm	23	–
75µm	22	–

Chart



Comments

Preliminary results issued on the 01/08/2022.

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S02
Issue No: 2
This report replaces all previous issues of report no 'MAT:MC22-01871-S02'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S02
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Clayey Sand
Specification	AS 1289.3.6.1
Client ID	2
Sample Location	TP01 1.60m to 2.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	12.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	60	
Plastic Limit (%)	AS 1289.3.2.1	19	
Plasticity Index (%)	AS 1289.3.3.1	41	
Date Tested		25/07/2022	

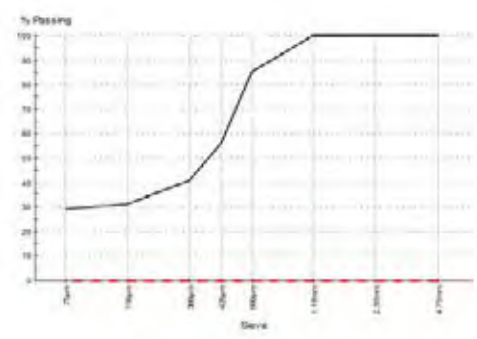
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 22/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	85	–
425µm	56	–
300µm	41	–
150µm	31	–
75µm	29	–

Chart



Comments

Replacement for certificate MAT:MC22-01871-S02 issue 1 dated 28/07/2022.
As per clients request, source amended.

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S03
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Preliminary Report Issued - Issue:
The results in this report relate only to the items/samples that were tested.

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S03
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Silty Sand
Specification	AS 1289.3.6.1
Client ID	3
Sample Location	TP02 0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Organic Matter (%)	AS 1289.4.1.1	6.2	
Date Tested		21/07/2022	

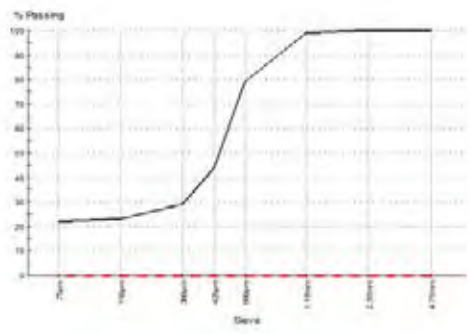
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	99	–
600µm	79	–
425µm	44	–
300µm	29	–
150µm	23	–
75µm	22	–

Chart



Comments

Preliminary results issued on the 01/08/2022.

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S04
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S04
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	4
Sample Location	TP02 0.80m to 1.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		28/07/2022	

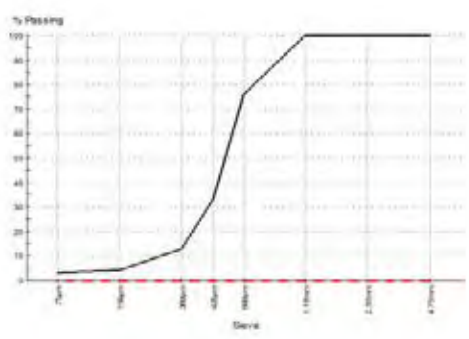
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	76	–
425µm	33	–
300µm	13	–
150µm	4	–
75µm	3	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S05
Preliminary Report Issued - Issue:1 **Issue No: 3**
This report replaces all previous issues of report no 'MAT:MC22-01871-S05'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 3/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S05
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sandy Silt
Specification	AS 1289.3.6.1
Client ID	5
Sample Location	TP03
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	3.0	
Mould Length (mm)		125	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	77	
Plastic Limit (%)	AS 1289.3.2.1	71	
Plasticity Index (%)	AS 1289.3.3.1	6	
Date Tested		1/08/2022	
Organic Matter (%)	AS 1289.4.1.1	10.1	
Date Tested		21/07/2022	

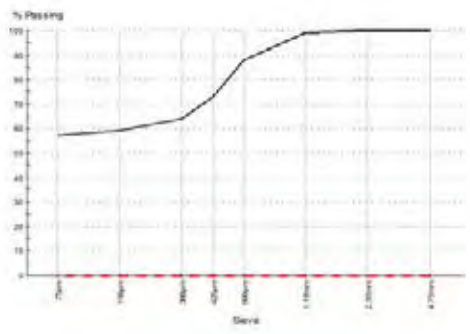
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	99	–
600µm	88	–
425µm	73	–
300µm	64	–
150µm	59	–
75µm	57	–

Chart



Comments

Preliminary results issued on the 01/08/2022.
Replacement for Test Report MAT:MC22-01871 issue 2 dated 02.08.2022
Test Depth amended

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S07
Preliminary Report Issued - Issue:1,1 **Issue No: 2**
This report replaces all previous issues of report no 'MAT:MC22-01871-S07'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 2/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S07
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sandy Silt
Specification	AS 1289.3.6.1
Client ID	7
Sample Location	TP04
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	5.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	70	
Plastic Limit (%)	AS 1289.3.2.1	55	
Plasticity Index (%)	AS 1289.3.3.1	15	
Date Tested		2/08/2022	
Organic Matter (%)	AS 1289.4.1.1	5.3	
Date Tested		21/07/2022	

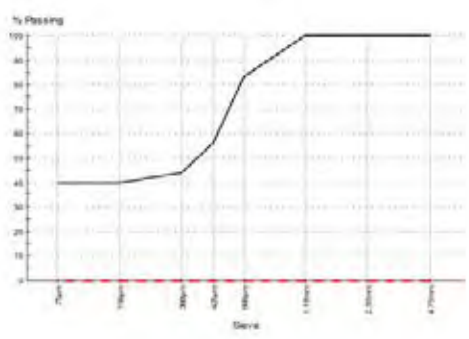
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	83	–
425µm	56	–
300µm	44	–
150µm	40	–
75µm	40	–

Chart



Comments

Preliminary results issued on the 01/08/2022.

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S08
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S08
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	8
Sample Location	TP04
	0.60m to 1.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		28/07/2022	

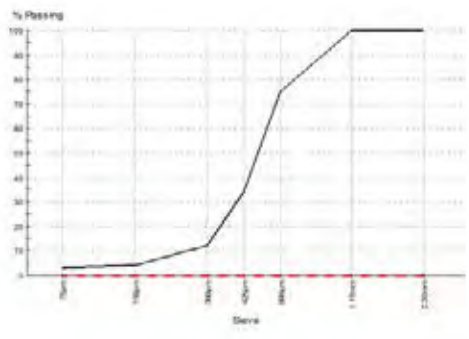
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	–
1.18mm	100	–
600µm	75	–
425µm	34	–
300µm	12	–
150µm	4	–
75µm	3	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S09
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S09
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	9
Sample Location	TP05
	0.70m to 1.60mm

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	

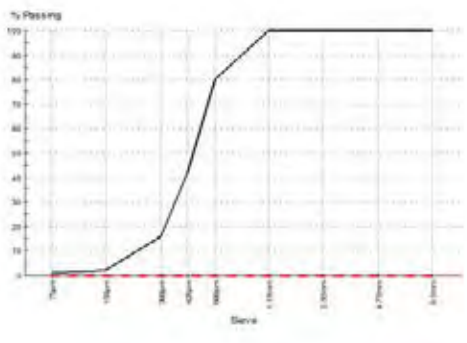
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	–
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	80	–
425µm	42	–
300µm	16	–
150µm	2	–
75µm	1	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S10
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S10
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with Silt & trace Gravel
Specification	AS 1289.3.6.1
Client ID	10
Sample Location	TP06
	0.30m to 1.20m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		28/07/2022	

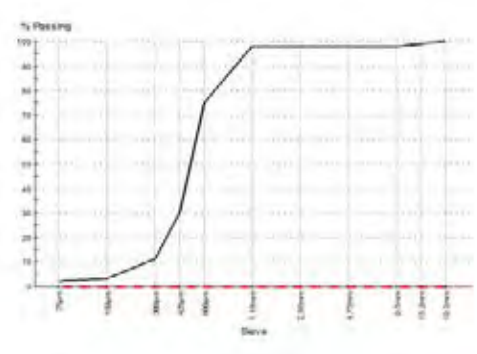
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
19.0mm	100	–
13.2mm	99	–
9.5mm	98	–
4.75mm	98	–
2.36mm	98	–
1.18mm	98	–
600µm	75	–
425µm	30	–
300µm	11	–
150µm	3	–
75µm	2	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S11
Preliminary Report Issued - Issue:1 **Issue No: 2**
This report replaces all previous issues of report no 'MAT:MC22-01871-S11'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 2/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S11
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sandy Silt
Specification	AS 1289.3.6.1
Client ID	11
Sample Location	TP07
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		125	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	72	
Plastic Limit (%)	AS 1289.3.2.1	62	
Plasticity Index (%)	AS 1289.3.3.1	10	
Date Tested		1/08/2022	
Organic Matter (%)	AS 1289.4.1.1	6.1	
Date Tested		21/07/2022	

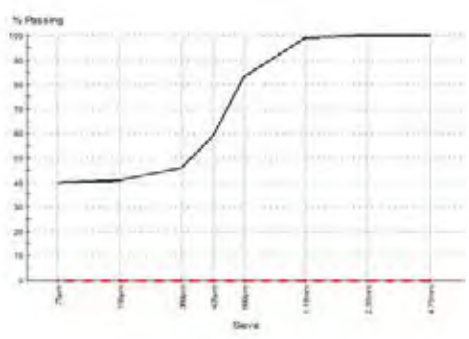
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	99	–
600µm	83	–
425µm	59	–
300µm	46	–
150µm	41	–
75µm	40	–

Chart



Comments

Preliminary results issued on the 01/08/2022.

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S12
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S12
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	12
Sample Location	TP07
	0.80m to 1.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		28/07/2022	

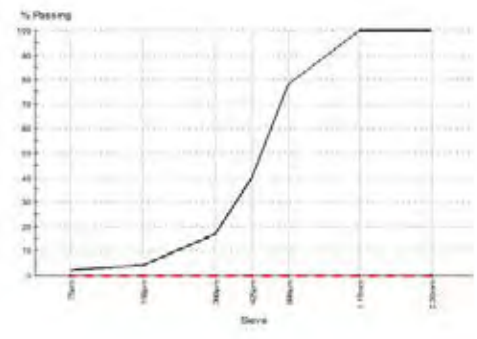
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	–
1.18mm	100	–
600µm	78	–
425µm	40	–
300µm	17	–
150µm	4	–
75µm	2	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S13
Preliminary Report Issued - Issue:1,1 **Issue No: 2**
This report replaces all previous issues of report no 'MAT:MC22-01871-S13'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 2/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S13
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Silty Sand
Specification	AS 1289.3.6.1
Client ID	13
Sample Location	TP08
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	4.0	
Mould Length (mm)		125	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	47	
Plastic Limit (%)	AS 1289.3.2.1	39	
Plasticity Index (%)	AS 1289.3.3.1	8	
Date Tested		2/08/2022	
Organic Matter (%)	AS 1289.4.1.1	5.7	
Date Tested		21/07/2022	

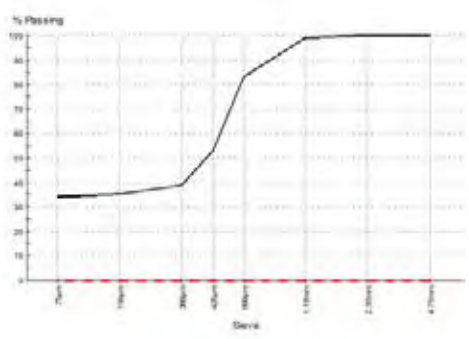
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	99	–
600µm	83	–
425µm	53	–
300µm	39	–
150µm	35	–
75µm	34	–

Chart



Comments

Preliminary results issued on the 01/08/2022.

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S14
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S14
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	14
Sample Location	TP08
	0.80m to 1.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	

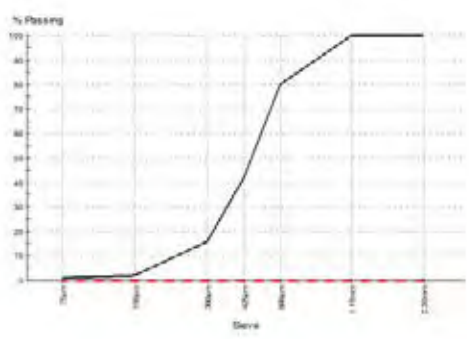
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 19/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	–
1.18mm	100	–
600µm	80	–
425µm	42	–
300µm	16	–
150µm	2	–
75µm	1	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S15
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S15
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Silty Sand
Specification	AS 1289.3.6.1
Client ID	15
Sample Location	TP09
	0.00m to 0.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	1.5	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	
Organic Matter (%)	AS 1289.4.1.1	2.0	
Date Tested		21/07/2022	

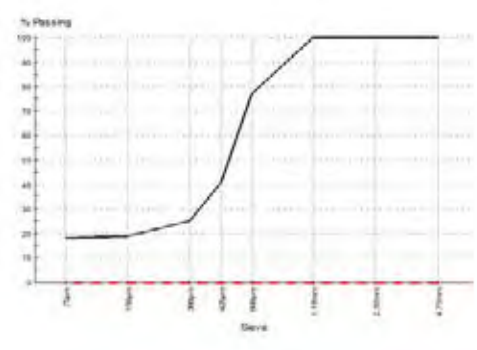
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	77	–
425µm	41	–
300µm	25	–
150µm	19	–
75µm	18	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S17
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S17
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	17
Sample Location	TP10
	0.40m to 1.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	

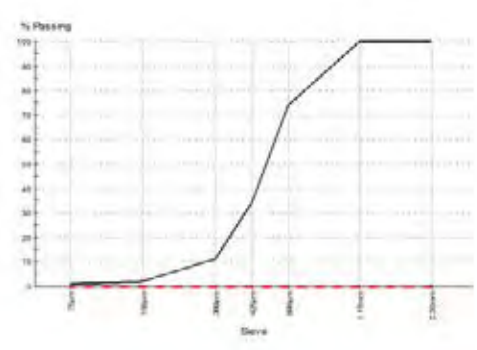
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 20/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
2.36mm	100	–
1.18mm	100	–
600µm	74	–
425µm	34	–
300µm	11	–
150µm	2	–
75µm	1	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S18
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S18
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Gravel & Silt
Specification	AS 1289.3.6.1
Client ID	18
Sample Location	TP11
	0.00m to 0.40m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	
Organic Matter (%)	AS 1289.4.1.1	2.6	
Date Tested		21/07/2022	

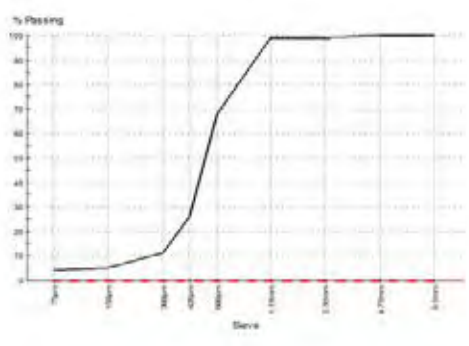
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 14/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
9.5mm	100	–
4.75mm	100	–
2.36mm	99	–
1.18mm	99	–
600µm	68	–
425µm	26	–
300µm	11	–
150µm	5	–
75µm	4	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Material Test Report

Report No: MAT:MC22-01871-S19
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID	MC22-01871-S19
Date Sampled	8/07/2022
Sampling Method	Tested as received
Source	Test Pit
Material	Sand
Soil Description	Sand with trace Silt
Specification	AS 1289.3.6.1
Client ID	19
Sample Location	TP11
	0.60m to 1.50m

Other Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	0.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	N/A	
Plastic Limit (%)	AS 1289.3.2.1	NP	
Plasticity Index (%)	AS 1289.3.3.1	NP	
Date Tested		29/07/2022	

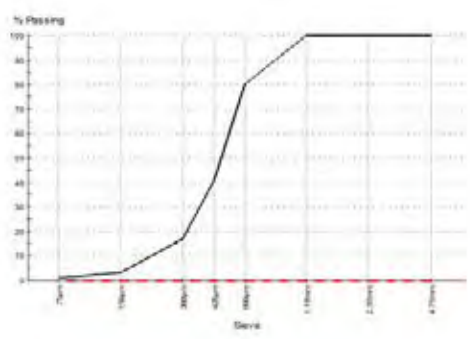
Particle Size Distribution

Method: AS 1289.3.6.1
Drying by: Oven
Date Tested: 21/07/2022

Note: Sample Washed

Sieve Size	% Passing	Limits
4.75mm	100	–
2.36mm	100	–
1.18mm	100	–
600µm	80	–
425µm	41	–
300µm	17	–
150µm	3	–
75µm	1	–

Chart



Comments

NP = Non Plastic

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Maximum Dry Density Report

Report No: MDD:MC22-01871-S02
Issue No: 2
This report replaces all previous issues of report no 'MDD:MC22-01871-S02'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

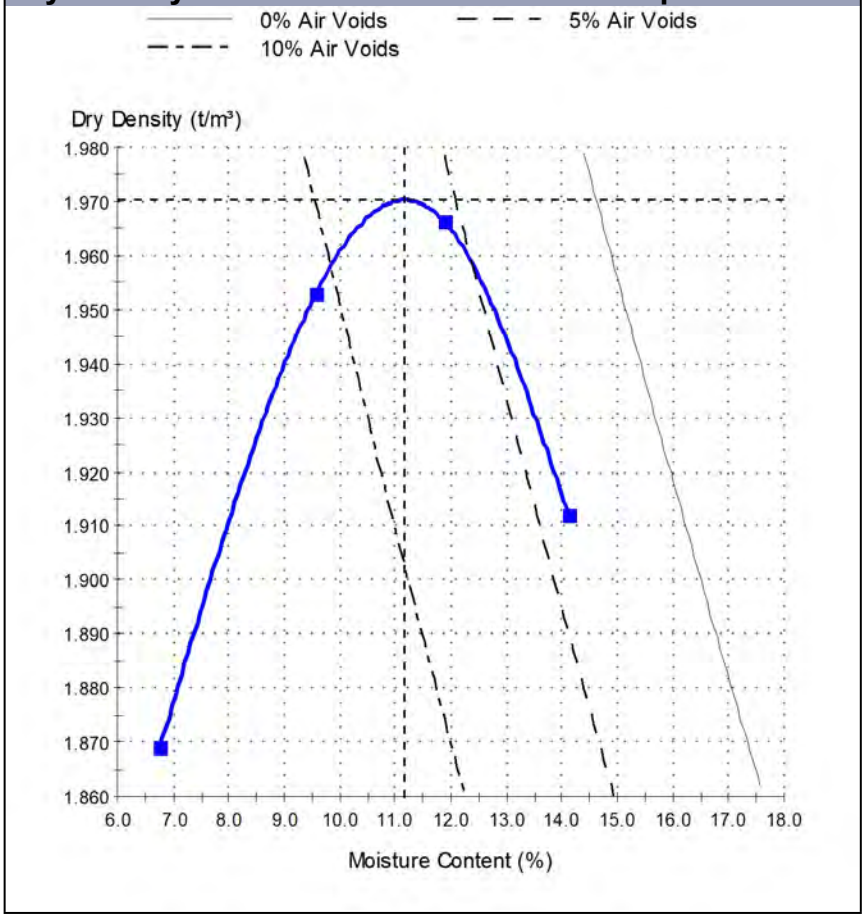
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S02	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Soil Description:	Clayey Sand		
Specification:	AS 1289.3.6.1		
Client ID:	2		
Location:	TP01, 1.60m to 2.50m		
Date Tested:	22/07/2022		

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.2.1

Modified MDD (t/m³):	**1.97**
Modified OMC (%):	**11.0**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	48
LL Method:	AS 1289.3.1.1

Comments

Replacement for certificate MDD:MC22-01871-S01 issue 1 dated 28/07/2022.
As per clients request, source amended.

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

California Bearing Ratio Test Report

Report No: CBR:MC22-01871-S02
Issue No: 2
This report replaces all previous issues of report no 'CBR:MC22-01871-S02'.

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

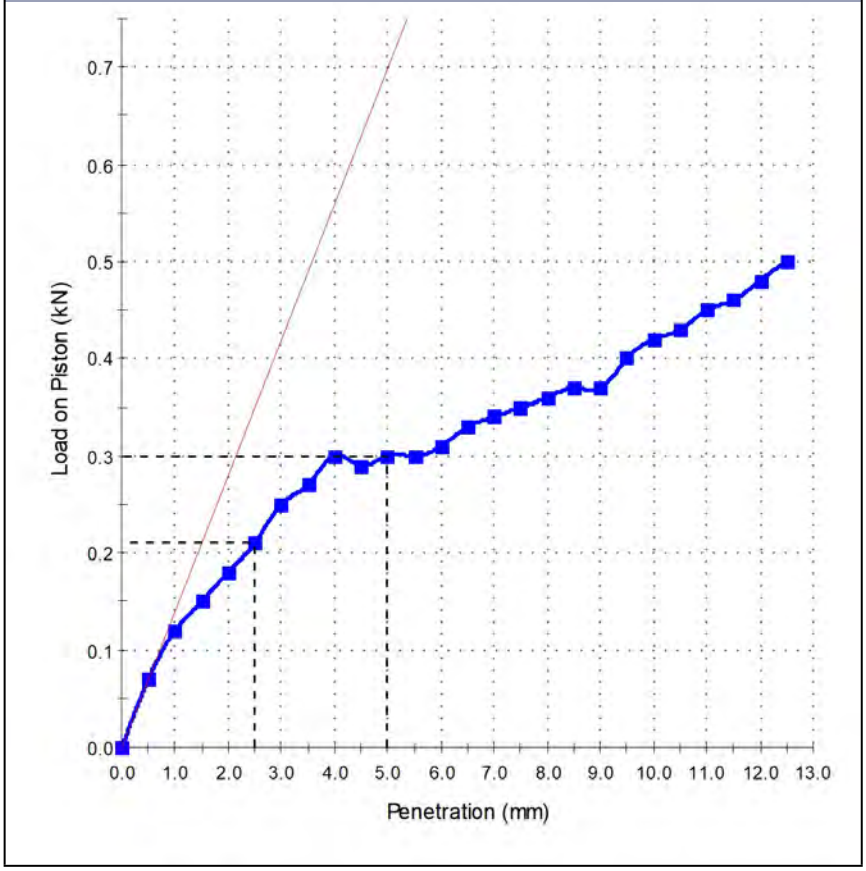
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S02	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Soil Description:	Clayey Sand		
Specification:	AS 1289.3.6.1	**Client ID:**	2
Sample Location:	TP01, 1.60m to 2.50m		
Date Tested:	22/07/2022		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 2.5mm (%):	**1.5**
Dry Density before Soaking (t/m³):	1.88
Density Ratio before Soaking (%):	95.5
Moisture Content before Soaking (%):	10.8
Moisture Ratio before Soaking (%):	97.0
Dry Density after Soaking (t/m³):	1.87
Density Ratio after Soaking (%):	95.0
Swell (%):	0.5
Moisture Content of Top 30mm (%):	23.1
Moisture Content of Remaining Depth (%):	12.8
Compaction Hammer Used:	Modified AS 1289.5.2.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	172
Plasticity Determination Method:	AS 1289.3.1.1

Comments

Replacement for certificate CBR:MC22-01871-S02 issue 1 dated 28/07/2022.
As per clients request, source amended.

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Maximum Dry Density Report

Report No: MDD:MC22-01871-S09
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

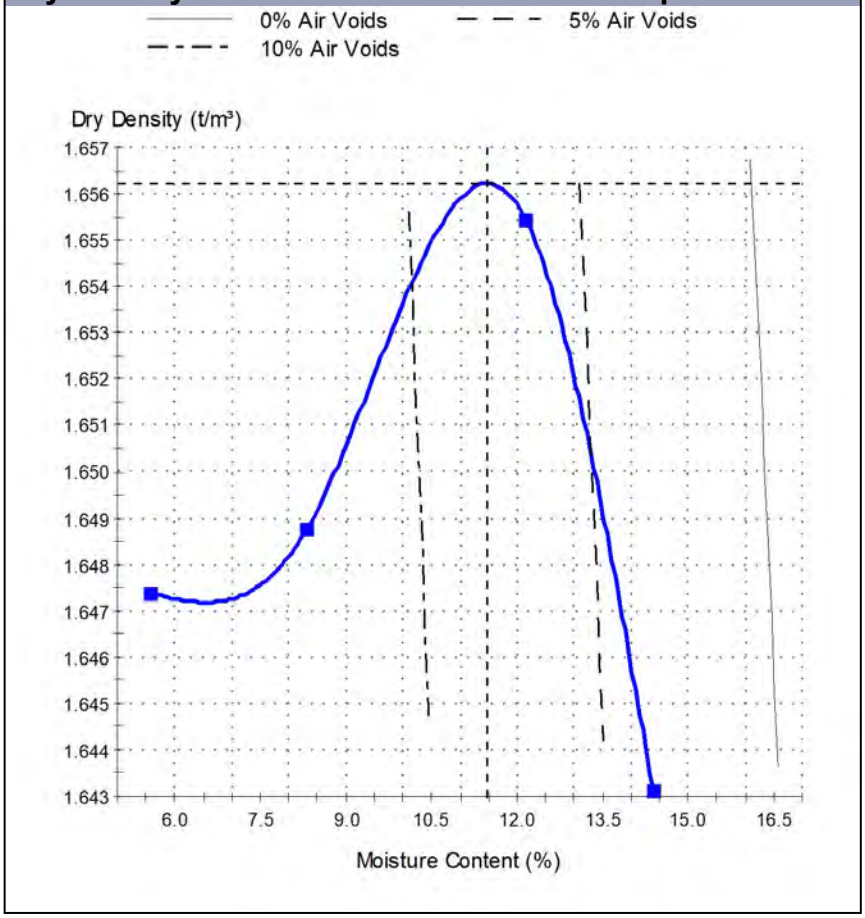
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S09	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Soil Description:	Sand with trace Silt		
Specification:	AS 1289.3.6.1		
Client ID:	9		
Location:	TP05, 0.70m to 1.60mm		
Date Tested:	15/07/2022		

Dry Density - Moisture Content Relationship



Test Results

AS 1289.5.2.1

Modified MDD (t/m³):	**1.66**
Modified OMC (%):	**11.5**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	19
LL Method:	Visual / Tactile

Comments

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

California Bearing Ratio Test Report

Report No: CBR:MC22-01871-S09
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

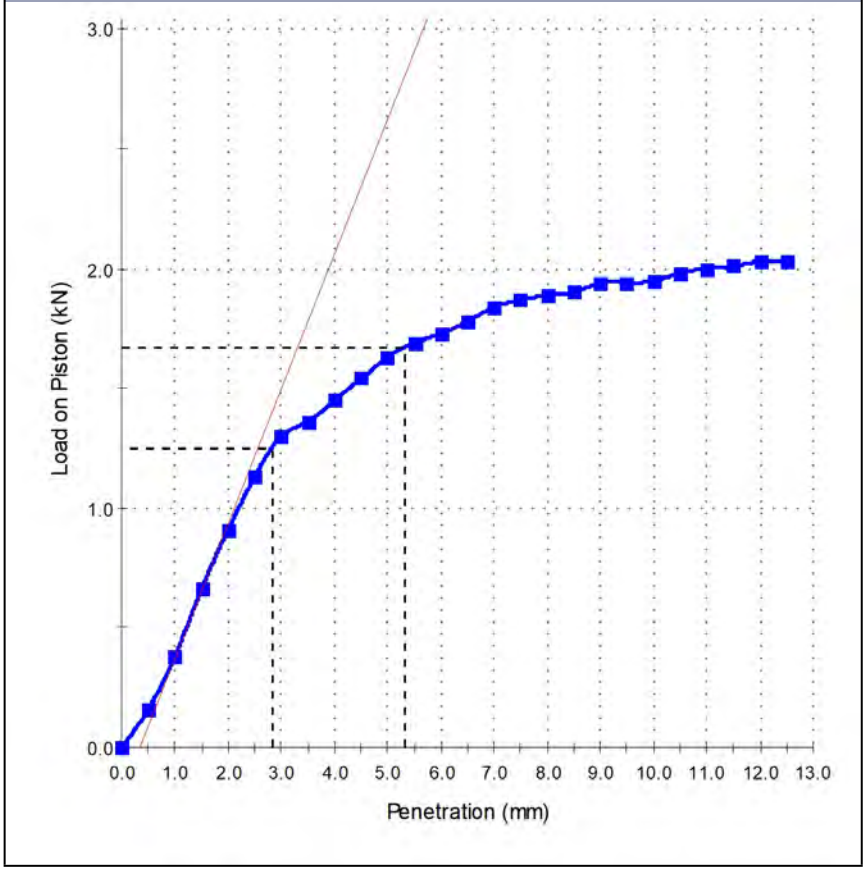
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S09	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Soil Description:	Sand with trace Silt		
Specification:	AS 1289.3.6.1	**Client ID:**	9
Sample Location:	TP05, 0.70m to 1.60mm		
Date Tested:	1/08/2022		

Load vs Penetration



Test Results

AS 1289.6.1.1

CBR at 2.5mm (%):	**9**
Dry Density before Soaking (t/m³):	1.58
Density Ratio before Soaking (%):	95.0
Moisture Content before Soaking (%):	11.0
Moisture Ratio before Soaking (%):	96.0
Dry Density after Soaking (t/m³):	1.59
Density Ratio after Soaking (%):	96.0
Swell (%):	-0.5
Moisture Content of Top 30mm (%):	20.4
Moisture Content of Remaining Depth (%):	22.1
Compaction Hammer Used:	Modified AS 1289.5.2.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	77
Plasticity Determination Method:	AS 1289.3.1.1

Comments

© 2000-2022 QESTLab by SpectraQEST.com

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

Maximum Dry Density Report

Report No: MDD:MC22-01871-S16
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

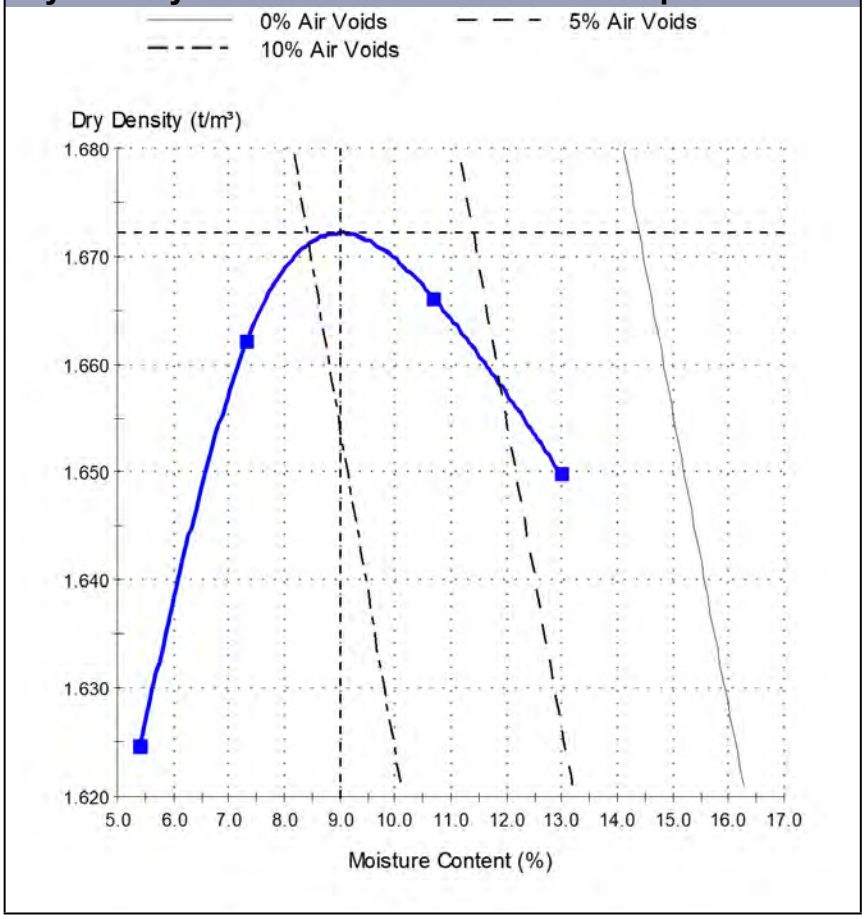
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S16	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Specification:	AS 1289.3.6.1		
Client ID:	16		
Location:	TP09, 0.80m to 1.60m		
Date Tested:	15/07/2022		

Dry Density - Moisture Content Relationship



Test Results

	AS 1289.5.2.1
Modified MDD (t/m³):	**1.67**
Modified OMC (%):	**9.0**
Retained Sieve (mm):	19.0
Oversize Material (%):	0
Curing Time (h):	24
LL Method:	Visual / Tactile

Comments

© 2000-2022 QESTLab by SpectraQEST.com

MATERIALS CONSULTANTS

300 Collier Road, Bassendean, WA 6054
PO Box 3090, Bassendean DC, WA 6942
Telephone: 08 6278 3755
Email:admin@matcons.com.au
www.matcons.com.au

California Bearing Ratio Test Report

Report No: CBR:MC22-01871-S16
Issue No: 1

Client: GGC Pty Ltd
433 Vincent Street West West Leederville WA 6007
Project: GGC221986 - Eastcourt Property Group, Providence East Estate

TRN: GGC221986

Accredited for compliance with ISO/IEC
The results in this report relate only to the items/samples that were tested.

NATA Accredited Laboratory Number:1763

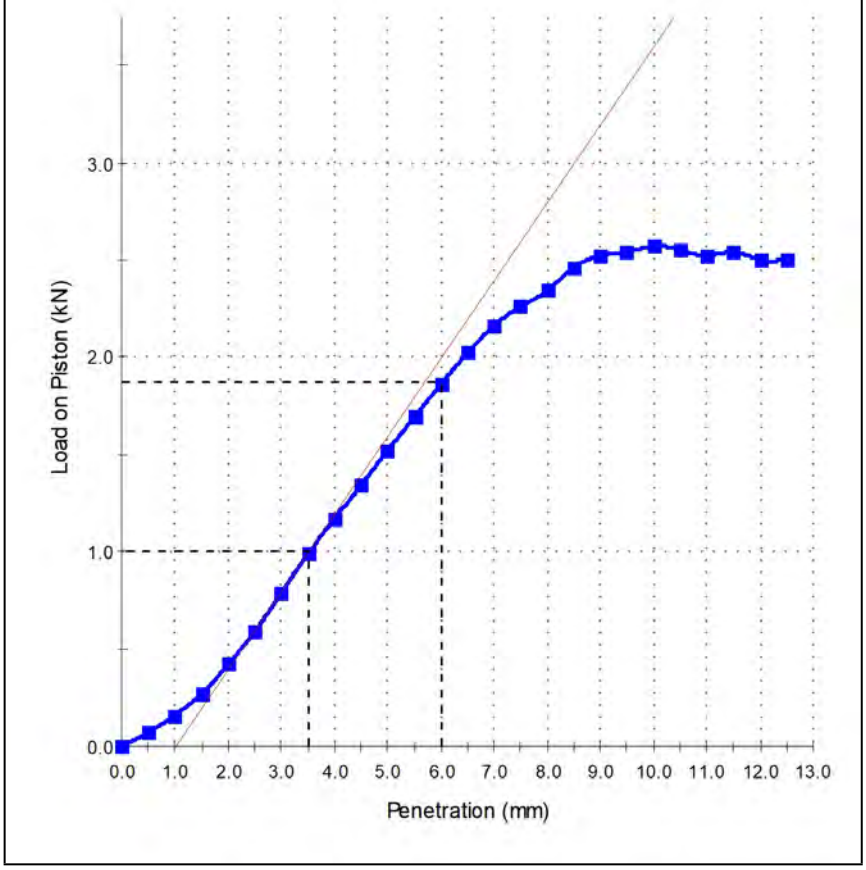
Signatory:Alex Briggs
(Laboratory Supervisor)
Date of Issue: 1/08/2022

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	MC22-01871-S16	**Date Sampled:**	8/07/2022
Sampling Method:	Tested as received		
Source:	Test Pit	**Material:**	Sand
Specification:	AS 1289.3.6.1	**Client ID:**	16
Sample Location:	TP09, 0.80m to 1.60m		
Date Tested:	22/07/2022		

Load vs Penetration



Test Results

	AS 1289.6.1.1
CBR at 5.0mm (%):	**9**
Dry Density before Soaking (t/m³):	1.58
Density Ratio before Soaking (%):	94.5
Moisture Content before Soaking (%):	9.3
Moisture Ratio before Soaking (%):	103.0
Dry Density after Soaking (t/m³):	1.60
Density Ratio after Soaking (%):	96.0
Swell (%):	-1.5
Moisture Content of Top 30mm (%):	18.7
Moisture Content of Remaining Depth (%):	20.0
Compaction Hammer Used:	Modified AS 1289.5.2.1
Surcharge Mass (kg):	4.50
Period of Soaking (Days):	4
Retained on 19 mm Sieve (%):	0
CBR Moisture Content Method:	AS 1289.2.1.1
Sample Curing Time (h):	26

Comments

© 2000-2022 QESTLab by SpectraQEST.com

Douglas PARTNERS | GROUNDED EXPERTISE

Wellard Residential Pty Ltd
PO Box 456
Applecross, WA 6953

Project 88799.08
29 April 2024
DR

Attention: Matthew Palmieri
Email: matt@eastcourt.com.au

Report on Infiltration Testing
Providence Estate
Irasburg Parade, Wellard WA

1. Introduction

This letter presents the results of an infiltration assessment undertaken by Douglas at the location of a proposed drainage basin located near Irasburg Parade at Providence Estate in Wellard, WA. The investigation was commissioned in an email dated 17 April 2024 by Matthew Palmieri on behalf of Wellard Residential Pty Ltd and was undertaken in accordance with Douglas' proposal P88799.08 dated 16 April 2024.

The purpose of this investigation was to undertake infiltration tests in the shallow soils at selected locations across the site nominated by the client, and thus provide comments on the suitability of the site to accept on-site stormwater disposal and to provide a suitable permeability value to assist with basin design by others.

2. Field Work Methods

Field work was carried out on 18 April 2024 and comprised the drilling of seven boreholes to depths of between 0.5 m and 0.7 m to allow infiltration testing within the proposed basin location.

The boreholes were drilled using a hand auger and logged in general accordance with the Australian Standard (AS 1726, 2017) by a geotechnical engineer from Douglas.

Infiltration testing was undertaken at each of the seven test locations using a constant head method.

Dynamic cone penetrometer (DCP) tests were carried out adjacent to each test location in accordance with the Australian Standard (AS 1289.6.3.2, 1997) to assess the in-situ relative density of the shallow soils.

The test locations are indicated on Drawing 1, attached.

3. Field Work Results

3.1 Ground conditions

Logs of the ground conditions and results of the field testing are attached, and should be read in conjunction with the attached notes defining descriptive terms and classification methods.

The ground conditions observed at the test locations were generally consistent across the site, and can be summarised as:

- **Organic Clayey SAND and Organic Sandy CLAY (SC and CI)** - dark grey-brown, generally firm to stiff, fine to medium sand, low to medium plasticity from surface to a depth of between 0.15 m and 0.25 m; overlying

- **Clayey Sand and Sandy CLAY (SC and CI)** – dark grey-brown, generally stiff to hard, medium plasticity to borehole termination depths of between 0.5 m and 0.7 m.

3.2 Groundwater

Groundwater was not encountered within the boreholes drilled on 18 April 2024 to depths of up to 0.7 m below surface level (RL 4.0 m AHD). The boreholes were immediately backfilled following the investigation, which precluded longer-term monitoring of groundwater levels. Groundwater is influenced by climate conditions and land usage and will vary with time.

3.3 Soil Permeability

In situ infiltration testing was undertaken using a constant head test method undertaken in accordance with the Australian Standard (AS 1547, 2012), at depths of between 0.3 m and 0.6 m at all borehole locations. Results of the permeability analysis are summarised in Table 1.

Table 1: Summary of Permeability Analysis

Test Location	Depth (m)	Measured Permeability (m/day)	In situ Ground Conditions at Testing Depth
1	0.3	3.4	Clayey SAND (SC) – firm to stiff
2	0.5	0.05	Sandy CLAY (CI) – firm to stiff
3	0.6	0.1	Sandy CLAY (CI) – stiff
4	0.45	0.7	Sandy CLAY (CI) – stiff
5	0.6	0.15	Sandy CLAY (CI) – hard
6	0.35	0.25	Clayey SAND (SC) – hard
7	0.5	0.05	Sandy CLAY (CI) – stiff

4. Comments

The ground conditions at the tested locations within the proposed basin area, generally comprise clayey sand and sandy clay, with the results of permeability testing undertaken at depths of between 0.35 m and 0.6 m indicating values of between approximately 0.05 m/day and 3 m/day. The measured values are within the typical range Douglas would anticipate for the encountered conditions.

Based on the results of the investigation, it is suggested that the soils beneath the basin location be considered as generally impermeable for drainage design purposes. Perched water can be expected to collect on the surface of the site following rainfall.

5. References

AS 1289.6.3.2. (1997). *Methods for testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - 9kg dynamic cone penetrometer test.* Reconfirmed 2013: Standards Australia.

AS 1289.6.3.3. (1997). *Methods for testing soils for engineering purposes - Soil strength and consolidation tests - Determination of the penetration resistance of a soil - Perth sand penetrometer test.* Reconfimed 2013: Standards Australia.

AS 1547. (2012). *On-site domestic wastewater management.* Standards Australia.

AS 1726. (2017). *Geotechnical Site Investigations.* Standards Australia.

Department of Environment. (2004). *Perth Groundwater Atlas, Second Edition, Dec 2004.*

6. Limitations

Douglas Partners Pty Ltd (Douglas) has prepared this report for a proposed drainage basin at Providence Estate located on Irasburg Parade, Wellard WA in accordance with Douglas' proposal dated 16 April 2024 and acceptance received from Matthew Palmieri dated 17 April 2024. The work was carried out under Douglas' Engagement Terms. This report is provided for the exclusive use of Wellard Residential Pty Ltd for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of Douglas, does so entirely at its own risk and without recourse to Douglas for any loss or damage. In preparing this report Douglas has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after Douglas' field testing has been completed. Douglas' advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by Douglas in this report may be affected by undetected variations in ground conditions across the site between

and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

The assessment of atypical safety hazards arising from this advice is restricted to the geotechnical components set out in this report and based on known project conditions and stated design advice and assumptions. While some recommendations for safe controls may be provided, detailed 'safety in design' assessment is outside the current scope of this report and requires additional project data and assessment.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. Douglas cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report. This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by Douglas. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope of work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of fill of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such fill may contain contaminants and hazardous building materials.

Please contact the undersigned if you have any questions on this matter.

Yours faithfully

Douglas Partners Pty Ltd

Dan Reaveley
Principal

Reviewed by

Fred Verheyde
Principal

Attachments: About this Report
Drawing 1: Test Location Plan
Borehole Logs

About this Report

November 2023

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

This report is the property of Douglas Partners Pty Ltd. The report may only be used for the purpose for which it was commissioned and in accordance with the Conditions of Engagement for the commission supplied at the time of proposal. Unauthorised use of this report in any form whatsoever is prohibited.

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

continued next page

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

intentionally blank

intentionally blank

Soil Descriptions

Terminology
Symbols
Abbreviations

November 2023

Introduction

All materials which are not considered to be "in-situ rock" are described in general accordance with the soil description model of AS 1726-2017 Part 6.1.3, and can be broken down into the following description structure:

The "classification" comprises a two character "group symbol" providing a general summary of dominant soil characteristics. The "name" summarises the particle sizes within the soil which most influence its behaviour. The detailed description presents more information about composition, condition, structure, and origin of the soil.

Classification, naming and description of soils require the relative proportion of particles of different sizes within the whole soil mixture to be considered.

Particle size designation and Behaviour Model

Solid particles within a soil are differentiated on the basis of size.

The engineering behaviour properties of a soil can subsequently be modelled to be either "fine grained" (also known as "cohesive" behaviour) or "coarse grained" ("non cohesive" behaviour), depending on the relative proportion of fine or coarse fractions in the soil mixture.

Particle Size Designation	Particle Size (mm)	Behaviour Model	
		Behaviour	Approximate Dry Mass
Boulder	>200	Excluded from particle behaviour model as "oversize"	
Cobble	63 - 200		
Gravel[1]	2.36 - 63	Coarse	>65%
Sand[1]	0.075 - 2.36		
Silt	0.002 - 0.075	Fine	>35%
Clay	<0.002		

[1] – refer grain size subdivision descriptions below

The behaviour model boundaries defined above are not precise, and the material behaviour should be assumed from the name given to the material (which considers the particle fraction which dominates the behaviour, refer "component proportions" below), rather than strict observance of the proportions of particle sizes. For example, if a material is named a "Sandy CLAY", this is indicative that the material exhibits fine grained behaviour, even if the dry mass of coarse grained material may exceed 65%.

Component proportions

The relative proportion of the dry mass of each particle size fraction is assessed to be a "primary", "secondary", or "minor" component of the soil mixture, depending on its influence over the soil behaviour.

Component Proportion Designation	Definition[1]	Relative Proportion	
		In Fine Grained Soil	In Coarse Grained Soil
Primary	The component (particle size designation, refer above) which dominates the engineering behaviour of the soil	The clay/silt component with the greater proportion	The sand/gravel component with the greater proportion
Secondary	Any component which is not the primary, but is significant to the engineering properties of the soil	Any component with greater than 30% proportion	Any granular component with greater than 30%; or Any fine component with greater than 12%
Minor[2]	Present in the soil, but not significant to its engineering properties	All other components	All other components

[1] As defined in AS1726-2017 6.1.4.4

[2] In the detailed material description, minor components are split into two further sub-categories. Refer "identification of minor components" below.

Composite Materials

In certain situations, a lithology description may describe more than one material, for example, collectively describing a layer of interbedded sand and clay. In such a scenario, the two materials would be described independently, with the names preceded or followed by a statement describing the arrangement by which the materials co-exist. For example, "INTERBEDDED Silty CLAY AND SAND".

Classification

The soil classification comprises a two character group symbol. The first character identifies the primary component. The second character identifies either the grading or presence of fines in a coarse grained soil, or the plasticity in a fine grained soil. Refer AS1726-2017 6.1.6 for further clarification.

Soil Name

For most soils, the name is derived with the primary component included as the noun (in upper case), preceded by any secondary components stated in an adjective form. In this way, the soil name also describes the general composition and indicates the dominant behaviour of the material.

Component [1]	Prominence in Soil Name
Primary	Noun (eg "CLAY")
Secondary	Adjective modifier (eg "Sandy")
Minor	No influence

[1] – for determination of component proportions, refer component proportions on previous page

For materials which cannot be disaggregated, or which are not comprised of rock or mineral fragments, the names "ORGANIC MATTER" or "ARTIFICIAL MATERIAL" may be used, in accordance with AS1726-2017 Table 14.

Commercial or colloquial names are not used for the soil name where a component derived name is possible (for example "Gravelly SAND" rather than "CRACKER DUST").

Materials of "fill" or "topsoil" origin are generally assigned a name derived from the primary/secondary component (where appropriate). In log descriptions this is preceded by uppercase "FILL" or "TOPSOIL". Origin uncertainty is indicated in the description by the characters (?), with the degree of uncertainty described (using the terms "probably" or "possibly" in the origin column, or at the end of the description).

Identification of minor components

Minor components are identified in the soil description immediately following the soil name. The minor component fraction is usually preceded with a term indicating the relative proportion of the component.

Minor Component Proportion Term	Relative Proportion	
	In Fine Grained Soil	In Coarse Grained Soil
With	All fractions: 15-30%	Clay/silt: 5-12% sand/gravel: 15-30%
Trace	All fractions: 0-15%	Clay/silt: 0-5% sand/gravel: 0-15%

The terms "with" and "trace" generally apply only to gravel or fine particle fractions. Where cobbles/boulders are encountered in minor proportions (generally less than about 12%) the term "occasional" may be used. This term describes the sporadic distribution of the material within the confines of the investigation excavation only, and there may be considerable variation in proportion over a wider area which is difficult to factually characterise due to the relative size of the particles and the investigation methods.

Soil Composition

Plasticity

Descriptive Term	Laboratory liquid limit range	
	Silt	Clay
Non-plastic materials	Not applicable	Not applicable
Low plasticity	≤50	≤35
Medium plasticity	Not applicable	>35 and ≤50
High plasticity	>50	>50

Note, Plasticity descriptions generally describe the plasticity behaviour of the whole of the fine grained soil, not individual fine grained fractions.

Grain Size

Type		Particle size (mm)
Gravel	Coarse	19 - 63
	Medium	6.7 - 19
	Fine	2.36 – 6.7
Sand	Coarse	0.6 - 2.36
	Medium	0.21 - 0.6
	Fine	0.075 - 0.21

Grading

Grading Term	Particle size (mm)
Well	A good representation of all particle sizes
Poorly	An excess or deficiency of particular sizes within the specified range
Uniformly	Essentially of one size
Gap	A deficiency of a particular size or size range within the total range

Note, AS1726-2017 provides terminology for additional attributes not listed here.

Soil Condition

Moisture

The moisture condition of soils is assessed relative to the plastic limit for fine grained soils, while for coarse grained soils it is assessed based on the appearance and feel of the material. The moisture condition of a material is considered to be independent of stratigraphy (although commonly these are related), and this data is presented in its own column on logs.

Applicability	Term	Tactile Assessment	Abbreviation code
Fine	Dry of plastic limit	Hard and friable or powdery	w<PL
	Near plastic limit	Can be moulded	w=PL
	Wet of plastic limit	Water residue remains on hands when handling	w>PL
	Near liquid limit	"oozes" when agitated	w=LL
	Wet of liquid limit	"oozes"	w>LL
Coarse	Dry	Non-cohesive and free running	D
	Moist	Feels cool, darkened in colour, particles may stick together	M
	Wet	Feels cool, darkened in colour, particles may stick together, free water forms when handling	W

The abbreviation code NDF, meaning "not-assessable due to drilling fluid use" may also be used.

Note, observations relating to free ground water or drilling fluids are provided independent of soil moisture condition.

Consistency/Density/Compaction/Cementation/Extremely Weathered Material

These concepts give an indication of how the material may respond to applied forces (when considered in conjunction with other attributes of the soil). This behaviour can vary independent of the composition of the material, and on logs these are described in an independent column and are generally mutually exclusive (i.e it is inappropriate to describe both consistency and compaction at the same time). The method by which the behaviour is described depends on the behaviour model and other characteristics of the soil as follows:

- In fine grained soils, the "consistency" describes the ease with which the soil can be remoulded, and is generally correlated against the materials undrained shear strength;
- In granular materials, the relative density describes how tightly packed the particles are, and is generally correlated against the density index;
- In anthropogenically modified materials, the compaction of the material is described qualitatively;
- In cemented soils (both natural and anthropogenic), the cemented "strength" is described qualitatively, relative to the difficulty with which the material is disaggregated; and
- In soils of extremely weathered material origin, the engineering behaviour may be governed by relic rock features, and expected behaviour needs to be assessed based the overall material description.

Quantitative engineering performance of these materials may be determined by laboratory testing or estimated by correlated field tests (for example penetration or shear vane testing). In some cases, performance may be assessed by tactile or other subjective methods, in which case investigation logs will show the estimated value enclosed in round brackets, for example (VS).

Consistency (fine grained soils)

Consistency Term	Tactile Assessment	Undrained Shear Strength (kPa)	Abbreviation Code
Very soft	Extrudes between fingers when squeezed	<12	VS
Soft	Mouldable with light finger pressure	>12 - ≤25	S
Firm	Mouldable with strong finger pressure	>25 - ≤50	F
Stiff	Cannot be moulded by fingers	>50 - ≤100	St
Very stiff	Indented by thumbnail	>100 - ≤200	VSt
Hard	Indented by thumbnail with difficulty	>200	H
Friable	Easily crumbled or broken into small pieces by hand	-	Fr

Relative Density (coarse grained soils)

Relative Density Term	Density Index	Abbreviation Code
Very loose	<15	VL
Loose	>15 - ≤35	L
Medium dense	>35 - ≤65	MD
Dense	>65 - ≤85	D
Very dense	>85	VD

Note, tactile assessment of relative density is difficult, and generally requires penetration testing, hence a tactile assessment guide is not provided.

Compaction (anthropogenically modified soil)

Compaction Term	Abbreviation Code
Well compacted	WC
Poorly compacted	PC
Moderately compacted	MC
Variably compacted	VC

Cementation (natural and anthropogenic)

Cementation Term	Abbreviation Code
Moderately cemented	MOD
Weakly cemented	WEK

Extremely Weathered Material

AS1726-2017 considers weathered material to be soil if the unconfined compressive strength is less than 0.6 MPa (i.e. less than very low strength rock). These materials may be identified as "extremely weathered material" in reports and by the abbreviation code XWM on log sheets. This identification is not correlated to any specific qualitative or quantitative behaviour, and the engineering properties of this material must therefore be assessed according to engineering principles with reference to any relic rock structure, fabric, or texture described in the description.

Soil Origin

Term	Description	Abbreviation Code
Residual	Derived from in-situ weathering of the underlying rock	RS
Extremely weathered material	Formed from in-situ weathering of geological formations. Has strength of less than 'very low' as per as1726 but retains the structure or fabric of the parent rock.	XWM
Alluvial	Deposited by streams and rivers	ALV
Estuarine	Deposited in coastal estuaries	EST
Marine	Deposited in a marine environment	MAR
Lacustrine	Deposited in freshwater lakes	LAC
Aeolian	Carried and deposited by wind	AEO
Colluvial	Soil and rock debris transported down slopes by gravity	COL
Slopewash	Thin layers of soil and rock debris gradually and slowly deposited by gravity and possibly water	SW
Topsoil	Mantle of surface soil, often with high levels of organic material	TOP
Fill	Any material which has been moved by man	FILL
Littoral	Deposited on the lake or seashore	LIT
Unidentifiable	Not able to be identified	UID

Cobbles and Boulders

The presence of particles considered to be "oversize" may be described using one of the following strategies:

- Oversize encountered in a minor proportion (when considered relative to the wider area) are noted in the soil description; or
- Where a significant proportion of oversize is encountered, the cobbles/boulders are described independent of the soil description, in a similar manner to composite soils (described above) but qualified with "MIXTURE OF".

intentionally blank

Terminology, Symbols and Abbreviations

November 2023

Introduction to Terminology, Symbols and Abbreviations

Douglas Partners' reports, investigation logs, and other correspondence may use terminology which has quantitative or qualitative connotations. To remove ambiguity or uncertainty surrounding the use of such terms, the following sets of notes pages may be attached Douglas Partners' reports, depending on the work performed and conditions encountered:

- Soil Descriptions;
- Rock Descriptions; and
- Sampling, insitu testing, and drilling methodologies

In addition to these pages, the following notes generally apply to most documents.

Abbreviation Codes

Site conditions may also be presented in a number of different formats, such as investigation logs, field mapping, or as a written summary. In some of these formats textual or symbolic terminology may be presented using textual abbreviation codes or graphic symbols, and, where commonly used, these are listed alongside the terminology definition. For ease of identification in these note pages, textual codes are presented in these notes in the following style `XW`. Code usage conforms with the following guidelines:

- Textual codes are case insensitive, although herein they are generally presented in upper case; and
- Textual codes are contextual (i.e. the same or similar combinations of characters may be used in different contexts with different meanings (for example `PL` is used for plastic limit in the context of soil moisture condition, as well as in `PL(A)` for point load test result in the testing results column)).

Data Integrity Codes

Subsurface investigation data recorded by Douglas Partners is generally managed in a highly structured database environment, where records "span" between a top and bottom depth interval. Depth interval "gaps" between records are considered to introduce ambiguity, and, where appropriate, our practice guidelines may require contiguous data sets. Recording meaningful data is not always appropriate (for example assigning a "strength" to a concrete pavement) and the following codes may be used to maintain contiguity in such circumstances.

Term	Description	Abbreviation Code
Core loss	No core recovery	`KL`
Unknown	Information was not available to allow classification of the property. For example, when auguring in loose, saturated sand auger cuttings may not be returned.	`UK`
No data	Information required to allow classification of the property was not available. For example, if drilling is commenced from the base of a hole predrilled by others	`ND`
Not Applicable	Derivation of the properties not appropriate or beyond the scope of the investigation. For example, providing a description of the strength of a concrete pavement	`NA`

Graphic Symbols

Douglas Partners' logs contain a "graphic" column which provides a pictorial representation of the basic composition of the material. The symbols used are directly representing the material name stated in the adjacent "Description of Strata" column, and as such no specific graphic symbology legend has been provided in these notes.

intentionally blank

Douglas PARTNERS

Test Location Plan

Infiltration Testing

Irasburg Parade, Wellard, WA

CLIENT: Wellard Residential Pty Ltd

PROJECT:	88799.08
Drawing No:	1
REV:	0
DATE:	22/4/2024

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 4.7 AHD
COORDINATE: E:390937.0, N:6429737.1
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH1
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS.(†) / DENSITY.(†)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.15	Organic Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC							DCP9/150	5 10 15
		Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay.		LAC	F to St	w<PL		D		0.30		
	0.40	Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC		w=PL						
	4	Borehole discontinued at 0.55m depth. (Hard digging, refusal on clay).										

NOTES: (#) Soil origin is "probable" unless otherwise stated. (†) Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
METHOD: 110 mm diamter borehole
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

OPERATOR: (GG)

LOGGED: GG
CASING: Nil

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 4.7 AHD
COORDINATE: E:390959.4, N:6429734.7
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH2
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[^]	DENSITY.[^]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.00	Organic Sandy CLAY (Cl): dark grey-brown; medium plasticity; fine to medium sand.		LAC	F to St		w<PL					DCP9/150	5 10 15
	0.15	Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay; cracked.		LAC									
	0.30	Sandy CLAY (Cl): dark grey-brown; medium plasticity; fine to medium sand.		LAC			w=PL		D		0.50		
	4	Borehole discontinued at 0.50m depth. (Hard digging, refusal on clay).											

NOTES: [#] Soil origin is "probable" unless otherwise stated. [^] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
OPERATOR: (GG)
LOGGED: GG
METHOD: 110 mm diamter borehole
CASING: Nil
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 4.7 AHD
COORDINATE: E:390979.5, N:6429739.1
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH3
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS.(†) DENSITY.(†)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		0.00	TOPSOIL / organic Clayey SAND (SC), trace rootlets: dark grey-brown; fine to medium; medium plasticity clay.		TOP	St to VSt	w<PL		D		0.60	DCP9/150	5 10 15
		0.15	Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay.		LAC								
		0.30	Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC		w=PL						
	4	0.60	Borehole discontinued at 0.60m depth. (Hard digging, refusal on clay).										

NOTES: [#] Soil origin is "probable" unless otherwise stated. [†] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
METHOD: 110 mm diamter borehole
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

OPERATOR: (GG)

LOGGED: GG
CASING: Nil

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 4.7 AHD
COORDINATE: E:390961.3, N:6429721.4
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH4
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m) / DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[^] / DENSITY.[^]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
	0.25	Organic Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay.		LAC	S to F	w<PL					DCP9/150	5 10 15
		Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC		w=PL		D		0.45		
	4	Borehole discontinued at 0.70m depth. (Hard digging, refusal on clay).										

NOTES: [#] Soil origin is "probable" unless otherwise stated. [^] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
METHOD: 110 mm diamter borehole
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

OPERATOR: (GG)

LOGGED: GG
CASING: Nil

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE-GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 4.9 AHD
COORDINATE: E:390984.2, N:6429719.2
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH5
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN (#)	CONSIS.(*) DENSITY.(*)	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		0.25	Organic Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay.		LAC	St to VSt	w<PL					DCP9/150	5 10 15 Refusal 30
			Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC	H	w=PL		D		0.60		
	4		Borehole discontinued at 0.60m depth. (Hard digging, refusal on clay).										

NOTES: (#) Soil origin is "probable" unless otherwise stated. (*) Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
OPERATOR: (GG)
LOGGED: GG
METHOD: 110 mm diamter borehole
CASING: Nil
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 5.0 AHD
COORDINATE: E:390971.4, N:6429705.4
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH6
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED								SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[^] / DENSITY.[^]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
			Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay; with organics to 0.2 m depth.		LAC	St	w<PL		D		0.35	DCP9/150	5 10 15 Refusal 30
						H	w=PL						
			Borehole discontinued at 0.55m depth. (Hard digging, refusal on clay).										
	4												

NOTES: [#] Soil origin is "probable" unless otherwise stated. [^] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
METHOD: 110 mm diamter borehole
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

OPERATOR: (GG)

LOGGED: GG
CASING: Nil

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

BOREHOLE LOG

CLIENT: Wellard Residential Pty Ltd
PROJECT: Infiltration Testing
LOCATION: Irasburg Parade, Wellard, WA 6170

SURFACE LEVEL: 5.0 AHD
COORDINATE: E:390992.4, N:6429694.0
DATUM/GRID: MGA2020 Zone 50
DIP/AZIMUTH: 90°/---°

LOCATION ID: BH7
PROJECT No: 88799.08
DATE: 18/04/24
SHEET: 1 of 1

CONDITIONS ENCOUNTERED									SAMPLE				TESTING AND REMARKS	
GROUNDWATER	RL (m)	DEPTH (m)	DESCRIPTION OF STRATA	GRAPHIC	ORIGIN[#]	CONSIS.[^]	DENSITY.[^]	MOISTURE	REMARKS	TYPE	INTERVAL	DEPTH (m)	TEST TYPE	RESULTS AND REMARKS
		0.30	Organic Clayey SAND (SC): dark grey-brown; fine to medium; low to medium plasticity clay.		LAC	St		w<PL					DCP9/150	5 10 15
			Sandy CLAY (CI): dark grey-brown; medium plasticity; fine to medium sand.		LAC			w=PL						
										D		0.50		
			Borehole discontinued at 0.50m depth. (Hard digging, refusal on clay).											
	4													

NOTES: [#] Soil origin is "probable" unless otherwise stated. [^] Consistency/Relative density shading is for visual reference only - no correlation between cohesive and granular materials is implied.

PLANT: hand auger
METHOD: 110 mm diamter borehole
REMARKS: Surface level surveyed using a differential GPS with a reported accuracy of +/- 0.1 m.
No free groundwater observed.

OPERATOR: (GG)

LOGGED: GG
CASING: Nil

Refer to explanatory notes for symbol and abbreviation definitions

Douglas PARTNERS

Generated with CORE:GS by Geroc - Soil Log with Photo

Appendix F

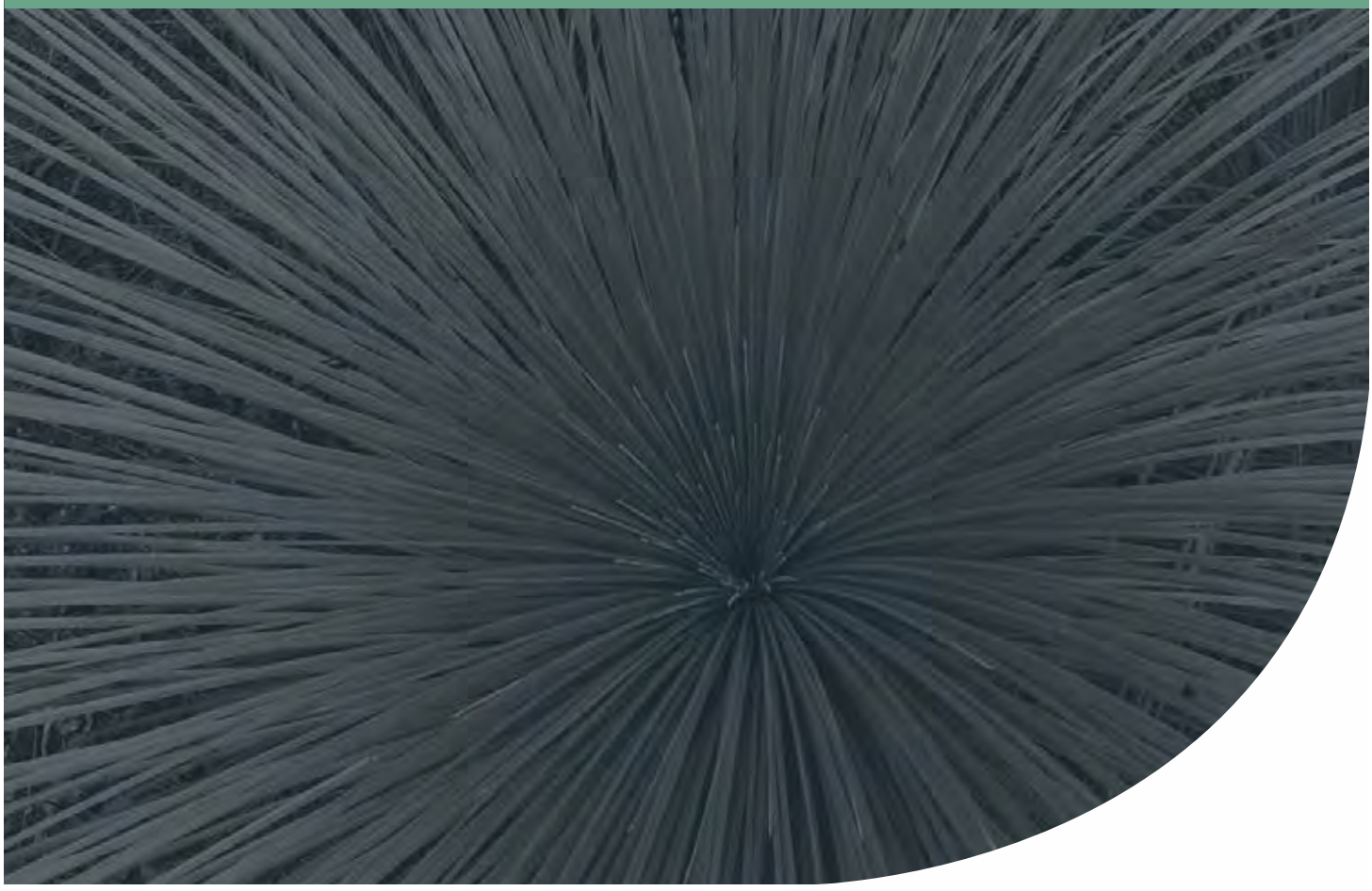
Modelling Assumption Report

Modelling Assumptions Report

Lot 506 Johnson Road, Wellard

Project No: EP22-062(03)

Prepared for Wellard Residential Pty Ltd
November 2024



Document Control

Doc name:	Modelling Assumptions Report Lot 506 Johnson Road, Wellard				
Doc no.:	**EP22-062(03)—016 JM**				
Version	**Date**	**Author**		**Reviewer**	
1	November 2023	Joyti Mabruk	JM	David Coremans	DPC
	Appendix to the LWMS				
A	November 2024	Fabio Hernandez	FMH	David Coremans	DPC
	Appendix to the LWMS				

© 2024 Emerge Associates All Rights Reserved. Copyright in the whole and every part of this document belongs to Emerge Associates and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Emerge Associates.

Table of Contents

1 Background 1

2 Methodology 2

2.1 Rainfall 2

3 Post-development model 3

4 References 5

4.1 General references 5
4.2 Online references 5

List of Tables

Table 1: Post-development parameters 3
Table 2: Post-development catchment areas (ha) 3

1 Background

Lot 506 Johnson Road Wellard East (referred to herein as the 'site') is located approximately 38 km south of Perth central business district (CBD), within the suburb of Wellard. The site is approximately 7.85 hectares (ha) in size, is within the City of Kwinana (CoK) and surrounded by Johnson Road and Irasburg Parade to the southeast, future developments to the north and the Peel Main Drain (PMD) to the west. The site currently consists of open paddocks and some remnant bushland.

This report is an appendix to the Lot 506 Johnson Road Local Water Management Plan (LWMS) and details the assumptions and calculations made in the hydrological modelling developed to determine the flood storage and water quality treatment requirements.

2 Methodology

XPSWMM hydrologic and hydraulic modelling software (v20.1) was used to calculate the surface water runoff volumes within the road reserves and lots associated with the development of Providence East.

The hydrologic component of the software uses the Laurenson non-linear runoff-routing method to simulate runoff from design storm events. Key assumptions regarding the hydrologic model include:

- Runoff is proportional to slope, area, infiltration and percentage of imperviousness of a catchment.
- Sub-catchment areas and slopes are determined from surveyed topographical data and earthworks plans.
- Infiltration rates and percentage imperviousness have been selected based on experience with model preparation for similar soil conditions.

Runoff from each sub-catchment is routed through the catchment using the hydraulic component of XPSWMM. Generally, assumptions associated with the hydraulic component of the model include:

- Virtual links (i.e. purely for model construction, not equivalent to flow path onsite) between nodes within a sub-catchment are given the length of 10 m and slope of 0.05 to minimise the lag time of conveying the water from a sub-catchment node to a 'storage' node, a 'dummy intermediate' node or a conduit/link.
- Links between sub-catchment storages act as conveyance channels (e.g. sheet flow within roads in a 1% annual exceedance probability (AEP)). These links are given lengths and slopes that are representative of the site conditions and actual pathway lengths between catchments.
- All channels are designed with a width of 5 m, roughness of 0.014 (Manning's n) and are trapezoidal in shape. This allows for easy conveyance and represents concrete pipes and road surfaces within the model.
- Where relevant median swales, bio-retention areas (BRAs), and flood storage areas (FSAs) are modelled as nodal-reservoirs with infiltration depth-rating curves to account for differential infiltration rates with changing depth.

2.1 Rainfall

The ensemble temporal patterns obtained from the Australian Rainfall and Runoff (AR&R) Data Hub (AR&R 2019) were used for the rainfall analysis.

Up to eight durations ranging between 1 hour and 72 hours were tested, with the peak flood elevation being assessed as the determining result.

Following the process suggested by AR&R (Ball J *et al.* 2019), the highest mean duration was selected as the critical duration. AR&R also recommends that when it is not practical to run the entire ensemble array, the ensemble that produces the result closest to the mean (for the critical duration) should be adopted. The 6 hour duration ensemble 8 and 3 hour duration ensemble 5 was adopted for both the 1% AEP and 20% AEP events.

3 Post-development model

An initial loss continuing loss model was adopted to account for post-development catchment losses. The post-development catchment area, land types and loss values were based on the structure plan design, typical infiltration rates for the soils which occur onsite and based on project team experience. Post-development catchment areas and land types within the site were informed by sub-division plan. **Table 1** summarises the loss parameters used within the post-development model.

Table 1: Post-development parameters

Land type	Initial loss (mm)	Continual loss (mm)	Roughness
Road Surface	1	0.1	0.02
Road Verge	9	1	0.05
Roof	15	0.1	0.02
Lot paved	15	1.5	0.02
POS	15	1.5	0.05

A summary of post-development catchment information is provided in **Table 2** with the catchment plan and basin location shown in Figure 8 of the LWMS.

Table 2: Post-development catchment areas (ha)

Catchment	Area (ha)							
	Total area	Total Road reserve	Road pavement	Road verge	Total Residential lot	Residential impervious	Residential pervious	POS
Ct – A	7.852	2.180	1.308	0.872	4.852	3.882	0.970	0.820

The following assumptions were incorporated into the model:

- Lots
  - Lots will have 80% impervious areas including roof areas, 20% pervious garden areas.
  - Soakwells and pervious areas in lots will retain up to the major rainfall event (i.e. 1% AEP).
  - Residential lots will have little slope (i.e. will be flat) and pockets of storage are likely. This will effectively increase the initial loss (storage) and overall infiltration rate (continual loss).
  - Garden areas in lots will have high infiltration rates as it is likely that sand-based landscape mix or mulch will be used.
- Road reserve
  - There will be no infiltration on roads, pavements and driveways. There will however be some minor absorption storage loss which is accounted for in the initial and continuing loss values.
  - Road reserve contains 60% pervious verge and 40% impervious bitumen areas.
- Basin catchments and POS
  - Basin catchment areas (basin footprint and contributing open space) are assumed to be 100% pervious.
  - Basin catchment areas will likely contain landscaped or remnant vegetation.

- Storage
  - BRA retains runoff from events up to and including the frequent event (i.e. first 15 mm).
  - BRA has 1:3 side slopes and maximum depth of 500 mm.
  - FSA has 1:6 side slopes and maximum depth of 1.2 m in response to the 1% AEP.
  - FSA retains runoff from events up to and including the 1% AEP event.
- Infiltration
  - A hydraulic conductivity of 2.16 m/day has been assumed for the BRA. The BRA will be vegetated and used for treatment and therefore assumed infiltration rate is already inclusive of a clogging factor.
  - BRA will be constructed over imported free draining sand.
  - A hydraulic conductivity of 0.5 m/day is assumed for the FSA and is consistent with infiltration testing.
  - Infiltration through base area and side slopes of the basins are considered in the overall infiltration rating curve for these areas.
- Evapotranspiration
  - Volumes leaving the system through evapotranspiration were assumed to be negligible when compared to the total runoff volume and since the duration of the model run was comparatively short. XPSWMM default evapotranspiration assumptions are therefore used.

4 References

4.1 General references

The references listed below have been considered as part of preparing this document.

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M and Testoni I (Editors) 2019, *Australian Rainfall and Runoff: A Guide to Flood Estimation*, Commonwealth of Australia (Geoscience Australia).

4.2 Online references

Bureau of Meteorology (BoM) 2021a, Climate Data Online, viewed 19 October 2023, Available from, <http://www.bom.gov.au/water/designRainfalls/revised-ifd/>.

Bureau of Meteorology (BoM) 2021b, Design Rainfall Data System (2016), viewed 19 October 2023, Available from, <http://www.bom.gov.au/water/designRainfalls/revised-ifd/>.

Appendix G

Groundwater Licence

File No: SN10771

Government of Western Australia
Department of Water

Instrument No. GWL96942(4)

LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Wellard Residential Pty Ltd		
Description of Water Resource	Serpentine Perth - Superficial Swan	Annual Water Entitlement	43500 kL
Location of Water Source	Lot 506 On Plan 71000 - Volume/Folio 2796/128 - Lot 506 Johnson Rd Wellard		

Authorised Activities	Taking of water for	Location of Activity
	Domestic use Irrigation of up to 0.2 ha of lawns and gardens Irrigation of up to 5.6 ha of pasture Stock watering	Lot 506 On Plan 71000 - Volume/Folio 2796/128 - Lot 506 Johnson Rd Wellard

Duration of Licence	From 10 June 2015 to 9 June 2025

This Licence is subject to the following terms, conditions and restrictions:

1 The licensee shall not use water for gardens, lawns and pasture between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.

2 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.

End of terms, conditions and restrictions

Government of **Western Australia**
Department of **Water**

making sure all our water needs

Your ref: GWL96942
Our ref: SN10771
Enquiries: Alana Patterson
Tel: 95504236

Wellard Residential Pty Ltd
PO Box 456
APPLECROSS WA 6953

Attn: Sam Gill

Dear Mr Gill

Re: Issue of a licence under the *Rights in Water and Irrigation Act 1914*
Property: Lot 506 Johnson Rd Wellard

Please find enclosed the following:

- Your licence to take water *(GWL96942 (4))*
- FAQ sheet *Your licence to take water*

Please take time to read these documents as they contain important information about your rights and responsibilities.

You may apply to the State Administrative Tribunal (SAT) for a review of our decision. You will need to contact the SAT office directly, within 28 days.

In person State Administrative Tribunal
4th floor, 12 St Georges Terrace Perth WA 6000

In writing: State Administrative Tribunal
GPO Box U1991
Perth WA 6845

By telephone: Metro: (08) 9219 3111
Regional: 1300 306 017 (for the cost of a local call)

By fax: (08) 9325 5099

For more information about the SAT please visit their website www.sat.justice.wa.gov.au.

Kwinana Peel Region
107 Breakwater Parade Mandurah Ocean Marina Mandurah Western Australia 6210
PO Box 332 Mandurah Western Australia 6210
Telephone (08) 9550 4222 Facsimile (08) 9581 4560
www.water.wa.gov.au

3DWA025

If you have any queries about this or any other water licensing matter please contact Alana Patterson on telephone 95504236.

Yours sincerely

Alana Patterson
Natural Resource Management Officer
Peel Region

12 June 2015

ATTACHMENT 3

Engineering Services Report [JDSi]

SERVICING REPORT

Lot 506 Johnson Road

JDS222081 December 2023

Prepared for:
Wellard Residential Pty Ltd

JDSi
CONSULTING ENGINEERS

P: 08 9227 0595
F: 08 9227 8617

Level 1, 432 Murray St,
Perth WA 6000

PO Box 7483
Cloisters Square PO
WA 8650

jdsi.com.au

Table of Contents

Introduction **6**

1 Key Objectives **7**

2 Study Area **8**

2.1 Topography 8

2.2 Groundwater 8

2.3 Surface Water 9

2.4 Geotechnical 9

2.5 Acid Sulphate Soils 9

3 Earthworks and Demolition **11**

3.1 Demolition & Clearing 11

3.2 Bulk Earthworks 11

4 Roadworks **12**

5 Stormwater Drainage **13**

6 Sewer Reticulation **14**

7 Water Reticulation **15**

8 Power Supply **16**

9 Gas **18**

10 Telecommunications **19**

11 Disclaimer **20**

Figures

Figure 1: Site Location 6
Figure 2: Site Topography (Department of Primary Industries and Regional Development 2023) 8
Figure 3: ASS Risk Map (DWER Data) 10
Figure 4: Preliminary Sewer Layout (Esinet) 14
Figure 5: Existing Water Corporation surrounding water infrastructure (Esinet) 15
Figure 6 Western Power Network Diagram 16
Table 1 Estimated Total Electrical Network Loads 16

DOCUMENT REVIEW				
Revision	**Date Issued**	**Issue Type**	**Written By**	**Approved By**
Rev A	15/3/2023	Draft for Review	SB	SF
Rev B	17/3/2023	Issued for Information	SB	SF
Rev C	5/12/2023	Issued for Information	SB	SF
Rev D	19/12/2023	Issued for Information	SB	SF

Introduction

Wellard Residential Pty Ltd c/- Eastcourt Property Group (the Client) have engaged JDSi Consulting Engineers to assess and report on the servicing of future lots in support of an amendment to the existing Providence Structure Plan.

Lot 506 Johnson Road is owned by Wellard Residential and is proposed to be developed into approximately 145 residential green title lots. An area of public open space (POS) is proposed at the north-western corner of the site to provide community amenity and stormwater disposal. The indicative layout is indicated on the subdivision concept plan (***Appendix A***).

This report covers the engineering infrastructure requirements to service the proposed Development. JDSi have considered earthworks, roads, stormwater drainage, wastewater, potable water, fuel gas and telecommunications.

The report has been based on a desktop study of existing services information, a site visit in February 2023, aerial imagery, advice from the service authorities and in-house experience of similar projects. The information is current as of February 2023 and may be subject to change over time with the development of nearby landholdings.

Figure 1: Site Location

1 Key Objectives

The key objectives of this report are to:

- Summarise any existing infrastructure assets within the vicinity of the site, including roads, drainage, and utility services.
- Provide commentary on clearing and earthworks required within the site.
- Outline how the development will be serviced with sewer, water, gas and telecommunications services.
- Provide commentary on the overall stormwater drainage strategy for the proposed development.
- Determine if there are any limitations/constraints in servicing the subdivision.
- Summarise requirements for the design and construction of new public roads proposed as part of the development.

2 Study Area

The Site is bounded by Private landholdings owned by LWP to the North, Johnson Road / Irasburg Parade to the east and the Water Corporation's Peel Main Drain to the west. Historical arial imagery indicate this lot has been used for rural purposes with a residence visible in the north-eastern corner of the lot in the from the late 70s and construction of additional sheds, fenced pens and horse tracks evident on aerial imagery from the late 90s. The Bollard Bullrush swamp, a conservation category wetland, is located to the north-west of the subject site.

The site is zoned as "Development" and "Rural A" under the City of Kwinana Town planning Scheme and "Urban" under the Metropolitan Region Scheme.

2.1 Topography

The Site has a triangular shape with surface elevation ranging from 3.8 -10.5m AHD with the site generally sloping from the most elevated areas along the eastern boundary to the lowest point at the western corner of the site.

A feature survey of the site has been undertaken by MNG on 7/5/2015. A copy of this survey is attached to the report as ***Appendix B.***

Refer to Figure 3 below for the indicative topography of the surrounding land.

Figure 2: Site Topography (Department of Primary Industries and Regional Development 2023)

2.2 Groundwater

Perth Groundwater Map (provided by Department of Water and Environmental Regulation) has limited information over the project site. Historic minimum and maximum groundwater contours immediately east of the site are recorded as 5m and 10m AHD respectively. Based on the DWER records, the maximum groundwater level approximates the surface level along this boundary.

Groundwater monitoring carried out by Emerge Associates indicates that the maximum groundwater levels vary between 4.7m, 6.1m and 5.4m AHD at the western, eastern, and southern extents of the site respectively. Groundwater levels transition from highest recorded levels at the east of the subject site gradually reducing to the lowest recorded levels at the western edge of the site.

Groundwater is a relevant constraint for the development of the site and the design of earthworks and drainage infrastructure. This is especially the case for the western portion of the site where groundwater levels are highest with respect to the existing ground level. Proposed lots and POS areas are required to be designed with adequate clearance from the maximum groundwater levels to ensure serviceability and stormwater disposal functionality.

2.3 Surface Water

The Peel Main Drain flows in a southerly direction and passes through several wetlands including the Bollard Bulrush swamp before discharging into the Serpentine River and ultimately into the Peel Inlet-Harvey Estuary. This drain was originally constructed to control regional groundwater and consequently the drain hydraulics is inextricably linked to groundwater.

The Department of Water and Environmental Regulation has published the “Jandakot Drainage and Water Management Plan – Peel Main Drain Catchment” to provide stormwater management advice for developers and other stakeholders in relation to the drain.

Adequate flood protection is required in the form of clearance a specified 500mm clearance between proposed floor levels and the 100 ARI water level. Flood modelling included in the management plan indicate 100-year ARI flood levels of 5.60m at the Bollard Bullrush swamp and the nearest downstream node PMD55. Consequently, a minimum design lot level of 6.10m AHD criteria is required to provide 0.5m clearance flood protection for waters in the Peel Main Drain.

2.4 Geotechnical

A geotechnical investigation report has been prepared by Geotechnical and Geological Consultants (GGC) for the project site. The Site was assessed in with accordance with AS2870 as “class-P”.

The site soil strata generally consist of a 3.1 to 4.4m thick sand layer overlying lower clayey/silty material. The western corner of the site currently proposed as POS was identified as a separate geotechnical zone and consists of an upper clay layer approximately 3.2m thick overlying the lower clay material.

The site classification is recommended to be improved to “Class-A” by carrying the following preparation measures:

- Remove any uncontrolled fill, structures, building pads and deleterious material
- Clear vegetation and strip all topsoil / organic material and grub out all roots and stumps
- Proof-roll and compact the exposed natural surface. Areas identified as loose will need to be tested and, if necessary, excavated and replaced with granular structural fill
- Import fill placed and compacted as required maintaining a minimum separation of 1.8m from any clayey soils where applicable.

It is recommended that bulk earthworks are carried out in the summer months of the year to avoid issues with compacting close to the groundwater table. Organic soils may be suitable to be processed and blended with structural fill however this will need to be confirmed with testing at construction.

2.5 Acid Sulphate Soils

Acid Sulfate Soils (ASS) in Western Australia frequently occur in low-lying wetlands, backswamps, estuaries, salt marshes and tidal flats. Acid sulfate soils (ASS) are naturally occurring soils and sediments containing iron sulfides. When ASS are exposed to air the iron sulfides in the soil react with

oxygen and water to produce a variety of iron compounds and sulfuric acid. Without proper management, disturbing ASS can cause serious ecological damage, contaminate groundwater with heavy metals, damage sub-surface infrastructure and potentially cause harm to the health of humans and animals.

The Department of Environmental Regulation (DER) has published Acid Sulfate Soils (ASS) risk maps for low lying areas of the coastal plains in Western Australia. These maps assist in identifying high-risk soils and are used by DWER in applying conditions for managing ASS during construction of the development.

DWER mapping data classify all but the entire site as “Class 1 High to moderate risk of ASS occurring within 3m of natural soil surface”. The risk rating and the anticipated scope of earthworks will require an ASS investigation is carried out in accordance with DWER’s requirements to understand what measures are required to manage the ASS risks during construction.

Figure 3: ASS Risk Map (DWER Data)

3 Earthworks and Demolition

3.1 Demolition & Clearing

Prior to development works commencing all sheds and other structures, fencing and deleterious material will need to be removed.

All vegetation marked for clearing will also be removed from the site. Any areas of protected vegetation shall be clearly marked, and physical controls implemented to restrict access by construction machinery.

It is recommended that if there is any vegetation to be protected / retained, a suitably qualified arborist be engaged to assess and provide advice on required tree protection methodologies / zones.

3.2 Bulk Earthworks

All earthworks will need to be undertaken in accordance with recommendations from a detailed Geotechnical Investigation and AS3798 *"Guidelines on earthworks for commercial and residential developments"*.

The magnitude of earthworks to be undertaken and the final earthworks levels will be dictated by the following:

- Interface of the existing road network and utility services.
- Preparation recommendations in accordance with the geotechnical report.
- The requirement to contain stormwater drainage onsite and applicable levels for this to be achieved.
- The invert level of the existing gravity sewer mains that the development will discharge into.
- Drainage outfall levels and clearance from 100-year flood levels. This is subject to further advice by the project hydrologist and verified during preliminary design.
- Required clearance between groundwater and proposed dwelling floor levels.
- Required clearance between flood levels in the Water Corporation Peel Main drain and the proposed dwelling floor levels.
- Drainage outfall levels for the stormwater drainage system and industry standard requirements for free-board from the finished floor level to the 100 year flood level. This is subject to further advice provided by the hydrologist and will be verified during preliminary design.
- The invert level of the existing gravity sewer mains that the development will discharge into.
- The interface with proposed developments on adjacent landholdings.

With consideration of the above constraints a concept bulk earthworks design has been completed for the site ***(Appendix C)***. The northern boundary of the site is dictated by proposed interface levels with LWP's Oakebella development. The eastern boundary of the site is controlled by the existing road and verge levels of Johnson Road and Irasburg Parade and the western portion of the site is controlled by groundwater clearance requirements.

Based on the above items and existing level constraints the site requires structural fill to be imported into the site. Topsoil/organic material was measured as 0.2-0.6m deep across the site and will require removal and potentially disposal from site. Blending of the topsoil may be appropriate depending on the material characteristics and will be verified during construction. Sand won on site (Bassendean sand) will be suitable for reuse as structural fill.

The POS area will require the removal of clay and replacement with permeable fill to approximately 1m below the invert of the basin to ensure infiltration requirements are met.

4 Roadworks

The Site is currently serviced by Johnson Road and Irasburg Parade along the south/eastern boundary which is classified as a local distributor under the Main Road's hierarchy. This road includes a three-legged roundabout at the intersection with Breccia Parade.

The site falls within the local government jurisdiction of the City of Kwinana and all roads, kerbs and footpaths to service the site will be required to be in accordance with the City's specifications and the Local Government Guidelines for Subdivisional Development (IPWEA). All roads within the site will be required to be kerbed, have an asphalt wearing course, and have a footpath located on at least one side of the road.

The anticipated road network will include modifying the Johnson Road / Irasburg Roundabout into a four-legged roundabout and construction of a major access road from this roundabout transecting the site and linking with the "Oakebella" development to the north. The remaining roads within the proposed development are anticipated to be local access roads.

Irasburg Parade and Johnson Road were upgraded in 2015 and 2016 and assumed to be suitable for the intended traffic volumes however will need to be confirmed by a Traffic Engineer's assessment.

5 Stormwater Drainage

The stormwater drainage from the development will need to be designed and constructed in accordance with City of Kwinana guidelines, DWER water sensitive urban design guidelines as well as the Local Government Guidelines for Subdivisional Development (IPWEA). The stormwater management approach will need to be approved by the City of Kwinana through submission of an Urban Water Management Plan and it is recommended that a suitably qualified hydrologist is engaged to assist with the study and preparation of the Urban Water Management Plan.

Stormwater management for the development will adopt principles of Water Sensitive Urban Design (WSUD) suited to the climatic and ground conditions, including:

- The design philosophy for the development site will need to demonstrate post development flows and volumes do not exceed pre-development flows;
- Suitable landscaping to prevent direct run-off from impervious surfaces to the existing drainage network or coastal area without suitable treatment.
- Detention storage areas provided where possible to reduce peak flow rates to the capacity of downstream facilities.
- Clear overland flow path for the 100year ARI event, with a minimum 300mm free-board to habitable floors.
- Surface and groundwater quality will need to be maintained at predevelopment levels and improve the quality of water leaving the area, if possible.

It is anticipated that road drainage will be managed using a pit and pipe network conveying catchment flows to a singular retention basin located in the POS area at the western corner of the site. Earthworks and subsoil drainage is required in the POS to provide adequate clearance from groundwater and to improve basin infiltration / stormwater disposal.

During the site visit a dry open channel drain was observed along the northern boundary of the site which presumably conveys overland water flows to the small depression/pool at the western edge of the site. The pool appears to include a direct trenched connection to the Peel main drain which suggests there are pre-development flows discharging directly into the drain that should be considered as part of the overall hydraulic strategy. The project Hydrologist will be able to provide further advice in this regard.

6 Sewer Reticulation

The Water Corporation (WC) owns and maintains the sewerage reticulation system around the subject area. Any connection into this system will need to be designed, approved, and constructed in accordance with standard WC requirements.

Reticulated sewerage is not immediately available to serve the subject area. WC has confirmed an external DN150 sewer main extension approximately 250m long will be required to be constructed through LWP landholdings to service the site. This sewer extension will provide a connection to existing sewer reticulation conveying flows to the Tikva Way Pumpstation located a further 250m north of the connection point.

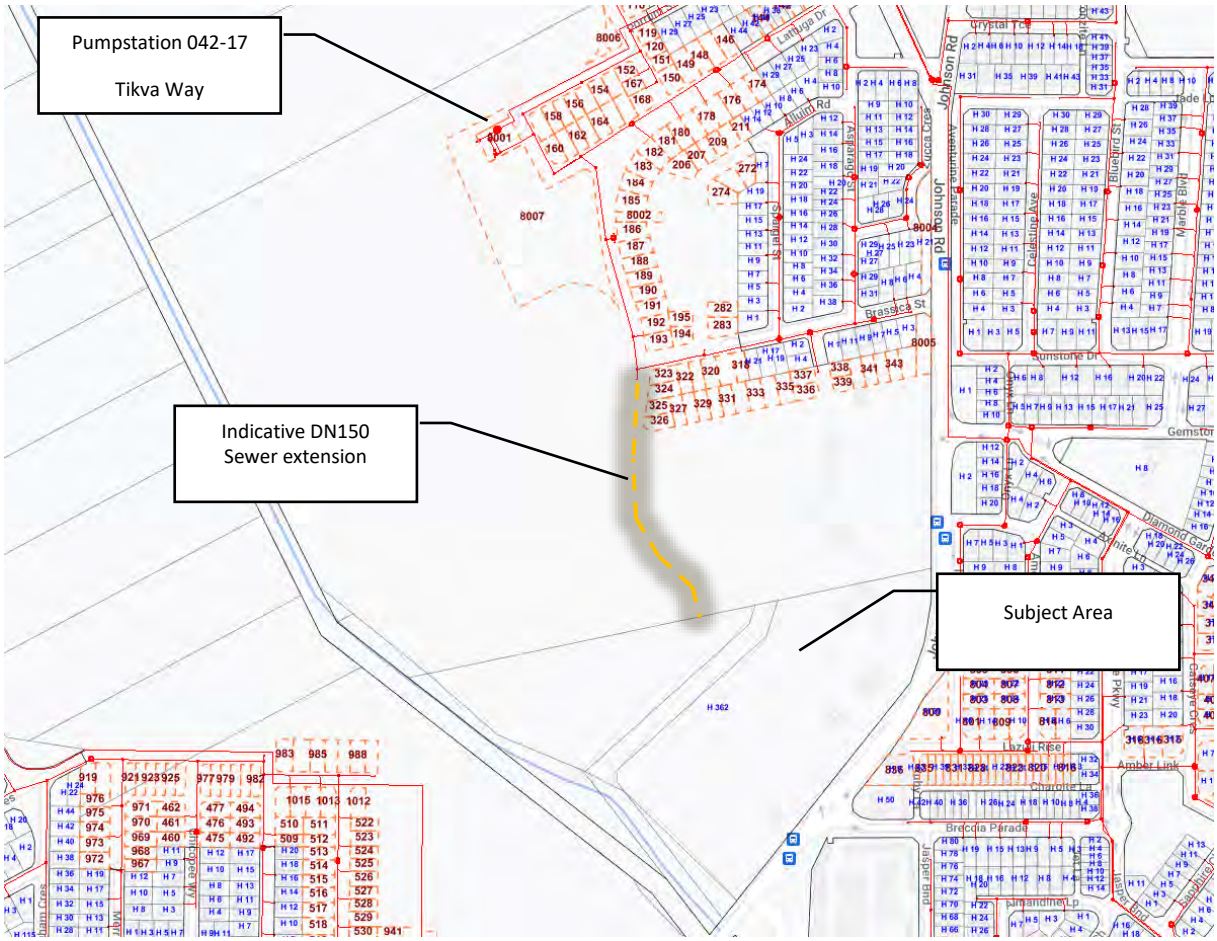


Figure 4: Preliminary Sewer Layout (Esinet)

Other than the offsite sewer main extension discussed above there are no other reported external works/upgrades required to service the site with sewer. Within the site the developer is required to provide internal gravity sewer to service individual lots including necessary access chambers and property connections. Normal open trenching construction methodologies are assumed to be appropriate however where sewers are constructed within the underlying clay material, a specialised bedding arrangement may be required. In this case it is recommended that professional Geotechnical advice be sought to provide recommendation based on the specific material encountered during construction.

7 Water Reticulation

The Water Corporation (WC) owns and maintains the potable water reticulation network in the vicinity of the Site. Any connection into this system will need to be designed, approved and constructed in accordance with standard WC requirements.

Based on the Water Corporation EsiNET data and WC advice, water is readily available to service the site. There is an existing DN300 water main located in the Johnson Road / Irasburg Parade verge which can be utilised.

Internal water reticulation pipework will be provided by the developer including hydrants, pre-laid property connections and valves for isolation. A DN200 water main will also be required to service the site. The main is anticipated to follow the major access road and provide linkage to the LWP development to the north. There are no required external water upgrades to service the site.

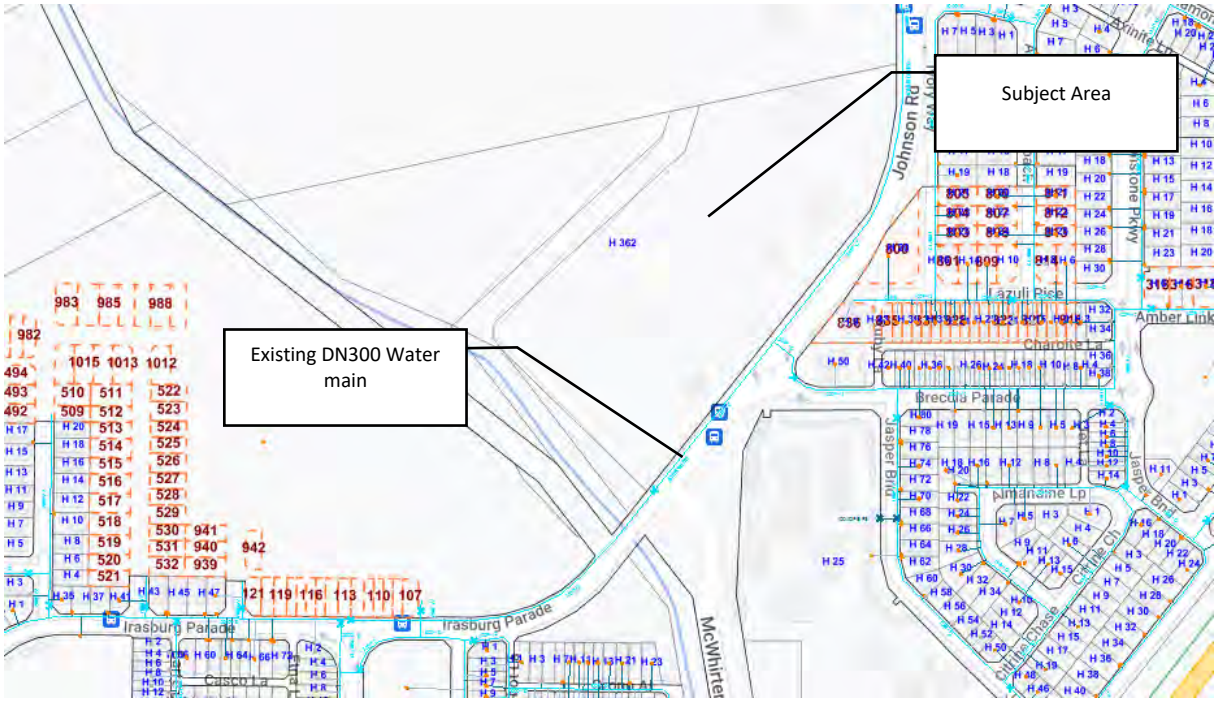


Figure 5: Existing Water Corporation surrounding water infrastructure (Esinet)

8 Power Supply

Western Power (WP) owns and operates all electrical supply network assets within the development area and therefore all new electrical supply equipment and cables will need to be installed in accordance with WP, WAER (West Australian Electrical Requirements), AS3000 specifications and Standards.

The following advice is based on JDSi desktop studies and information obtained from the WP NCMT (Network Capacity Mapping Tool) online database.

Existing High Voltage (HV) Underground network has been identified within the vicinity of the development along Irasburg Parade/Johnson Road on the opposite side of the development. These HV networks are understood to be originating from the Medina Zone Substation. The Medina Zone Substation is the existing bulk electricity supply with the closest point of connection to the development site which is approximately 6km away. Based on Western Power forecasts remaining capacity for 2028, it is estimated that there is 25-30MVA available for this HV feeder from the Zone substation.

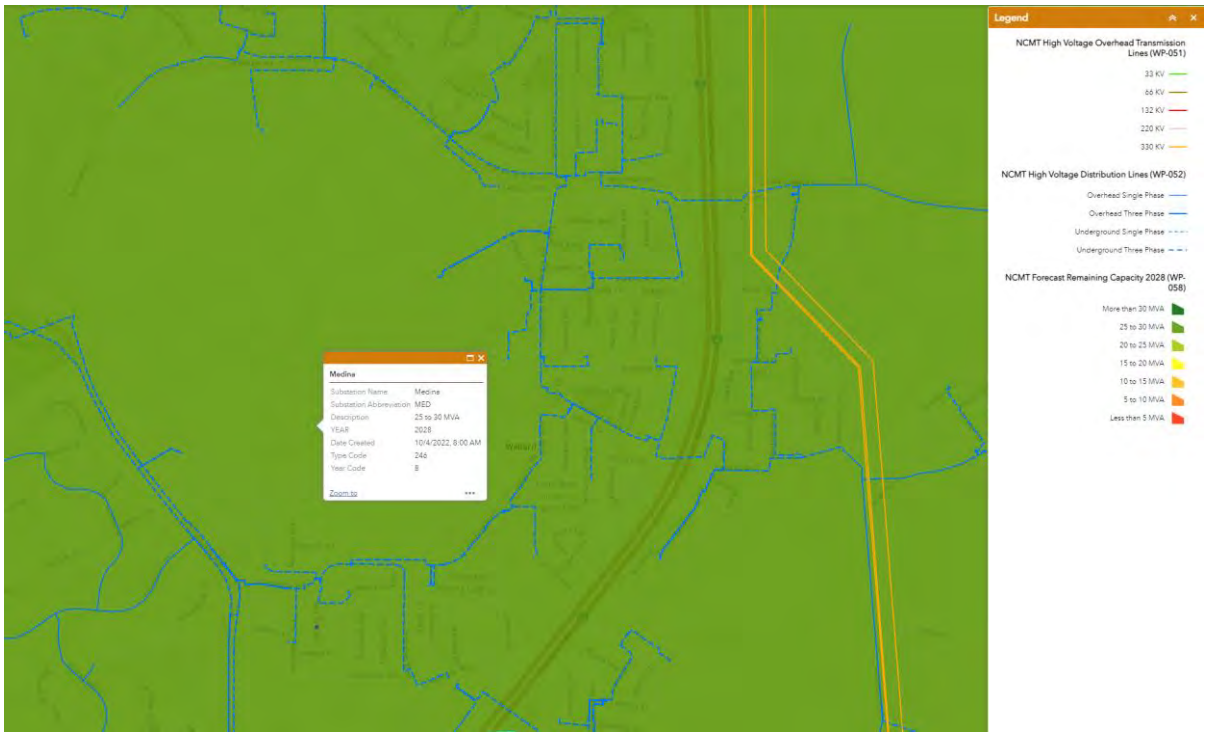


Figure 6 Western Power Network Diagram

The total load for the development has been estimated to be 557kVA and has been calculated using WP's recommended Design After Diversity Maximum Demand (DADMD). The estimated loads are summarised below:

Load Type	Volume	Load Allowance	kVA Allocated
Urban Residential	112 Dwellings	4.7kVA/dwelling	527 kVA
POS	1 Lots	30kVA/lot	30 kVA
		Total Demand	**557 kVA**

Table 1 Estimated Total Electrical Network Loads

Based on the estimated load the development will require a minimum of one 630kVA transformer. Furthermore, the site will require a minimum of one HV switchgear kiosks to bring the HV power network into the subdivision.

The site will require at least two HV feeders to run through the development. It is unlikely that the development will require WP power network reinforcement / augmentation. However, this will be determined by and confirmed by WP upon project application.

Please note WP cannot reserve network capacity therefore the above advice is current as at the date of this report. Once the Development planning has been finalised it is recommended a formal Design Information Package (DIP) request is submitted to Western Power to progress the design of the first stage of the Development.

9 Gas

Reticulated gas is not considered to be an essential service and as such is not required as a condition of development. However, for residential developments ATCO will generally provide gas reticulation at no cost to the developer during the construction of common trench services.

Before You Dig (BYD) information indicates that there is an existing DN110 Polyethylene (PE) natural gas Medium Pressure gas main located in the Irasburg Parade / Johnson Road verge between the southern extent of the site and Lazuli Rise. Based on the existing infrastructure it's likely that there would be no major constraints for providing natural gas reticulation to the subject area.

10 Telecommunications

Dial Before You Dig (DB4YD) information indicates existing communication infrastructure provided by Telstra and NBN is currently situated in the Johnson Road / Irasburg Parade verge.

JDSi anticipate this existing infrastructure would serve as connection points for the site however this would need to be confirmed with NBNCo at the time of making an application for connection. Communications services for the development will consist of pit and pipe network which will generally be provided and funded by the developer and the internal cabling which is provided by NBNCo.

Due to the proximity of the existing communications infrastructure, it is not expected that significant service back haul would be required, however if it is this is a cost that will be borne by the Developer.

11 Disclaimer

JDSi have undertaken this assessment based on a desktop study and subsequently assumptions have been made which, if incorrect, have potential to change the assessment and/or recommendations. Major cost implications exist through factors which cannot be assured at this time including upgrading and provision of utility services, WAPC conditions of development, Local Authority Scheme Requirements, ground conditions, timing of adjacent developments, etc.

While JDSi has taken all care in the preparation of the likely development requirements and has noted key assumptions, JDSi accepts no responsibility for the accuracy of this report and provides it only as an indicative summary of engineering requirements.

If any further information is required or should you wish to clarify any issue, please contact our office.

APPENDIX A
PROPOSED DEVELOPMENT LAYOUT

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

LATTUGE DRIVE
CAROTA VIEW
NAVET STREET
POS
30
60
54.5
16m Reserve
13m Reserve
15m Reserve
POS
60
506
40
55
53
45
54
16m Reserve
15m Reserve
13m Reserve
ROAD
JOHNSON
PARADE
IRASBURG
BRECCIA
PARADE
58
59
353
360
359
358
357
356
805
804
803
801
802
800
846
835
834
833
832
831
830
829
828
827
722
721
720
719
718
717
716
715
714
665
666
667
668
664
663
691
692

LEGEND
SUBJECT SITE

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

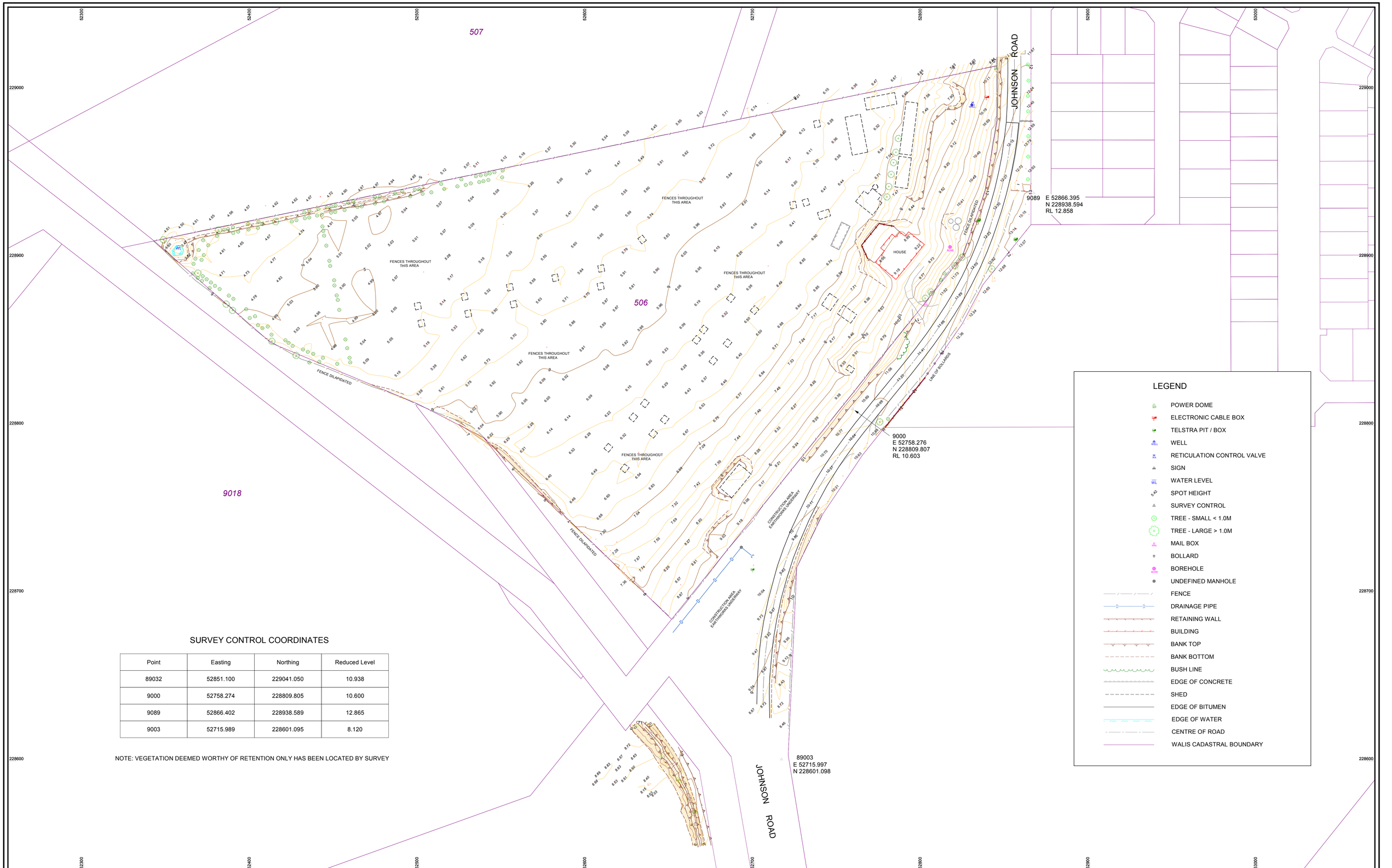
CONCEPT PLAN
Lot 506 Johnson Road, Wellard

DRAFT

plan no: **2263-186C-01**
date: 12 October 2022
scale: 1:1,500 @A3, 1:750 @A1

N

APPENDIX B
FEATURE SURVEY



LEGEND

- POWER DOME
- ELECTRONIC CABLE BOX
- TELSTRA PIT / BOX
- WELL
- RETICULATION CONTROL VALVE
- SIGN
- WATER LEVEL
- SPOT HEIGHT
- SURVEY CONTROL
- TREE - SMALL < 1.0M
- TREE - LARGE > 1.0M
- MAIL BOX
- BOLLARD
- BOREHOLE
- UNDEFINED MANHOLE
- FENCE
- DRAINAGE PIPE
- RETAINING WALL
- BUILDING
- BANK TOP
- BANK BOTTOM
- BUSH LINE
- EDGE OF CONCRETE
- SHED
- EDGE OF BITUMEN
- EDGE OF WATER
- CENTRE OF ROAD
- WALIS CADASTRAL BOUNDARY

SURVEY CONTROL COORDINATES

Point	Easting	Northing	Reduced Level
89032	52851.100	229041.050	10.938
9000	52758.274	228809.805	10.600
9089	52866.402	228938.589	12.865
9003	52715.989	228601.095	8.120

NOTE: VEGETATION DEEMED WORTHY OF RETENTION ONLY HAS BEEN LOCATED BY SURVEY

Rev.	Description	Drawn	Date	Checked
B	Additional Data Added	SAH	07/05/2015	CAY
A	Initial Issue	HBL	01/05/2015	CAY

SCALE 1:1000 @ A1

0 20 40 60 80 100

ALL DISTANCES ARE IN METRES

For a true to scale reproduction of this plan, plot it to A1 with the Paging Scaling set to None.

The contents of this plan are current and correct as of the date stated within the revision panel. All consultants and persons wishing to utilise this data should satisfy themselves of this plans currency by contacting the McMullen Nolan Group.

Surveyor:- GSU
Survey Date:- 24/04/2015
Precal/Cad:- WALIS MAR 2014

bsi. ISO 9001 Quality Management
AS/NZS 4801:2001 Occupational Health and Safety Management
FS 565311 OSH 591267

N

The boundaries shown on this plan were not re-established as part of this survey, therefore this plan does not guarantee their accuracy. Existing easements, encumbrances or interests are not depicted and a title search is recommended to obtain this information. Re-establishment of the cadastral boundaries is recommended for any proposed works on or near existing boundaries.

MNG
MCMULLEN NOLAN GROUP
Level 1, 2 Sabre Crescent
Jandakot, W.A. 6164
PO Box 3526, Success
W.A. 6964, Australia
Offices in: Broome, Bunbury, Kununurra, Newman, Onslow, Port Hedland
Tel: (08) 6436 1599
Fax: (08) 6436 1500
info@mngsurvey.com.au
www.mngsurvey.com.au
ABN 90 009 363 311

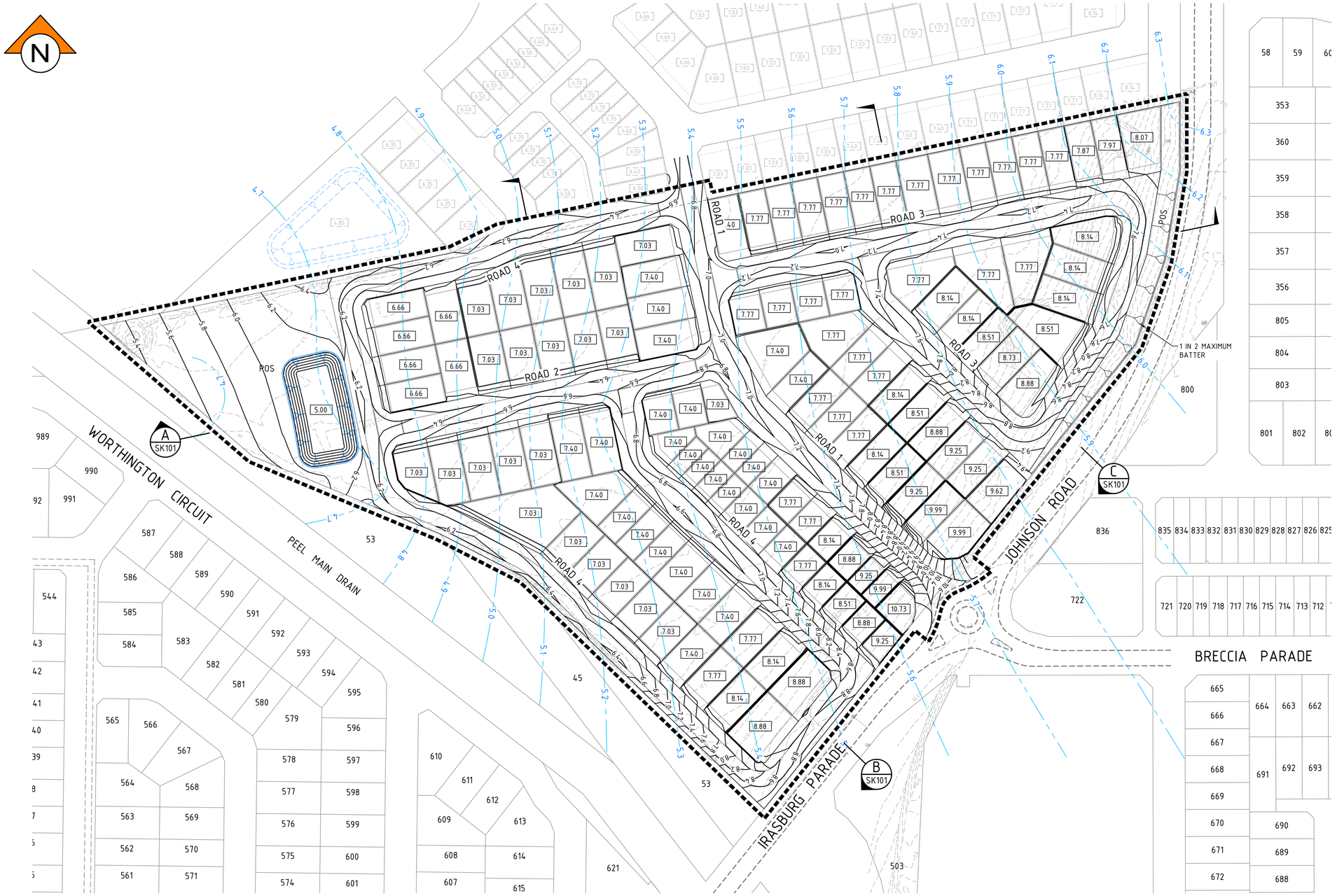
LOT 506 JOHNSON ROAD WELLARD DETAIL SURVEY

CLIENT: *EASTCOURT PROPERTY GROUP*

Project Mngr.	Charles Younge	Datum	PCG94 / AHD

96766	DE	117	B
Job Number	Type	Plan Number	Revision

APPENDIX C
BULK EARTHWORKS CONCEPT PLAN



NOTES

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH THE CONTRACT DRAWINGS AND SPECIFICATION
2. SETOUT OF ROAD CENTERLINE, FACE OF KERB AND EDGE OF SEAL FOR UN-KERBED ROADS SHALL BE BASED ON SUPPLIED AUTOCAD DATA. ALL OTHER WORKS SHALL BE SETOUT BASED ON INFORMATION CONTAINED ON THE CONTRACT DRAWINGS
3. ALL DIMENSIONS SHOWN ARE IN METRES UNLESS OTHERWISE SHOWN
4. SURVEY DATA PROVIDED BY MNG SURVEY
5. ALL LEVELS SHALL BE DETERMINED FROM BENCH MARKS ESTABLISHED BY THE PROJECT SURVEYOR
6. ALL SETBACKS TO BE 4.0m FROM FRONT BOUNDARY UNLESS NOTED OTHERWISE
7. ALL LEVELS ARE FINISHED SURFACE LEVELS. ROADS, FOOTPATHS AND HARDSTANDS TO BE BOXED OUT TO APPROPRIATE DEPTHS
8. FOR RETAINING WALL LEVELS REFER TO DRAWING C110 OF THIS SET
9. GEOTECHNICAL INSPECTIONS AND ASSESSMENTS TO BE CARRIED OUT AS PER SPECIFICATION AND AT RECOMMENDATION FROM THE PRINCIPAL NOMINATED GEOTECHNICAL CONSULTANT
10. EXISTING SERVICES ARE SHOWN FOR INFORMATION ONLY - FOR CONSTRUCTION DETAILS REFER TO RELEVANT SERVICES DRAWINGS

LEGEND

- LIMIT OF WORKS
- 2 — LOT NUMBER
- 8.51 — PROPOSED LOT LEVEL
- 8.51 — FUTURE LOT LEVEL
- 8.51 — EXISTING LOT LEVEL
- PROPOSED CONTOURS (0.20m INTERVAL)
- EXISTING CONTOURS (0.25m INTERVAL)
- MAXIMUM GROUNDWATER CONTOUR
- PROPOSED ROAD
- EXISTING ROAD/TRACK
- PROPOSED BATTER
- EXISTING EMBANKMENT
- PROPOSED SHALLOW SWALE

0 10 20 40 60m
SCALE 1:1000 @ ORIGINAL SHEET SIZE A1

WARNING
BEWARE OF UNDERGROUND SERVICES
BEFORE YOU DIG www.byda.com.au
The location of underground cables are approximate only and their exact position should be checked on site. No guarantee is given that all existing cables and services are shown. Locate all underground cables and services before commencement of work. Refer to Work Health and Safety (General) Regulations 2022.

REV	DATE	DRAWN	CHECKED	APPROVED	
B	19.12.23	MS	BG	SB	EARTHWORKS LEVELS AMEDNED TO SUIT NEW CADASTRAL LAYOUT
A	14.03.23	MS	BG	SB	ISSUED FOR INFORMATION

COPYRIGHT
This drawing is copyright and the property of JDSi Pty Ltd (JDSi). Use without written permission from JDSi constitutes an infringement of copyright.
This document and the information are solely for the use of the authorised recipient and may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by JDSi.

NOTE
This drawing shall be preliminary only until it is issued for Construction.
Certified Quality System to ISO 9001

JDSi CONSULTING ENGINEERS
Level 1, 432 Murray Street, Perth WA 6000
P: (08) 9227 0595 F: (08) 9227 8617

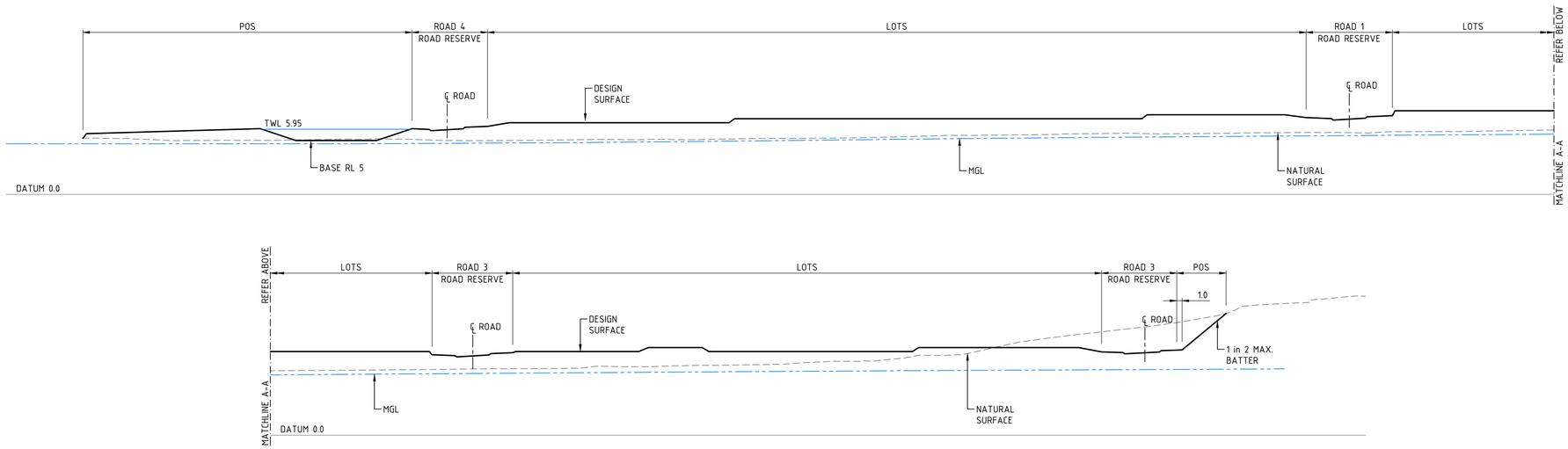
CLIENT: PROVIDENCE

PROJECT: PROVIDENCE EAST BULK EARTHWORKS

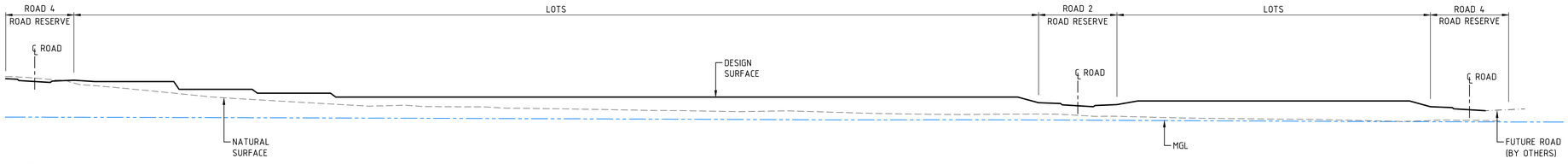
DRAWING TITLE: EARTHWORKS CONCEPT PLAN

DRAWN: M.SABBATINO		WAPC No.	
DESIGNED: M.SABBATINO		SCALE @ A1: 1:1000	
PROJECT MANAGER: S.BROERE		DATUM: PCG94	CO-ORDS: AHD
JDSI PROJECT No.: JDS222081.BE01	DRAWING No.: SK100		REVISION: B

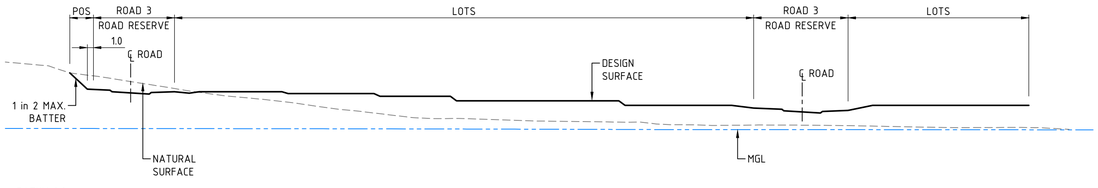
Plotted By: msabbatino Plot Date: 19/12/23 - 15:03 Cad File: I:\JDS222081\JDS222081.BE01\02 CIVIL\Drawings\Sketches\JDS222081.BE01_SK100.dwg



SECTION A
SCALE 1:500H
1:250V
SK100



SECTION B
SCALE 1:500H
1:250V
SK100



SECTION C
SCALE 1:500H
1:250V
SK100

0 5 10 20 30m
SCALE 1:500 @ ORIGINAL SHEET SIZE A1

0 2.5 5 10 15m
SCALE 1:250 @ ORIGINAL SHEET SIZE A1

REV	DATE	DRAWN	CHECKED	APPROVED	
B	19.12.23	MS	BG	SB	EARTHWORKS SECTIONS REVISED TO SUIT NEW LEVELS AND CADASTRAL LAYOUT
A	14.03.23	MS	BG	SB	ISSUED FOR INFORMATION

COPYRIGHT
This drawing is copyright and the property of JDSi Pty Ltd (JDSi). Use without written permission from JDSi constitutes an infringement of copyright.
This document and the information are solely for the use of the authorised recipient and may not be used, copied or reproduced in whole or part for any purpose other than that for which it was supplied by JDSi.

NOTE
This drawing shall be preliminary only until it is issued for Construction.

Certified Quality System to ISO 9001

JDSi
CONSULTING ENGINEERS
Level 1, 432 Murray Street, Perth WA 6000
P: (08) 9227 0595 F: (08) 9227 8617

CLIENT: PROVIDENCE

PROJECT: PROVIDENCE EAST
BULK EARTHWORKS

DRAWING TITLE: EARTHWORKS SECTIONS

DRAWN: M.SABBATINO	WAPC No.
DESIGNED: M.SABBATINO	SCALE @ A1: AS SHOWN
PROJECT MANAGER: S.BROERE	DATUM: PCG94 / CO-ORDS: AHD
JDSi PROJECT No.: JDS222081.BE01	DRAWING No.: SK101 / REVISION: B

Plotted By: msabbatino Plot Date: 19/12/23 - 15:17 Cad File: I:\JDS222081\JDS222081.BE01\02 CIVIL\Drawings\Sketches\JDS222081.BE01_SK101.dwg

ATTACHMENT 4

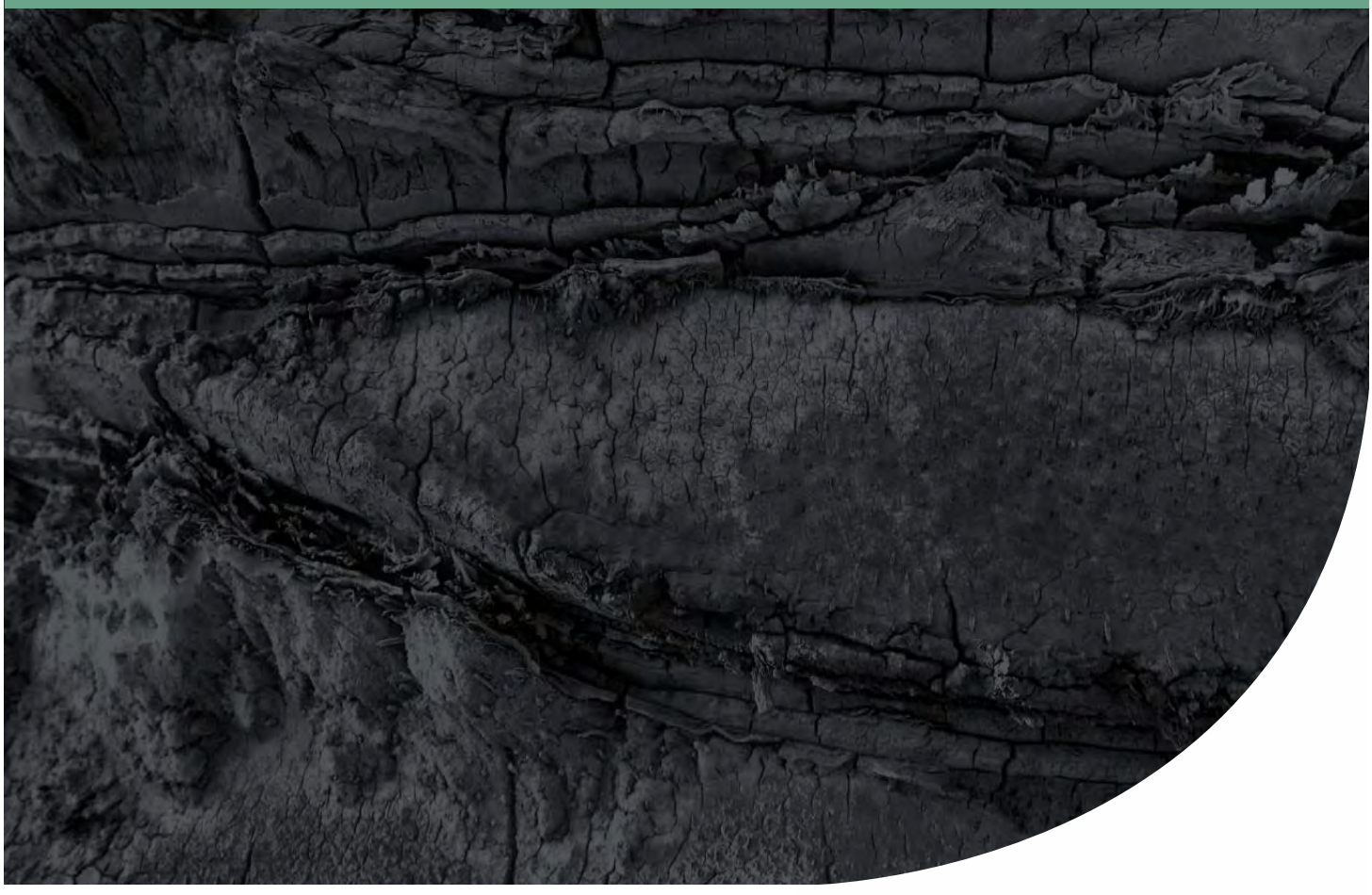
Bushfire Management Plan [Emerge Associates]

Bushfire Management Plan

Lot 506 Johnson Road, Wellard

Project No: EP22-062(05)

Prepared for Wellard Residential Pty Ltd
July 2024



Document Control

Doc name:	Bushfire Management Plan Lot 506 Johnson Road, Wellard				
Doc no.:	EP22-062(04)—017c DVB				
Version	**Date**	**Author**		**Reviewer**	
1	December 2023	Daniel Bussell	DVB	Kirsten Knox	KK
				Anthony Rowe	AJR
	Report issued to client for review				
A	December 2023	Daniel Bussell	DVB	Kirsten Knox	KK
				Anthony Rowe	AJR
	Minor update following client review				
B	July 2024	Kirsten Knox	KK	Anthony Rowe	AJR
	Update to include subdivision layout detail and amend public open space classification based on City of Kwinana comments.				
C	July 2024	Kirsten Knox	KK	Anthony Rowe	AJR
	Minor update following client review				

Disclaimer:

This document has been prepared in good faith and is derived from information sources believed to be reliable and accurate at the time of publication. Nevertheless, it is distributed on the terms and understanding that the author is not liable for any error or omission in the information sources available or provided to us, or responsible for the outcomes of any actions taken based on the recommendations contained herein. It is also expected that our recommendations will be implemented in their entirety, and we cannot be held responsible for any consequences arising from partial or incorrect implementation of the recommendations provided.

This document has been prepared primarily to consider the layout of development and/or the appropriate building construction standards applicable to development, where relevant. The measures outlined are considered to be prudent minimum standards only based on the standards prescribed by the relevant authorities. The level of bushfire risk mitigation achieved will depend upon the actions of the landowner or occupiers of the land and is not the responsibility of the author. The relevant local government and fire authority (i.e. Department of Fire and Emergency Services or local bushfire brigade) should be approached for guidance on preparing for and responding to a bushfire.

Notwithstanding the precautions recommended in this document, it should always be remembered that bushfires burn under a wide range of conditions which can be unpredictable. An element of risk, no matter how small, will always remain. The objective of the Australian Standard AS 3959:2018 is to “prescribe particular construction details for buildings to reduce the risk of ignition from a bushfire” (Standards Australia 2018). Building to the standards outlined in AS 3959 does not guarantee a building will survive a bushfire or that lives will not be threatened by the effects of bushfire attack.

© 2024 Emerge Associates All Rights Reserved. Copyright in the whole and every part of this document belongs to Emerge Associates and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Emerge Associates.

Executive Summary

Wellard Residential Pty Ltd (the proponent) are progressing a structure plan amendment and future subdivision over Lot 506 Johnson Road, Wellard (herein referred to as 'the site)' to facilitate future residential development. The site is approximately 7.85 hectares (ha) in size and is currently zoned 'Development' under the *City of Kwinana Local Planning Scheme No. 2.*

It is located approximately 38 km south of the Perth central business district (CBD) within the City of Kwinana (CoK). The site is bounded by Johnson Road and Irasburg Parade to the east, Oakebella Estate (currently progressing) to the north, Bollard Bulrush Swamp to the north-west, the Peel Main Drain to the west and residential areas currently under development further to the south.

The site is identified within a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas*, prepared by the Office of Bushfire Risk Management (OBRM 2021). The identification of a site within an area declared as bushfire prone necessitates further assessment of the determined bushfire risk affecting the site in accordance with *Australian Standard 3959:2018 Construction of buildings in bushfire prone areas* (AS 3959), and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021).

The purpose of this bushfire management plan (BMP) is to assess the bushfire hazards, affecting the site (risk) and identify the 'management' strategies (risk treatments) required to ensure the development can achieve the intent of SPP 3.7 - *to preserve life and reduce the impact of bushfire on property and infrastructure.*

As part of assessing the risk, a Bushfire Attack Level (BAL) assessment involving the classification of vegetation and topography within 150 m of the site has been undertaken.

The assessment includes an identification of the transition stages and the long-term bushfire risk to the site. It includes the consideration of temporary bushfire hazards to the north that are likely to be removed in the long-term based on existing approved structure plans.

The following bushfire hazards were identified as applicable to the site:

- Forest (Class A) vegetation, associated with vegetation within the Peel Main Drain reserve and the Bollard Bulrush Wetland northwest of the site. This includes assumptions about future treatment of the wetland based on the implementation of the *City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan (LPP No. 3).*
- Woodland (Class B) vegetation, within the Peel Main Drain reserve adjacent to the west of the site.
- Shrubland (Class C) vegetation, associated with the future public open space area in the north-western portion of the site. This will include shrub and drainage basin planting and can include up to 10% foliage cover of taller trees species or similar.
- Scrub (Class D) vegetation, within the Peel Main Drain reserve adjacent to the west and south of the site.
- Grassland (Class G) vegetation adjacent to the north of the site, associated with existing cleared land that forms part of Oakebella Estate where residential development is progressing. Some

management of the paddock grasses north of the site is evident (grasses generally less than 100 mm in height); however it has been identified as an unmanaged temporary hazard for the purposes of this assessment. Areas of unmanaged grassland have also been identified to the south and southwest within the Peel Main Drain reserve, and are associated with areas that have remained cleared for over 20 years.

For the purposes of the subdivision application, the public open space area in the north-western portion of the site is assumed to contain classified vegetation and be a bushfire hazard. The design of this area will be refined as part of the detailed design stage (a condition of subdivision approval) and it is highly likely the extent of area that would be considered a bushfire hazard will reduce. This will be further considered once detailed landscape design is progressed, and will inform BAL assessments that will be required to support building licence.

The narrow strip of public open space along Johnson Road/Irasburg Parade has been excluded as a nature strip under clause 2.2.3.2 (f) of AS 3959. No specific ongoing management is required for this exclusion to apply in this context, and the area will be designed and implemented as a nature strip.

Compliance Assessment

The bushfire protection criteria provided in the Guidelines represent the risk treatments applicable to achieving the intent and the objectives listed in SPP 3.7. Bushfire protection criteria are divided into four subsystems (elements), plus a standalone element for tourism. Each subsystem is provided with an intent and solution methods, either performance principle or by acceptable solution (predetermined solution). Compliance with each subsystem (as a risk treatment) is required to demonstrate to the decision-maker, that the risk is within acceptance.

The BMP has identified that as development progresses, it will comply with the acceptable solution to be adopted for each of the applicable bushfire protection criteria outlined in the Guidelines.

This includes:

- **Element 1 Location**: a BAL contour plan has been prepared for the site and shows that, on completion, development cells have sufficient area to accommodate habitable buildings that achieve BAL-29 or less.
- **Element 2 Siting and Design**: the site accommodates a suitable asset protection zone (APZ) for all proposed lots through a mix of public road reserves, areas of managed public open space and in-lot setbacks in order to achieve BAL-29 or less at habitable buildings.
    - The BAL ratings are a result of temporary hazards to the north, which will be removed in the long-term, the Peel Main Drain to the west/south, which is predicted to stay unmanaged in the long-term; and public open space areas in the north-west and north-east of the site.
    - A small portion of the development cells adjacent to the undeveloped land to the north will be subject to BAL-FZ and BAL-40 due to these temporary hazards. Where BAL-40 or BAL-FZ extend into the lots and the hazards remains at the time of subdivision, this can be managed through a range of measures, including the use of in-lot (rear) setbacks and/or by delaying the release of lots (e.g. staging of development) until the temporary hazard is removed.
    - A small area of BAL-40 (1 m-wide) extends into the lots adjacent to the Peel Main Drain. A public road is provided between the lots and the drain, and a 1 m in-front setback will be required to achieve BAL-29.

- **Element 3 Vehicular Access**: appropriate vehicle access to at least two different destinations can be provided, with the site connecting to Oakebella Estate (and the approved structure plan road layout) to the north and Irasburg Parade to the south. Irasburg Parade provides connection to the north, south and south-west and broader public road network. There is no option of access from within the site to the west given the presence of the Bollard Bullrush Swamp and the Peel Main Drain. As part of staged development within the site, temporary emergency access ways (EAW) can be used to provide for additional access to Johnson Road/Irasburg Parade until the road network to the north is constructed.
- **Element 4 Water**: the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

The management/mitigation measures outlined as part of this BMP, ensure, the site can appropriately manage risk as demonstrated through compliance with SPP 3.7 and the Guidelines.

Table of Contents

1 Introduction 1

1.1 Background 1
1.2 Aim of this report 2
1.3 Statutory policy and framework 2
1.4 Description of the proposed development 3
1.5 Description of land characteristics 3

2 Environmental Considerations 5

2.1 Native vegetation – modification and clearing 6
2.2 Revegetation and landscape plans 7

3 Bushfire Assessment Results 8

3.1 Assessment inputs 8
3.1.1 Assumptions 8
3.1.2 Vegetation classification 9
3.2 Assessment outputs 15

4 Identification of Bushfire Hazard Issues 17

4.1 Permanent hazards 17
4.2 Temporary hazards 18
4.3 Vulnerable land use 18

5 Assessment Against the Bushfire Protection Criteria 19

5.1 Additional management strategies 23
5.1.1 Future approval considerations 23
5.1.2 Landscape management 23
5.1.2.1 Within the site 23
5.1.2.2 Surrounding the site 24
5.1.3 City of Kwinana Firebreak Notice 24
5.1.4 Public education and preparedness 25

6 Responsibilities for Implementation and Management of Bushfire Measures 26

7 Applicant Declaration 29

7.1 Accreditation 29
7.2 Declaration 29

8 References 30

8.1 General references 30
8.2 Online references 31

List of Tables

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) 5
Table 2: AS 3959 vegetation classification (refer to **Figure 2**) 10
Table 3: Summary of the assumed post-development vegetation classification and associated effective slope within the site and 150 m in accordance with Table 2.5 (AS 3959) 15
Table 4: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment 16
Table 5: Assessment against the bushfire protection criteria from the Guidelines 19
Table 6: Considerations for the implementation of this BMP as part of structure plan approval 26
Table 7: Responsibilities for the implementation of this BMP to support subdivision and issue of titles 27
Table 8: Responsibilities for the implementation of this BMP during development and ongoing management . 27

List of Plates

Plate 1: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021). 1
Plate 2: Metropolitan Region Scheme reservations and zoning, within and surrounding the site. 4
Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007) 9
Plate 4: Excerpt of Table 6 from The Guidelines 22
Plate 5: Excerpt of Figure 24 from the Guidelines showing turn-around areas. 22

Figures

Figure 1: Site Location and Topographic Contours
Figure 2: AS 3959 Vegetation Classifications and Effective Slope
Figure 3: Bushfire Attack Level Contour Plan
Figure 4: Spatial Representation of Bushfire Management Strategies

Appendices

Appendix A

Structure plan and subdivision plan

Appendix B

Landscape Masterplan

List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
ESA	Environmentally sensitive area
FDI	Fire Danger Index
FZ	Flame Zone
TEC	Threatened ecological community

Table A2: Abbreviations – Organisations

Organisations	
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
DFES	Department of Fire and Emergency Services
DPLH	Department of Planning, Lands and Heritage
OBRM	Office of Bushfire Risk Management
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – Legislation and policies

Legislation	
AS 3959	Australian Standard 3959-2018 Construction of buildings in bushfire prone areas
Guidelines	*Guidelines for Planning in Bushfire Prone Areas version 1.4* (DPLH & WAPC 2021)
LPP No. 3	*City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan*
SPP 3.7	State Planning Policy 3.7 Planning in Bushfire Prone Areas (WAPC 2015)

Table A4: Abbreviations – Planning and building terms

Planning and building terms	
MRS	Metropolitan Regional Scheme
LPS	Local Planning Scheme
NCC	National Construction Code

Table A4: Abbreviations – units of measurement

Units of measurement	
cm	centimetre
ha	hectare
m	metre
m^2	square metre
m AHD	m in relation to the Australian height datum
mm	millimetre

1 Introduction

1.1 Background

Wellard Residential Pty Ltd (the proponent) are progressing a structure plan amendment and future subdivision over Lot 506 Johnson Road, Wellard (herein referred to as 'the site)' to facilitate future residential development. The proposed structure plan layout is provided in **Appendix A**. The site is approximately 7.85 hectares (ha) in size and is bounded by Johnson Road and Irasburg Parade to the east, Oakebella Estate (currently progressing subdivision) to the north, Bollard Bulrush Swamp to the northwest, the Peel Main Drain to the west and residential areas further to the south. The site and surrounding area is shown in **Figure 1**.

The site is located within a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2021), as shown in **Plate 1**. The identification of a site within an area declared as bushfire prone necessitates a further assessment of the determined bushfire risk affecting the site in accordance with *Australian Standard 3959:2018 Construction of buildings in bushfire prone areas* (AS 3959), and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021).

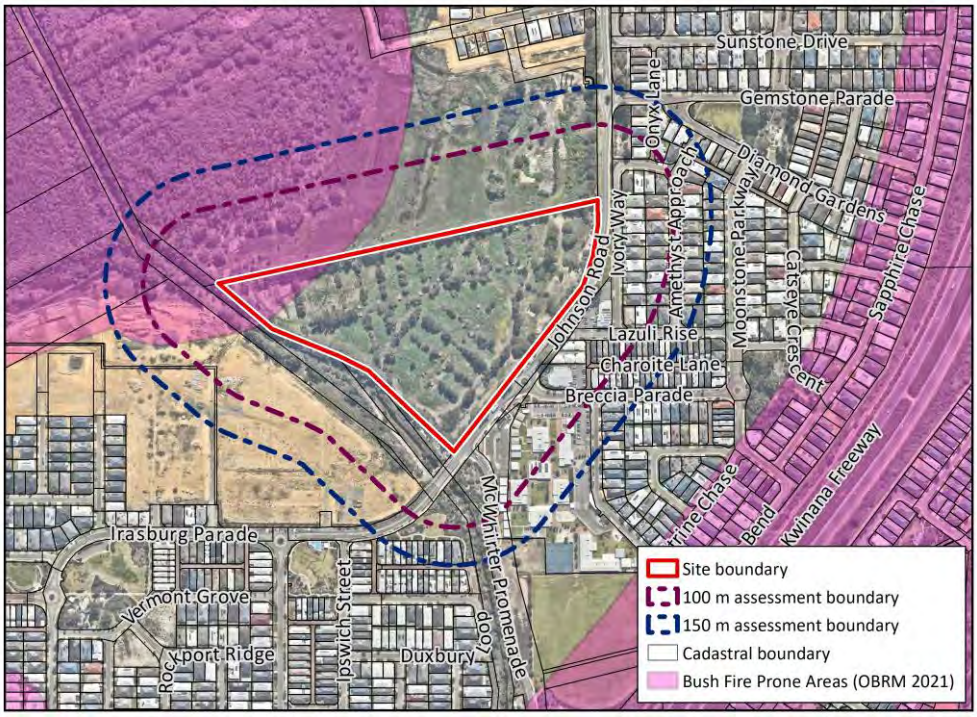


Plate 1: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2021).

The purpose of SPP 3.7 and its policy intent is to preserve life and reduce the impact of bushfire on property and infrastructure through effective risk-based land use planning. Importantly, it is risk-based, requiring a methodical approach to identify and evaluate the hazards and provide the treatments to ameliorate these hazards to an acceptable level. SPP 3.7 requires that the determining authority give consideration to the precautionary principle (clause 6.11 in SPP 3.7), and they must be satisfied that the potential for significant adverse impacts can be adequately reduced or managed. In particular:

> *SPP 3.7 does not require that there be no increase at all in the threat of bushfire to people property or infrastructure. Rather, as is seen in clause 2 of SPP 3.7, the intention of the policy is to 'implement effective, risk¬based land use planning and development to preserve life and* ***reduce the impact of bushfire on property and infrastructure'****.* (emphasis added) [1]

1.2 Aim of this report

The purpose of this BMP is to assess bushfire hazards both within the site and nearby and demonstrate that the threat posed by any identified hazards can be appropriately mitigated and managed. This BMP has been prepared to support the structure plan amendment for and future subdivision of the site and addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (DPLH & WAPC 2021) and AS 3959 (Standards Australia 2018). The document includes:

- Overview of the proposed development (**Section 1.4**)
- An assessment of the existing classified vegetation in the vicinity of the site (within 150 m) and consideration of bushfire hazards that will exist in the post development scenario (**Section 3**).
- Commentary on how the future development can achieve the bushfire protection criteria outlined within the Guidelines including an indication of Bushfire Attack Level (BAL) ratings likely to be applicable to future dwellings (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (**Section 6**).

1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a BMP:

- *Bush Fires Act 1954*
- *Fire and Emergency Services Act 1998*
- *Planning and Development Act 2005* and associated regulations
- *Building Act 2011* and associated regulations
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (DPLH & WAPC 2021)
- *Australian Standard AS* 3959 *– 2018 Construction of buildings in bushfire prone areas* (Standards Australia 2018)

[1] Harmanis Holdings No. 2 Pty Ltd and Western Australian Planning Commission [2019] WASAT 43 (Harmanis).

1.4 Description of the proposed development

The site is proposed to be developed for residential purposes, with the structure plan (CLE 2023) provided in **Appendix A**. Development will include:

- Residential lots;
- An area of public open space (POS), which will support recreation and drainage purposes. It is intended to align with the broader landscape approach for the Bollard Bulrush Swamp (located adjacent to the north of the site and POS); and
- An interconnected public road network.

The structure plan has been developed in consideration of a range of planning policy prepared by the City of Kwinana, including the:

- C*ity of Kwinana Local Planning Policy No. 1 -Landscape Feature and Tree Retention (LPP No. 1)* (City of Kwinana 2016), which stipulates management considerations for significant landscape features or trees within the site. No significant landscape features or trees have been identified for retention, however effort will be made to retain existing trees where they are in the POS. Tree areas can be managed to achieve low threat; and
- *City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan (LPP No. 3)* (City of Kwinana 2022), which provides overarching guidance for integrated buffer and POS areas surrounding the wetland feature. The buffer for the wetland does not extend into the site, however the POS within the site is adjacent to this area and is the policy has been considered in the landscape concept approach.

1.5 Description of land characteristics

The site has been historically cleared of native vegetation, with the vegetation consisting of predominantly planted trees; designed to act as shelter and windbreaks for the previous agistment land uses.

The site is generally flat, with a gentle downward slope toward Bollard Bullrush Swamp to the north-west of the site. A review of the available topographic contours indicates the site is highest in the eastern portion of the site, ranging from 10 m AHD Australian height datum (m AHD) to 4 m AHD in the north-western portion of the site. External to the site, it is generally flat. This is shown in **Figure 1**.

The site is zoned 'Urban' under the Metropolitan Region Scheme (MRS), as shown in **Plate 2** below, and 'Development' under the *City of Kwinana Town Planning Scheme No. 2*. The proposed development is in accordance with the zoning for the land.

The site is located within a broader area where previous agricultural land uses have been changing to residential uses. The land uses surrounding the site include:

- Vacant land to the immediate north which is part of Oakebella Estate and is currently in the process of being developed for residential purposes in accordance with the approved *Lots 503 and 504 Tamblyn Place and Lots 505, 507 and 900 Johnson Road, Wellard Local Structure Plan* (Taylor Burrell Barnett 2016).

- Bollard Bulrush Swamp, which is a conservation category wetland (CCW) (unique feature identifier (UFI) 15866) to the north/north-west. This wetland feature and associated buffer does not extend into the site.
- The Peel Main Drain to the south, which is a Water Corporation drain discharging to the Serpentine River at Kerulup Pool further south. Established and under construction residential areas are located further south, south-west and south-east.
- Johnson Road/Irasburg Parade and existing residential areas to the east.

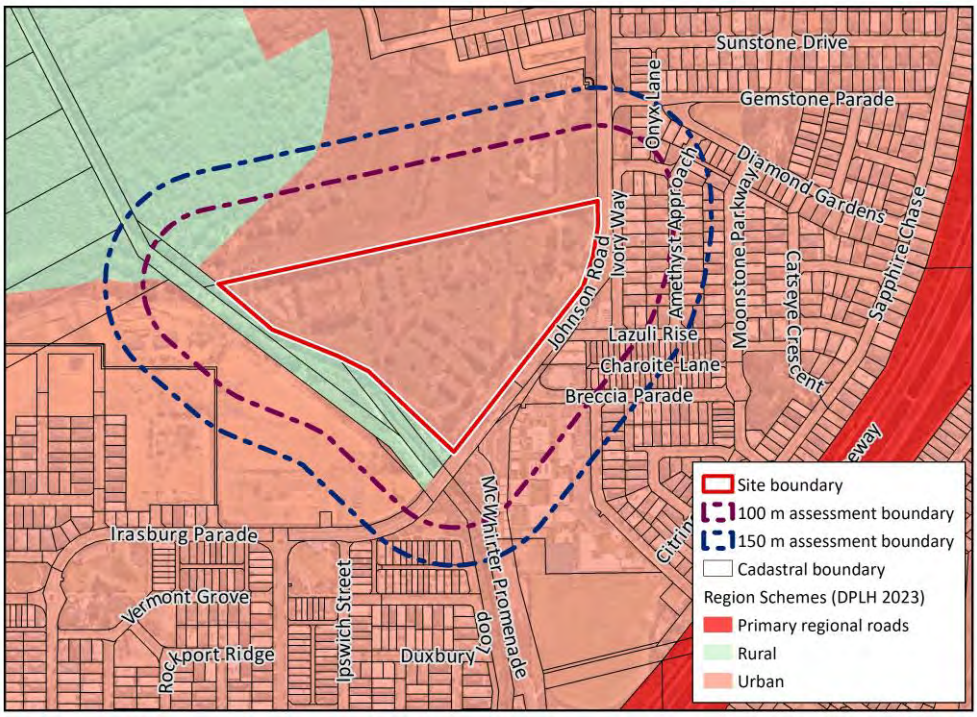


Plate 2: Metropolitan Region Scheme reservations and zoning, within and surrounding the site.

2 Environmental Considerations

In accordance with the *Bushfire Management Plan – BAL Contour* template prepared by the Department of Planning, Lands and Heritage (DPLH) (2018), this BMP has considered whether there are any environmental values that may require specific consideration through either protection, retention or revegetation and be relevant for the bushfire assessment. To support this, a review of publicly available databases has been undertaken, with particular reference to the Shared Location Information Platform (SLIP) databases, and also consideration of the *Environmental Assessment and Management Strategy* (Emerge Associates 2023a) prepared to support the structure plan. A summary of the values relevant to the site and bushfire management has been provided in **Table 1**.

The site has been historically cleared of native vegetation and is currently composed of pasture grasses with scattered planted trees. The site does not contain any environmental values of conservation significance, with Bollard Bulrush Swamp and its buffer located outside the site.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Conservation category wetlands (CCW) and buffer (Geomorphic wetlands, Swan Coastal Plain (DBCA-019))	No	No CCW or REW are identified within the site. The site is mapped as a multiple use wetland (MUW) (UFI: 13327), however this wetland feature does not need to be retained, and no buffer or revegetation is required. A CCW wetland (UFI: 15866) and REW wetland (UFI: 15867) associated with Bollard Bulrush Swamp is located north-west of the site. A proposed buffer to the CCW is indicated in the *Local Planning Policy No 3 Bollard Bulrush Swamp Landscape Masterplan* (City of Kwinana 2022) but does not does not extend into the site (see **Figure 1**).
RAMSAR wetlands (DBCA-010)	No	No RAMSAR wetlands are identified within the mapping as occurring within the site or in close proximity.
Waterways (DWER-031)	No	Mapping by the Department of Water and Environmental Regulation (DWER) identifies the Peel Main Drain (a constructed drainage feature) to the immediate south and west of the site and Bollard Bulrush Swamp to the north-west of the site. An area identified as an inundation area is also identified by the mapping through the central portion of the site.
Threatened and priority flora (DBCA-036)	No	While no site specific surveys have been completed, the site has been historically cleared of native vegetation to support agricultural activities, and a site inspection confirmed vegetation now comprises planted trees and paddock grasses. Due to previous disturbances within the site threatened or priority flora is considered unlikely to occur.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Threatened and priority fauna (DBCA-037)	No	Due to historical clearing and lack of intact native vegetation, the site has limited natural values, apart from planted rows of predominantly non- native tree species (to Western Australia) with some occasional *Agonis flexuosa* and *Eucalyptus rudis* amongst extensive cleared areas. This planted vegetation and regrowth trees are unlikely to provide important habitat for any threatened or priority fauna species.
Threatened ecological communities (DBCA-038)	No	The site is highly modified from its natural state and is currently comprised of predominantly planted rows of various non-native trees with some occasional regrowth *Agonis flexuosa* and *Eucalyptus rudis* amongst large extents of paddock grasses and weeds. No threatened or priority ecological communities are considered likely to occur.
Clearing regulations – Environmentally Sensitive Areas (DWER-046)	No	No environmentally sensitive areas (ESA) are identified within the site. An ESA associated with the CCW wetland feature (UFI 15866) is located to the north-west of site.

2.1 Native vegetation – modification and clearing

As outlined above, the site has been historically cleared and modified to support agricultural activities. The site currently comprises large areas of non-native paddock grasses and weeds and rows of predominantly planted trees. Where possible trees will be retained within the POS area, but all other vegetation will be removed from the site.

With regard to bushfire management, clearing of vegetation will include the removal of paddock trees and grasses and is required to enable the relevant siting and access requirements of the Guidelines for:

- Future lots
- Public open space (POS)
- Asset protection zones (APZs)
- Public roads
- Water infrastructure.

No native vegetation identified external to the site associated with Bollard Bulrush Swamp is proposed to be impacted as part of development or during clearing/vegetation modification.

Where clearing of native vegetation is undertaken in accordance with a subdivision approval under the *Planning and Development Act 2005*, it is exempt from requiring a clearing permit under Schedule 6 of the *Environmental Protection Act 1986* (EP Act), even when identified within an ESA. Additionally, a clearing permit will not be required where other exemptions exist pursuant to the *Environmental Protection Act 1986*, such as Section 33 of the *Bush Fires Act 1954*,or the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 (where outside an ESA), such as those associated with a building licence.

2.2 Revegetation and landscape plans

While no revegetation is required within the site, in accordance with *LPP No. 3* (City of Kwinana 2022), the wetland core and wetland buffer associated with Bollard Bulrush Swamp to the north will be retained and the buffer areas are anticipated to be revegetated. Accordingly, for the purposes of this BMP the wetland buffer is assumed to be revegetated and has been factored into the bushfire assessment.

Vegetation within the site will be removed and/or modified as part of development. Where possible trees will be retained within the western most POS area. To support this assessment undertaken within this BMP, the north-western POS area is assumed to contain classified vegetation and be a bushfire hazard. It is noted that the narrow strip of public open space along Johnson Road/Irasburg Parade has been excluded as a nature strip under clause 2.2.3.2 (f) of AS 3959. No specific ongoing management is required for this exclusion to apply in this context, and the area will be designed and implemented as a nature strip.

The design of the POS areas will be refined as part of the detailed design stage (a condition of subdivision approval) and it is highly likely the extent of area that would be considered a bushfire hazard will reduce, with areas likely to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. The specific design and approach will be detailed as part of the implementation of subdivision and the BAL assessment will be updated as relevant.

Where low threat vegetation is designed and implemented, management will align with typical POS management and is likely to include activities such as:

- Low pruning of trees (branches below 2 m in height removed where appropriate).
- Regular mowing/slashing of grass to less than 100 m in height.
- Regular removal of built-up dead material and weeds (such as fallen branches, leaf litter etc.)
- Re-application of surface cover, such as mulch or other non-flammable materials as required.
- Irrigation of grass and garden beds (where required).

A landscape concept plan has been prepared to illustrate the intended approach and is provided in **Appendix B**.

3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered both in context to the site and potential impacts upon the site using AS 3959 and the Guidelines.

The objective of AS 3959 is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack. AS 3959 measures the Bushfire Attack Level (BAL) as the radiant heat level (kW/m^2) over a distance of 100 m. AS 3959 also prescribes deemed-to-satisfy construction responses that can resist the determined radiant heat level at a given distance from the fire. It is based on six BAL ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

3.1 Assessment inputs

A BAL assessment has been undertaken in accordance with Method 1 of AS 3959. Vegetation classifications and effective slope relevant to the assessment have been detailed below in Table 2 and shown in **Figure 2**. A BAL Contour Plan has been prepared based on the assumed developed condition of the site in accordance with Appendix Three of the Guidelines and is discussed further below and is shown in **Figure 3**. A site visit was undertaken on the 22 November 2023.

3.1.1 Assumptions

The BAL assessment is based on the following assumptions:

- **Designated FDI**: 80
- **Flame temperature**: 1090 K
- **Vegetation classification**: Forest (Class A), Woodland (Class B), Scrub (Class D) and Grassland (Class G) (**Figure 2** and **Table 3**)
- **Effective slope beneath classified vegetation**: Flat/upslope (**Figure 2**)
- **Setback distances**: as per Table 2.5 in AS 3959 with the relevant distances used to inform the BAL contour plan summarised in **Table 3** and the BAL contour plan shown in **Figure 3**.
- Classified vegetation will be removed from within the site for future lots and public roads. These areas maintained to achieve low threat in accordance with Section 2.2.3.2 of AS 3959.
- The north-western POS area is assumed to contain classified vegetation and be a bushfire hazard. The design of this area will be refined as part of the detailed design stage (a condition of subdivision approval) and it is highly likely the extent of area that would be considered a bushfire hazard will reduce. This will be further considered once detailed landscape design is progressed, and will inform BAL assessments that will be required to support building licence.
- Areas of low threat vegetation outside the site will continue to be managed and/or considered to achieve low threat (in accordance with Section 2.2.3.2 of AS 3959) based on existing maintenance regimes, and/or as per the City of Kwinana Fire Break Notice.
- Classified vegetation that has been identified outside of the proponent's landholdings has been assumed to remain in its current state and will therefore continue to be a bushfire hazard to development within the site. An exception to this is to areas within the wetland buffer area which are expected to be revegetated and based on revegetation in adjacent areas is assumed to achieve a forest classification.

- Areas of grassland can include up to 10% foliage cover from shrubs and trees, per AS 3959.

3.1.2 Vegetation classification

Assessing bushfire hazards takes into account the vegetation classifications and exclusions within the site and surrounding area for a minimum of 100 m, in accordance with AS 3959 and the Guidelines. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types, as outlined in **Plate 3** below**.** All vegetation within 150m of the site was classified in accordance with Section 2.2.3 of AS 3959. Each distinguishable vegetation plot is described in **Table 2** and shown in **Figure 2**. This classification is a conservative assessment of the predominant vegetation.

Not all vegetation is a classified bushfire risk. Vegetation and ground surfaces that are exempt from classification as a potential hazard are identified as a low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

a) Vegetation of any type that is more than 100 m from the site.
b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other or of other areas of vegetation being classified.
d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings, and rocky outcrops.
f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves, and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and wind breaks.

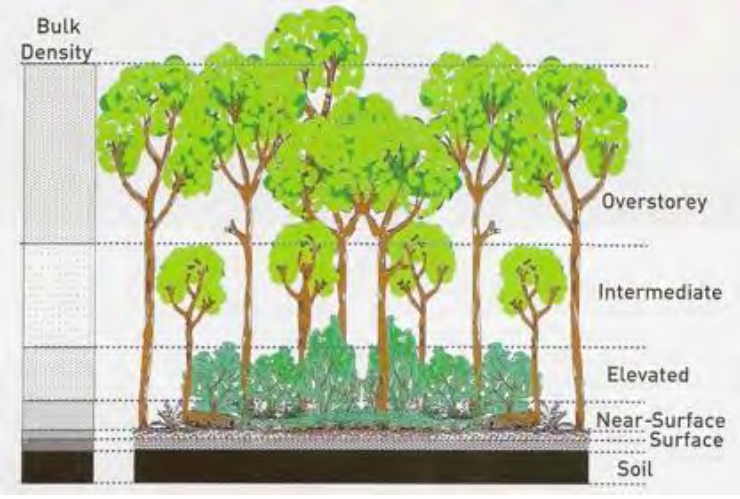


Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

*Table 2: AS 3959 vegetation classification (refer to **Figure 2**)*

Photo ID:	1	**Plot:**	1
Vegetation Classification or Exclusion Clause			
Forest (Class A) – Flat/upslope			
Description / Justification for Classification			
Forest vegetation has been identified to the north-west of the site, within Bollard Bulrush Swamp (wetland core) and its associated buffer. The wetland area consists of dense tree canopy (primarily *Melaleuca rhaphyiophylla* and *Eucalyptus rudis*) up to 15 m in height with dense understorey of sedges and grasses. The wetland buffer currently comprises areas of grassland and shrubland vegetation however is assumed to be revegetated to achieve forest in the long-term.			

Photo ID:	2	**Plot:**	1
Vegetation Classification or Exclusion Clause			
Forest (Class A) – Flat/upslope			
Description / Justification for Classification			
Forest vegetation has been identified to the north of the site, within Bollard Bulrush Swamp (wetland core) and its associated buffer. The wetland area consists of dense tree canopy (primarily *Melaleuca rhaphyiophylla* and *Eucalyptus rudis*) up to 15 m in height with dense understorey of sedges and grasses. The wetland buffer (in foreground of photo) currently comprises areas of grassland and shrubland vegetation however is assumed to be revegetated to achieve a forest classification in the long-term.			

Photo ID:	3	**Plot:**	2
Vegetation Classification or Exclusion Clause			
Forest (Class A) – Flat/upslope			
Description / Justification for Classification			
A small patch of forest vegetation (in background of photo) has been identified to the north of the site, within the undeveloped portions of Oakebella Estate. The area consists of Eucalypt species over shrubs and grasses. The area is identified for future development and is considered a temporary hazard.			

*Table 2: AS 3959 vegetation classification (refer to **Figure 2**) (continued)*

Photo ID:	4	**Plot:**	3
Vegetation Classification or Exclusion Clause			
Woodland (Class B) – Flat/upslope			
Description / Justification for Classification			
Woodland vegetation has been identified adjacent to the west of the site within the Peel Main Drain reserve (planted trees are also visible to the background of the photo and are within the site). The vegetation comprises predominantly *Eucalyptus rudis* 20 m in height and an understorey of grasses. Foliage cover is less than 30% with canopy separation evident. This vegetation has remained in a similar condition over a long period of time and is assumed to remain in the long-term.			
Photo ID:	5	**Plot:**	3
Vegetation Classification or Exclusion Clause			
Woodland (Class B) – Flat/upslope			
Description / Justification for Classification			
Woodland vegetation has been identified adjacent to the western boundary of the site within the Peel Main Drain reserve (to the background of photo), comprising predominantly *Eucalyptus rudis* up to 15 m in height and a predominant understorey of grasses. Foliage cover is less than 30% with canopy separation evident. This vegetation has remained in a similar condition over a long period of time and is assumed to remain in the long-term.			
Photo ID:	6	**Plot:**	4
Vegetation Classification or Exclusion Clause			
Scrub (Class D) – Flat/upslope			
Description / Justification for Classification			
Scrub vegetation has been identified to the south of the site within the Peel Main Drain reserve and is dominated by shrubs approximately 4m in height (predominantly *Kunzea glabrescens and Acacia spp.)* and occasional trees.			

*Table 2: AS 3959 vegetation classification (refer to **Figure 2**) (continued)*

Photo ID:	7	**Plot:**	4
Vegetation Classification or Exclusion Clause			
Scrub (Class D) – Flat/upslope			
Description / Justification for Classification			
Scrub vegetation has been identified to the south of the site within the Peel Main Drain reserve and is dominated by shrubs approximately 4m in height (predominantly *Kunzea glabrescens and Acacia spp.)* and occasional trees.			
Photo ID:	8	**Plot:**	5
Vegetation Classification or Exclusion Clause			
Shrubland (Class C) – Flat/upslope			
Description / Justification for Classification			
Shrubland vegetation has been identified to the south of the site, associated with a planted drainage basin located adjacent to the Peel Main Drain. The dominant vegetation form was between 1-2 m in height. This vegetation does not appear to be subject to regular maintenance and has been assumed to remain in the long-term.			
Photo ID:	9	**Plot:**	6
Vegetation Classification or Exclusion Clause			
Grassland (Class G) – Flat/upslope			
Description / Justification for Classification			
Unmanaged grassland vegetation (taller than 10 cm) was identified west of the site within and adjacent to the Peel Main Drain reserve. The vegetation is characterised by open weedy pasture grass cover (of variable density/cover). This vegetation does not appear to be routinely maintained and has therefore been classified as grassland (Class G). Vegetation within the Peel Main Drain Reserve has been assumed to remain similar to its current state in the long-term.			

*Table 2: AS 3959 vegetation classification (refer to **Figure 2**) (continued)*

Photo ID:	10	**Plot:**	6
Vegetation Classification or Exclusion Clause			
Grassland (Class G) – Flat/upslope			
Description / Justification for Classification			
Unmanaged grassland vegetation (taller than 10 cm) was identified west of the site within and adjacent to the Peel Main Drain reserve. The vegetation is characterised by open weedy pasture grass cover (of variable density/cover). This vegetation does not appear to be routinely maintained to a low threat condition and has therefore been classified as grassland (Class G). Tis vegetation has remained in a similar condition over a long period of time and is assumed to remain in the long-term.			
Photo ID:	11	**Plot:**	7
Vegetation Classification or Exclusion Clause			
Grassland (Class G) – Flat/upslope			
Description / Justification for Classification			
Grassland vegetation has been identified external to the north of the site characterised by open weedy pasture grasses in an unmanaged state. Some scattered exotic and native trees are present but form less than 10% foliage cover for the area. This vegetation will be removed in the long-term for residential development and is identified as a temporary hazard.			
Photo ID:	12	**Plot:**	7
Vegetation Classification or Exclusion Clause			
Grassland (Class G) – Flat/upslope			
Description / Justification for Classification			
Grassland vegetation has been identified external to the north of the site characterised by open weedy pasture grasses in an unmanaged state. Some scattered exotic and native trees are present but form less than 10% foliage cover for the area. This vegetation will be removed in the long-term for residential development and is identified as a temporary hazard.			

*Table 2: AS 3959 vegetation classification (refer to **Figure 2**) (continued)*

Photo ID:	13	**Plot:**	8
Vegetation Classification or Exclusion Clause			
Exclusion clause 2.2.3.2 (e)			
Description / Justification for Classification			
Existing non-vegetated areas surrounding the site including roads, existing urban areas and exposed mineral earth have been excluded in accordance with Clause 2.2.3.2 (e) of AS 3959.			
Photo ID:	14	**Plot:**	8
Vegetation Classification or Exclusion Clause			
Exclusion clause 2.2.3.2 (e)			
Description / Justification for Classification			
Areas surrounding the site to the west associated with future residential areas are currently under construction and comprised of exposed mineral earth and have been excluded in accordance with Clause 2.2.3.2 (e) of AS 3959.			
Photo ID:	15	**Plot:**	9
Vegetation Classification or Exclusion Clause			
Exclusion clause 2.2.3.2 (f)			
Description / Justification for Classification			
Managed low threat vegetation including POS areas comprising regularly mowed turf and irrigated/managed (weeding, mulch applied etc.) garden beds has been identified to the south of the site and excluded from classification as a bushfire hazard.			

3.2 Assessment outputs

The vegetation classifications applicable to the site are summarised in **Table 3** (and shown in **Figure 2**) and incorporate the known changes to vegetation post-development, including the revegetation of the wetland buffer external to the site. The resultant BALs are shown in **Figure 3**. BAL ratings are based on the minimum distances outlined in Table 2.5 of AS 3959, with the relevant distances summarised in **Table 4**.

Table 3: Summary of the assumed post-development vegetation classification and associated effective slope within the site and 150 m in accordance with Table 2.5 (AS 3959)

Plot	Applied vegetation classification	Effective slope
1	Class A – Forest	Flat/upslope
2	Class A – Forest	Flat/upslope
3	Class B – Woodland	Flat/upslope
4	Class D – Scrub	Flat/upslope
5	Class C – Shrubland	Flat/upslope
6	Class G - Grassland	Flat/upslope
7	Class G - Grassland	Flat/upslope
8	Exclusion 2.2.3.2 (e), associated with existing non-vegetated areas external to the site	N/A
9	Exclusion 2.2.3.2 (f), associated with existing areas of managed low threat vegetation	N/A
10	Exclusion 2.2.3.2 (e), associated with future lots and road areas within the site	N/A
11	Class C – Shrubland, associated with a future POS area	Flat/upslope
12	Exclusion 2.2.3.2 (f), associated with a nature strip along Johnson Road/Irasburg Parade.	N/A

The BAL assessment demonstrates that all areas proposed for residential development (and therefore future habitable buildings) can achieve BAL-29 or less based on the proposed structure plan, as shown in **Figure 3**. Exceptions to this are:

- The development cells adjacent to the northern boundary, where BAL-40 and BAL-FZ extends into the rear of the future lots due to temporary grassland hazards to the north. This vegetation will be removed in the short to medium term, as residential development progresses and will no longer pose hazard to development within the site. There is sufficient area within the cells to accommodate habitable buildings within BAL-29 or below using in-lot setbacks if required (minimum 8 m-wide), and/or can be managed through staging of development.
- The development cells adjacent to the Peel Main Drain, where BAL-40 extends into the front of the future lots by 1 m. This development cell is separated from the main drain by a public road.

Table 4: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment

Plot number (see Figure 2)	Vegetation classification (see Figure 2)	Effective slope (see Figure 2)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 3)
Plot 1 and Plot 2	Forest (Class A)	Flat/upslope	< 16 m	BAL-FZ
			16 - < 21 m	BAL-40
			21 - < 31 m	BAL-29
			31 - < 42 m	BAL-19
			42 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 3	Woodland (Class B)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 14 m	BAL-40
			14 - < 20 m	BAL-29
			20 - < 29 m	BAL-19
			29 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 4	Scrub (Class G)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 13 m	BAL-40
			13 - < 19 m	BAL-29
			19 - < 27 m	BAL-19
			27 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 5 and Plot 11	Shrubland (Class C)	Flat/upslope	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 13 m	BAL-29
			13 - < 19 m	BAL-19
			19 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 6, Plot 7 and Plot 12	Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

4 Identification of Bushfire Hazard Issues

The key hazards with potential to impact the site include:

- Ember attack (particularly from nearby forest vegetation within the Bollard Bulrush Swamp to the north and areas of classified vegetation to the south and west of the site within the Peel Main Drain).
- Potential fire runs associated with:
  - Contiguous grassland to the north of the site (considered a hazard until development in that area progresses);
  - Contiguous forest vegetation associated with Bollard Bulrush Swamp (including its buffer) to the north;
  - Contiguous woodland, scrub and grassland vegetation associated with the Peel Main Drain to the west.

From a bushfire hazard management perspective, based on the requirements of SPP 3.7 and the Guidelines with consideration for potential hazards, future development is likely to require the following management and/or consideration:

- Provision of appropriate separation distance from bushfire hazards to ensure a BAL rating of BAL-29 or less can be achieved at future habitable buildings. This includes addressing setbacks from temporary hazards to the north, and achieving setbacks from the Peel Main Drain.
- Provision of appropriate vehicular access to ensure that egress to at least two different destinations will be available to future residents and emergency personnel. This is likely to require the use of temporary emergency access ways (EAWs) as part of internal staging of subdivision (where temporary no-through roads exceed 200 m in length) and to Johnson Road/Irasburg Parade until the connection through Oakebella Estate to the north is available .
- Ensuring that where specified/agreed, the POS areas within the site are designed, implemented and managed to achieve low threat in accordance with Section 2.2.3.2 of AS 3959.
- Ensuring the provision of water for firefighting is sufficient and accessible by firefighting services (reticulated water supply and associated hydrant network).

4.1 Permanent hazards

Permanent long-term hazards relevant to development within the site are the existing classified vegetation associated with the Peel Main Drain reserve and Bollard Bulrush Swamp. Additionally, it is assumed that the wetland buffer area will be revegetated in accordance with *LPP No. 3* as urban development progresses in the areas adjoining the wetland. These areas are shown in **Figure 2**.

4.2 Temporary hazards

Urban development (associated with Oakebella Estate) is progressing to the north of the site in line with the approved local structure plan (Taylor Burrell Barnett 2016). Existing grassland and forest hazards identified in this area will be removed permanently as development is progressed. These areas of vegetation are identified as a hazard for the purposes of this BMP given the timing for completion of all works is not known. Areas identified as a temporary hazard are shown in **Figure 2**.

If the entire site is not cleared of vegetation as a single stage of works, the proponent will need to ensure the minimum area around each stage is cleared/managed to ensure BAL-29 or less can be achieved at future habitable buildings. Where this approach is undertaken, vegetation will need to be managed by the proponent until residential development in those areas progresses.

4.3 Vulnerable land use

The definition of a vulnerable land use is where occupants are less able to respond in an emergency. The types of land uses considered vulnerable include *"facilities that, due to the building design or use, or the number of people accommodated, are likely to present evacuation challenges."* The identification of a land use as a vulnerable use is at the discretion of the decision maker.

A high-risk land use is one where practices that occur within the site may lead to a potential ignition and spread of a fire from the site or could prolong the duration or intensity of a bushfire should a fire arrive from outside the site.

No vulnerable or high-risk land uses are currently proposed as part of the development.

5 Assessment Against the Bushfire Protection Criteria

This BMP provides an outline of the mitigation strategies that will ensure that as the development progresses within the site, an acceptable solution can be adopted for each of the bushfire protection criteria detailed within Appendix Four of the Guidelines. The applicable bushfire protection criteria identified in the Guidelines and addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply

As part of future development, an 'acceptable solution' will be able to address the intent of all four bushfire protection criteria as part of both structure planning and subdivision. A summary of how the criterion can be addressed has been provided in **Table 5.**

Table 5: Assessment against the bushfire protection criteria from the Guidelines

Bushfire protection criteria	Proposed bushfire management strategies
Element 1: Location	
A1.1 Development location	Once development is progressed within the site, the entire site will be identified as a having a low or moderate hazard level, with moderate applying where within 100 m of classified vegetation adjacent to the site (including areas of temporary hazard). The site addresses Clause 6.2 (b) of SPP 3.7, which requires development to have a moderate or lower hazard level rating, either before or as part of implementing the proposed development. The BAL assessment (**Figure 3**) indicates that the majority of the site can achieve BAL-29 or less, with most of the site subject to BAL-12.5 or BAL-LOW. Small portions of the site are subject to BAL-FZ or BAL-40 but are associated with either temporary hazards that will be removed, or a minor incursion that can be addressed through a front-lot setback (and has a road interface). There is sufficient area within the development cells to accommodate habitable buildings within BAL-29 or below using in-lot setbacks. Consideration for achieving BAL-29 or less is addressed under Element 2 further below. The proposal complies with A1.1.
Element 2: Siting and design	
A2.1 Asset Protection Zone	All development areas/future lots are required to be managed to a low threat condition with a minimum Asset Protection Zone (APZ) equivalent to enable BAL-29 to be achieved. APZs are typically contained within a lot but can also include areas external to a lot that achieve low threat in accordance with Section 2.2.3.2 of AS 3959 where the APZ cannot be contained within the lot boundaries. It is typical for urban type development for the APZ to extend into adjacent lots, public open space and public road reserves. (Continued below)

Table 5: Assessment against the bushfire protection criteria from the Guidelines (continued)

Bushfire protection criteria	Proposed bushfire management strategies
Element 2: Vehicular access (continued)	
A2.1 Asset Protection Zone	(Continued from above) All proposed development areas that are intended to support habitable buildings are able to achieve an APZ with sufficient separation from classified vegetation to achieve BAL-29 or below. Separation from permanent bushfire hazards is provided within the development layout through the strategic placement of public roads and areas of managed public open space (as shown in **Figure 4**). Lots adjacent to the Peel Main Drain would only require a 1 m-wide front lot setback to achieve BAL-29. Setbacks from temporary hazards to the north are able to be accommodated in future lots based on the use of in-lot setbacks (the depth of the development cells is sufficient to accommodate the 8 m-wide setback to achieve BAL-29) and/or by delaying the release of lots (e.g. staging of development) until the hazard is removed. Overall, the development cells within the site are suitability sized, in combination with the public road network, to enable lots to accommodate the minimum separation distances outlined in **Table 4** and shown in **Figure 3**. The proposal complies with A2.1.
Element 3: Vehicular access	
A3.1 Public roads	Surrounding public roads (i.e. Johson Road and Irasburg Parade) and all new internal public roads can and will be able to comply with the minimum standards outlined in Appendix Four of the Guidelines (DPLH & WAPC 2021) (refer to **Plate 4** further below). The road reserves within the site will likely vary between 13 m and 16 m wide (depending upon the road type), meeting neighbourhood connectors and access street requirements, as per the Institute of Public road Works Engineering Australasia (IPWEA) guidelines (IPWEA 2017). Therefore, the proposal complies with A3.1.
A3.2a Multiple access routes.	The proposed structure plan provides for connections to the urban development to the north (in accordance with the approved structure plan) and Johnson Road/Irasburg Parade to the south, providing multiple access routes to different destinations. Irasburg Parade/Johnson Road connect to the broader public road network which links to Bertram in the north and the locality of Baldivis in the south though connection to Millar Road and Baldivis Road, with access to the Kwinana Freeway via Mortimer Road and Kulija Road, respectively. The proposed development can comply with A3.2a.
A3.2b Emergency access way	Given the development will be able to provide egress to at least two different destinations, no permanent emergency access ways (EAWs) are required.

Table 5: Assessment against the bushfire protection criteria from the Guidelines (continued)

Bushfire protection criteria	Proposed bushfire management strategies
Element 3: Vehicular access (continued)	
A3.3 Through-roads	The proposed development layout provides for a through road network and is part of a residential built out area, with internal loop roads connecting to the proposed public road network. The proposed development complies with A3.3 or the exceptions. Temporary no-through roads may be generated as part of staging of development and should comply with Appendix Four of the Guidelines or agreed with the City of Kwinana. This includes the provision of appropriate turning heads (see excerpt from the Guidelines in **Plate 5**) and where longer than 200 m or do not satisfy the exemption provisions of A3.2 can be addressed through the use of an EAW. Where required, EAWs should be less than 500 m in length (unless agreed otherwise) and provide a through connection to other public roads and meet the requirements outlined in **Plate 4**. Until the road network within the development to the north of the site is constructed, a temporary EAW may be required to provide additional connections to the public road network. A possible EAW location has been indicated within **Figure 4**, and the need for this connection and/or location will be confirmed with the City of Kwinana as part of subdivision works within the site.
A3.4a Perimeter roads	The development layout provides a perimeter road between future lots and areas of permanent bushfire hazard (see **Appendix A** and **Figure 4**). The development cell adjacent to the northern boundary of the site is not provided with a perimeter road as the layout is aligning with the existing approved structure plan and road layout to the north. The identified hazard at this location is also grassland vegetation and a perimeter road is not required adjacent to grassland. The proposed development complies with A3.4a.
A3.4b Fire service access route	No fire service access route is proposed or required to achieve compliance with any other criterion.
A3.5 Battle-axe access legs	Not applicable. No battle-axe access is indicated at this stage of the planning process. While not anticipated given the density of development and development cell configuration, while battle-axe access legs should be avoided where possible within designated bushfire prone areas, if proposed as part of future subdivision, their inclusion will need to be justified and will need to address the minimum standards outlined in Appendix Four of the Guidelines which includes technical requirements in Table 6 (reproduced in **Plate 4**).
A3.6 Private driveway longer than 70 metres	In accordance with Appendix Four of the Guidelines, this criterion is not a relevant consideration for a structure plan and/or subdivision. Based on the density of the proposed residential development, private driveways longer than 70 m are unlikely to be required. If future dwellings require private driveways longer than 70 m they will need to comply with the requirements of the Guidelines, including Table 6 of the Guidelines.
Element 4: Water	
A4.1 Identification of future water supply	The proposed development is located in an area that is to be serviced by a reticulated water supply. The reticulated water supply network will be extended to the site from the existing urban areas. The proposed development is able to comply with A4.1
A4.2 Provision of water for firefighting purposes	As outlined, the proposed development will be serviced by reticulated water supply and hydrant connections in accordance with the specifications of the Water Corporation.

Table 6: Vehicular access technical requirements

TECHNICAL REQUIREMENTS	1 Public roads	2 Emergency access way[1]	3 Fire service access route[1]	4 Battle-axe and private driveways[2]
Minimum trafficable surface (metres)	In accordance with A3.1	6	6	4
Minimum horizontal clearance (metres)	N/A	6	6	6
Minimum vertical clearance (metres)	4.5			
Minimum weight capacity (tonnes)	15			
Maximum grade unsealed road[3]	As outlined in the IPWEA Subdivision Guidelines	1:10 (10%)		
Maximum grade sealed road[3]		1:7 (14.3%)		
Maximum average grade sealed road		1:10 (10%)		
Minimum inner radius of road curves (metres)		8.5		

Notes:

[1] To have crossfalls between 3 and 6%.

[2] Where driveways and battle-axe legs are not required to comply with the widths in A3.5 or A3.6, they are to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision.

[3] Dips must have no more than a 1 in 8 (12.5% -7.1 degree) entry and exit angle.

Plate 4: Excerpt of Table 6 from The Guidelines

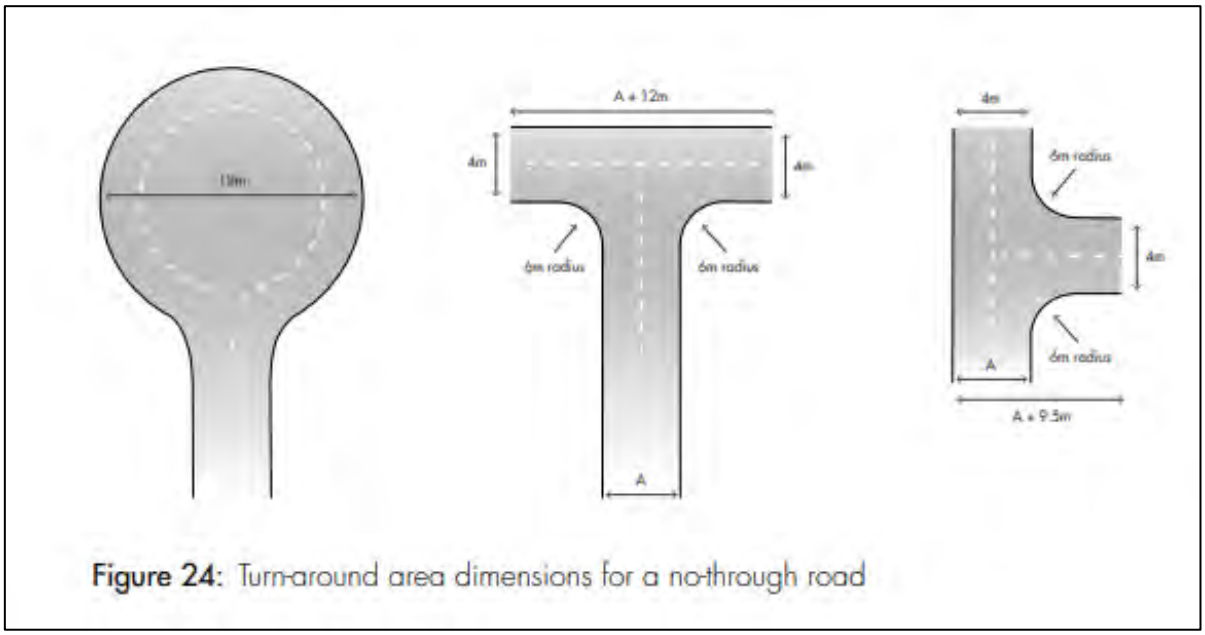


Figure 24: Turn-around area dimensions for a no-through road

Plate 5: Excerpt of Figure 24 from the Guidelines showing turn-around areas.

5.1 Additional management strategies

5.1.1 Future approval considerations

The BAL assessment in this BMP is a conservative and cautious assessment of the potential bushfire risk posed to future habitable buildings within the site based on the proposed management of vegetation and assumptions outlined in **Section 3**. This includes consideration of future revegetation and temporary hazards.

As no future habitable buildings are likely to exceed BAL-29, additional planning or development approval will not be required to address bushfire considerations. Future Class 1, 2, 3 and 10a buildings designated bushfire prone and in an area subject to a BAL rating of BAL-12.5 or higher, will need to satisfy construction standards in accordance with the National Construction Code (NCC) (e.g., AS 3959 or the National Association for Steel-framed Housing (NASH) Standard).

Dwellings will need to be constructed in accordance with BAL ratings determined following development.

5.1.2 Landscape management

5.1.2.1 Within the site

Lots

All lots, once created, are required to be managed by the owner to a low threat condition (Section 2.2.3.2 of AS 3959), in accordance with this BMP and the City of Kwinana Firebreak Notice.

Public road reserves

Road pavement within public road reserves are excluded pursuant to clause 2.2.3.2(e) of AS 3959 as non-vegetated.

Nature strips (verges) within public road reserves (and adjacent areas) are excluded pursuant to clause 2.2.3.2(f) of AS 3959, where they are listed as a type of use/vegetation that can be excluded. Specific management is not required.

Public open space

As outlined in previous sections of the BMP, the north-western POS area within the site is assumed to be a bushfire hazard. The location of the POS area is shown in **Figure 2** and **Figure 4**, and also indicated in **Appendix B**. Following the progression of detailed landscape design, the areas identified as a bushfire hazard will be reviewed and where applicable, an updated BAL assessment will be prepared.

Future management of the POS areas, where required/agreed, would be no different than that required/implemented in existing POS areas in surrounding suburbs and parkland areas.

5.1.2.2 Surrounding the site

Within public reserves

Bollard Bulrush Swamp and the associated buffer are assumed to remain in their existing condition and/or be revegetated to achieve a forest classification. No ongoing management is assumed in this area.

Peel Main Drain is assumed to remain in its existing condition and no ongoing management of vegetation has been assumed.

Within the public road reserves

Areas of existing road reserves and public open space will continue to be maintained by the relevant authorities in accordance with the existing maintenance regimes.

Within private landholdings

The private landholdings surrounding the site are assumed to be managed by the applicable landowners in accordance with the City of Kwinana Firebreak Notice in perpetuity and/or in accordance with existing maintenance regimes.

All other vegetation will remain in its existing condition for the foreseeable future. It is noted that land to the north (Oakebella Estate) is undergoing residential development and this will likely change the bushfire risk applicable to the site as development is progressed and building licence is applied for.

5.1.3 City of Kwinana Firebreak Notice

The City of Kwinana releases a Firebreak Notice on an annual basis to provide a framework for bushfire management within the City. The City of Kwinana are able to enforce this notice in accordance with Section 33 of the *Bush Fires Act 1954*. In addition, Section 33 1(b) also provides the City with additional power to direct landowners to undertake works to remedy conditions conducive to the outbreak or spread of bushfire.

Following development for residential purposes, all lots will be required to comply with the most recent Firebreak Notice, which may include (but is not limited to):

- Ensuring of all long grass, weeds etc. are slashed, mowed or trimmed down by other means to a height no greater than 50 mm across the entire property; and
- Remove all flammable materials from all rooftops and gutters of buildings.

In addition, all lots subject to an approved bushfire management plan through subdivision will be required to comply with that plan. This BMP has been prepared to support subdivision and accordingly all future lots will need to be managed to achieve low threat in accordance with Section 2.2.3.2 of AS 3959.

5.1.4 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES website (https://www.dfes.wa.gov.au/bushfire/prepare/) provides a range of materials to help the community prepare for and survive the bushfire season.

The City of Kwinana provides bushfire safety advice to residents available from their website (https://www.kwinana.wa.gov.au/community/health,-safety-and-security/fire-and-emergency-services). Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high-risk areas in addition to that provided in this BMP.

In the case of a bushfire in the area, advice would be provided to residents by DFES, Department of Biodiversity Conservation and Attractions (DBCA) and/or the City of Kwinana on any specific recommendations with regard to responding to the bushfire, including evacuation if required. However, it is highly recommended that future residents make themselves aware of their responsibilities with regard to preparing for and responding to a potential bushfire that may impact them, their family and property, regardless of the BAL rating their properties are subject to.

6 Responsibilities for Implementation and Management of Bushfire Measures

Table 6 outlines the future considerations of the proponent (developer) associated with developing the site in accordance with the proposed structure plan with reference to future risk treatments to be accommodated as part of subdivision. This is a summary of the information discussed in **Section 5**.

Table 6: Considerations for the implementation of this BMP as part of structure plan approval

Proponent – to support structure plan and future subdivision		
No.	**Implementation and management actions**	**Timing**
1	Make a copy of the BMP available to relevant decision makers to support consideration of the structure plan.	To support the structure plan approval process
2	Where applicable, as part of the subdivision process, make spatial provisions for: • A suitable public road network that provides egress to at least two different destinations and meets the technical requirements of Appendix Four of the Guidelines and the associated Table 6 (or as otherwise determined by a bushfire consultant and relevant approval authority). This includes making provision for temporary emergency access ways where these are required. • Where possible, avoid no through roads and battle-axe lots as part of the spatial layout. If these are proposed as part of future development, these will need to be justified from a planning/development perspective and be consistent with the minimum requirements outlined in Appendix Four of the Guidelines (or as otherwise determined by a bushfire consultant and relevant approval authority). This includes provision of suitable turn-around areas. • Ensure future habitable buildings are able to be located in an area subject to BAL-29 or less. The minimum separation distances between habitable buildings and classified vegetation to achieve BAL-29 should be in accordance with • • **Table** 4 in this BMP or as specified in subsequent BAL assessments. These separation distances can be accommodated by locating public roads and/or managed POS between the habitable building/s and classified vegetation and/or ensuring proposed residential lots are adequately sized to ensure in-lot setbacks can be accommodated to achieve BAL-29 at the future dwelling. • Provide for a water supply dedicated to firefighting purposes in the form of a reticulated network of water hydrants.	To support structure plan and/or future subdivision

To support subdivision:

- **Table 7** outlines the developer responsibilities to be undertaken to support the clearance of titles. These items will need to be certified by a bushfire consultant.
- **Table 8** outlines the future responsibilities of the proponent (developer) and future landowners associated with implementing this BMP or future mitigation measures to be accommodated as part of the development process but not necessary for title clearances. These responsibilities will need to be considered as part of the subsequent development and implementation process.

Table 7: Responsibilities for the implementation of this BMP to support subdivision and issue of titles

Proponent – Prior to Issue of Certificates of Title for New Lots	
No.	**Implementation action**
1	As required, remove and/or manage classified vegetation within the site and areas identified to be managed by the proponent (see **Figure 4**) to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. This is only permitted in areas under the control of the proponent, or where agreement with the adjacent landowner is in place.
2	Install the public roads to the standards outlined in Appendix Four of the Guidelines or as agreed with the City of Kwinana. Public roads reserves should be designed and maintained to achieve low threat in accordance with Section 2.2.3.2 of AS 3959.
3	Reticulated water supply and hydrants are to be installed as per standard Water Corporation requirements, unless otherwise agreed.
4	To support staged development: • If required, construct and maintain any temporary emergency access ways (EAWs) in accordance with the minimum requirements of Table 6 of the Guidelines, to provide for multiple access to/from the site. This is to be in place until access through development to the north is able to be achieved. • Temporary no-through roads should meet the minimum requirements of the Guidelines, including the provision of appropriate turning heads (Figure 24 Guidelines v1.4).

Table 8: Responsibilities for the implementation of this BMP during development and ongoing management

Proponent – Ongoing	
No.	**Implementation and management actions**
1	Until fully developed, areas within the site including the future lots and proposed road reserves (shown in **Figure 4**) are to be subject to regular and ongoing management to ensure these areas achieve low threat in accordance with Section 2.2.3.2 of AS 3959 (as required). This is likely to include (but is not limited to): • Clearing/modification of vegetation • Regular removal of weeds and built-up dead material (such as fallen branches, leaf litter etc.) • Where grass is present, this should be maintained at or below 100 mm in height, and there is no accumulation of fine fuel load. Once lots are sold, management of the lot will be the responsibility of the landowner in accordance with this BMP and the firebreak notice. The City of Kwinana will be responsible for the management of road reserves following handover, noting nature strips can be excluded pursuant to clause 2.2.3.2 (f) of AS 3959 without specific management.
2	Design, implement and manage areas of public open space to the standards agreed with the City of Kwinana. Where relevant (e.g. low threat), ongoing management to achieve the relevant exclusion clause under AS 3959 will be applied and include (but is not limited to): • Clearing/modification of vegetation. Trees can be retained but will form part of the managed landscape areas. • Regular removal of weeds and built-up dead material (such as fallen branches, leaf litter etc.). • Low pruning of trees (i.e. removal of branches less than 2 m in height) if individual trees are proposed for retention, or as trees are planted, particularly where these are located in future road reserves or public open space). • Application/re-application of ground/surface covers such as mulch or non-flammable materials as required. • Where grass is present, this should be regularly cut and removed/mulched or otherwise disposed of so that the grass is maintained at or below 100 mm in height, and there is no accumulation of fine fuel load.
3	Make a copy of the BMP and BAL certification/assessment available to each lot owner within designated bushfire prone areas.

Table 8: Responsibilities for the implementation of this BMP during development and ongoing management (continued)

Property owner/occupier	
No.	**Management action**
1	Where within a bushfire prone area, ensuring construction of new dwelling/s is in accordance with the National Construction Code (NCC) and complies with a BAL rating assessed in accordance with AS 3959 (which may include the applicable BAL rating determined as part of this BMP (outlined within **Section 5**) or through a separate BAL assessment).
2	Ensuring that their property complies with the City of Kwinana Firebreak Notice/s as published and/or in accordance with directions given by the local government. This includes maintaining the entire lot to a low threat standard, even when vacant.
3	Ensuring fire hydrants are accessible at all times.
Water Corporation	
No.	**Management action**
1	The Water Corporation is responsible for the ongoing maintenance and repair of water hydrants.

7 Applicant Declaration

7.1 Accreditation

This assessment has been prepared by Emerge Associates who have been providing bushfire risk management advice for more than 10 years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry. Emerge Associates have a number of team members who have undertaken Bushfire Planning and Design (BPAD) Level 1 and Level 2 training and are Fire Protection Association of Australia (FPAA) accredited practitioners.

Anthony Rowe is a FPAA Level 3 BPAD accredited practitioner (BPAD No. 36690) in accordance with clause 6.12 of the Guidelines.

7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

Name: Anthony Rowe

Company: Emerge Associates/Envision Bushfire Protection

Date: 31 July 2024

BPAD Accreditation: Level 3 BPAD no. 36690

8 References

8.1 General references

The references listed below have been considered as part of preparing this document.

City of Kwinana 2016, *Local Planning Policy No.1 - Landscape Feature and Tree Retention*.

City of Kwinana 2022, *Local Planning Policy No. 3 - Bollard Bulrush Landscape Masterplan*.

(CLE) 2023, *Concept Plan - Lot 506 Johnson Road, Wellard*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017, *Ramsar Sites (DBCA-010)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2022a, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*, Western Australia, <https://catalogue.data.wa.gov.au/dataset/geomorphic-wetlands-swan-coastal-plain>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2022b, *Threatened Ecological Communities (DBCA-038)*, Perth, Western Australia <https://catalogue.data.wa.gov.au/dataset/threatened-ecological-communities>.

Department of Planning, Lands and Heritage (DPLH) 2019, *Bush Forever Areas 2000 (DPLH-019)*, <https://catalogue.data.wa.gov.au/org/department-of-planning-lands-and-heritage>.

Department of Planning, Lands and Heritage, and Western Australian Planning Commission, (DPLH & WAPC) 2021, *Guidelines for Planning in Bushfire Prone Areas Version 1.4*, Perth, Western Australia.

Department of Water and Environmental Regulation (DWER) 2021, *Clearing Regulations - Environmentally Sensitive Areas (DWER-046)*, <https://catalogue.data.wa.gov.au/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046>.

Emerge Associates 2023a, *Environmental Assessment and Management Stratergy - Lot 506 Johnson Road, Wellard* Version 1.

Emerge Associates 2023b, *Providence East, Wellard WA - Preliminary Landscape Design Report*

Gould, J., McCaw, W., Cheney, N., Ellis, P. and Matthews, S. 2007, *Field Guide: Fuel Assessment and Fire Behaviour Prediction in Dry Eucalypt Forest*, CSIRO and Department of Environment and Conservation, Perth, Western Australia.

Institute of Public Works Engineering Australasia (IPWEA) 2017, *Local Government Guidelines for Subdivisional Development*, West Perth.

Office of Bushfire Risk Management (OBRM) 2021, *Map of Bush Fire Prone Areas*, Landgate, https://maps.slip.wa.gov.au/landgate/bushfireprone/.

Standards Australia 2018, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney.

Taylor Burrell Barnett 2016, *Lots 503 and 504 Tamblyn Place and Lots 505, 507 and 900 Johnson Road, Wellard*.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

8.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 8.1**, with access date information provided in **Table R-1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
(OBRM 2021)	17 November 2023	Bush Fire Prone Areas
(DBCA 2022a)	17 November 2023	Geomorphic Wetlands, Swan Coastal Plain
(DBCA 2017)	17 November 2023	Ramsar Sites
(DBCA 2022b)	17 November 2023	Threatened ecological communities
(DWER 2021)	17 November 2023	Environmentally Sensitive Areas
(DPLH 2019)	17 November 2023	Bush Forever areas

Figures

Figure 1: Site Location and Topographic Contours

Figure 2: AS 3959 Vegetation Classifications and Effective Slope

Figure 3: Bushfire Attack Level Contour Plan

Figure 4: Spatial Representation of Bushfire Management Strategies

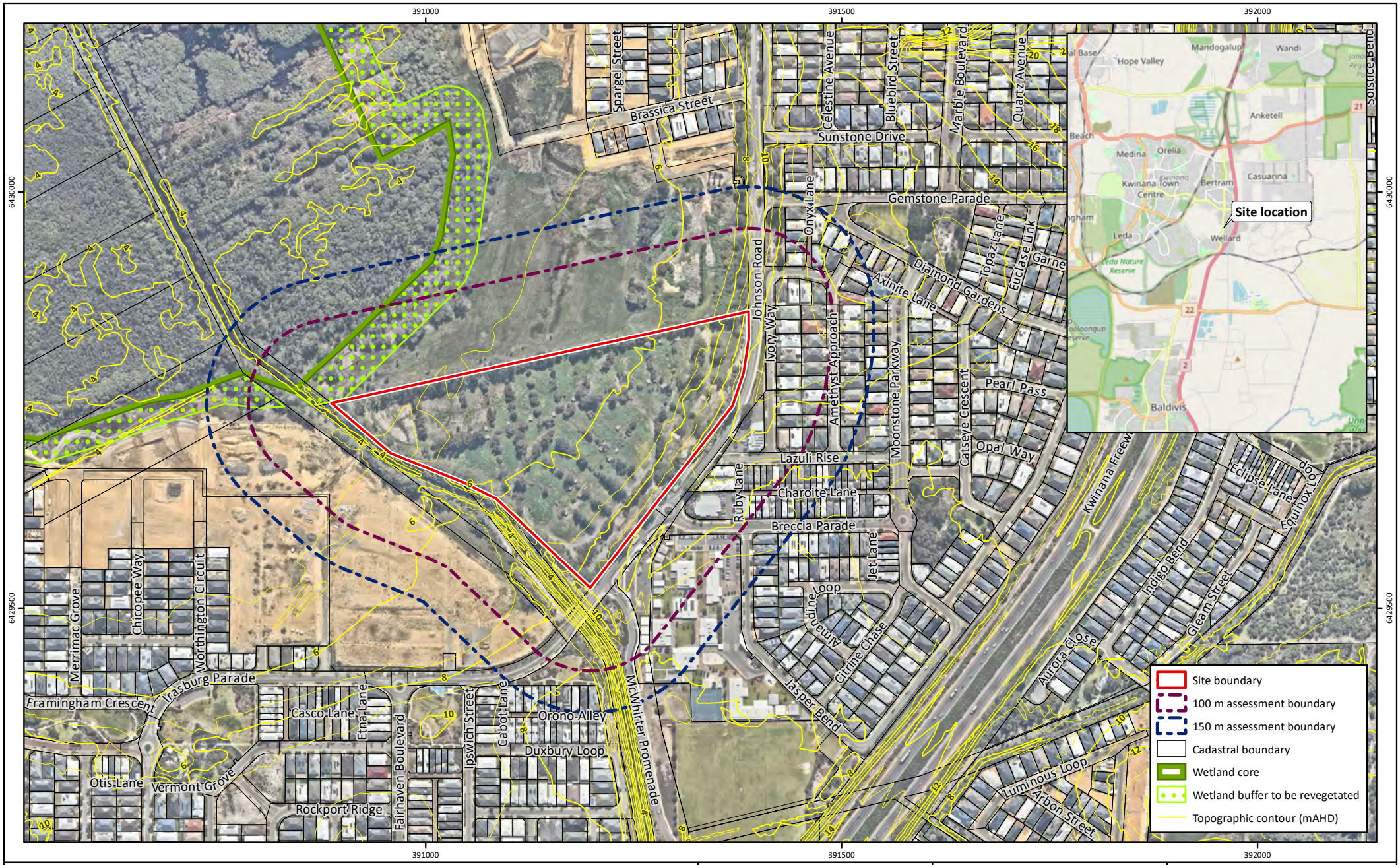


Figure 1: Site Location and Topographic Contours

Project:	Bushfire Management Plan Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(04)--F11

Drawn:	GAR
Date:	04/12/2023
Checked:	DVB
Approved:	KK
Date:	07/12/2023

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

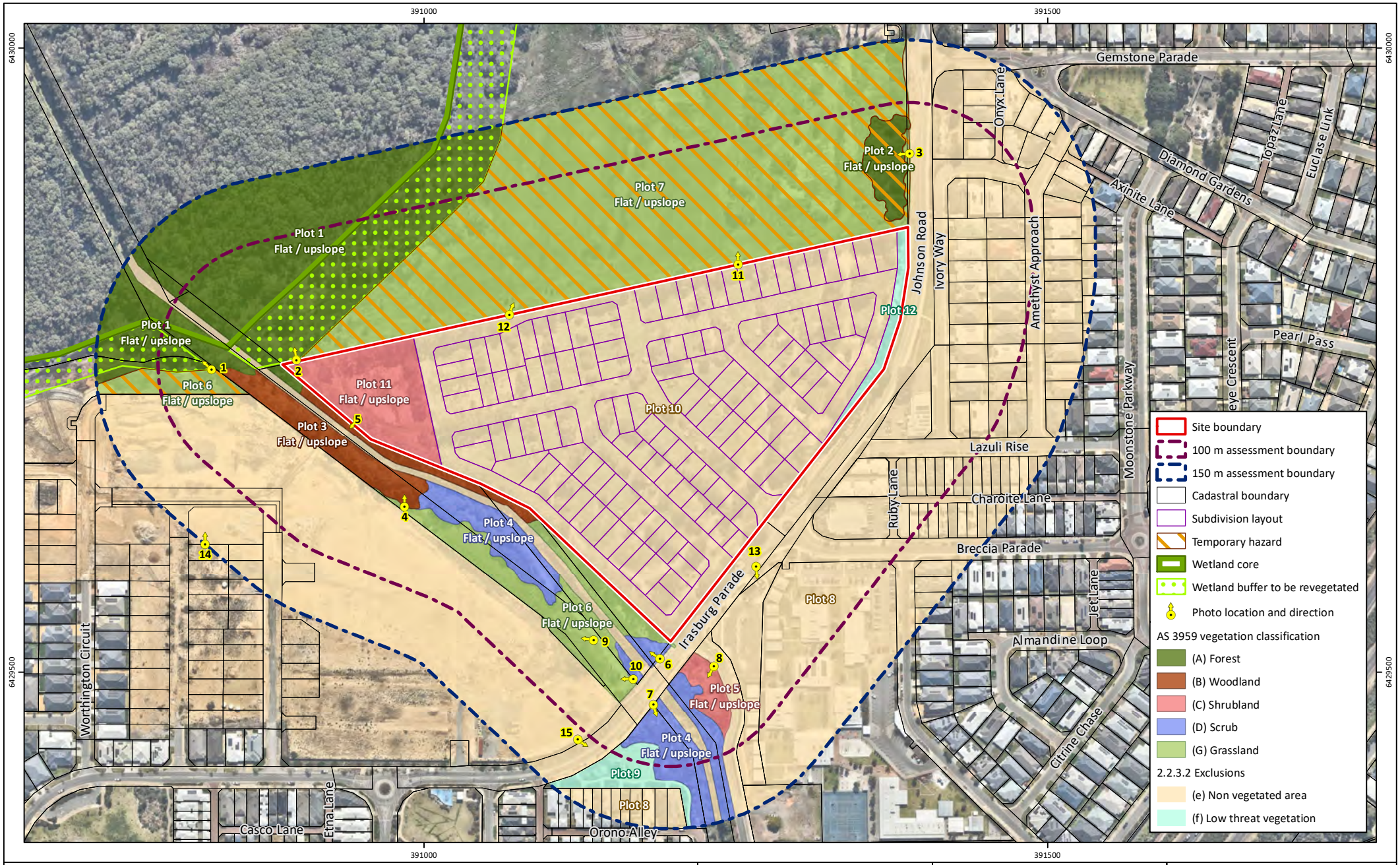


Figure 2: AS 3959 Vegetation Classification and Effective Slope

Project:	Bushfire Management Plan Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(04)--F12b

Drawn:	CTH
Date:	31/07/2024
Checked:	KK
Approved:	AJR
Date:	31/07/2024

N

0 50 100 150
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2024). Nearmap Imagery date: 30/08/2023

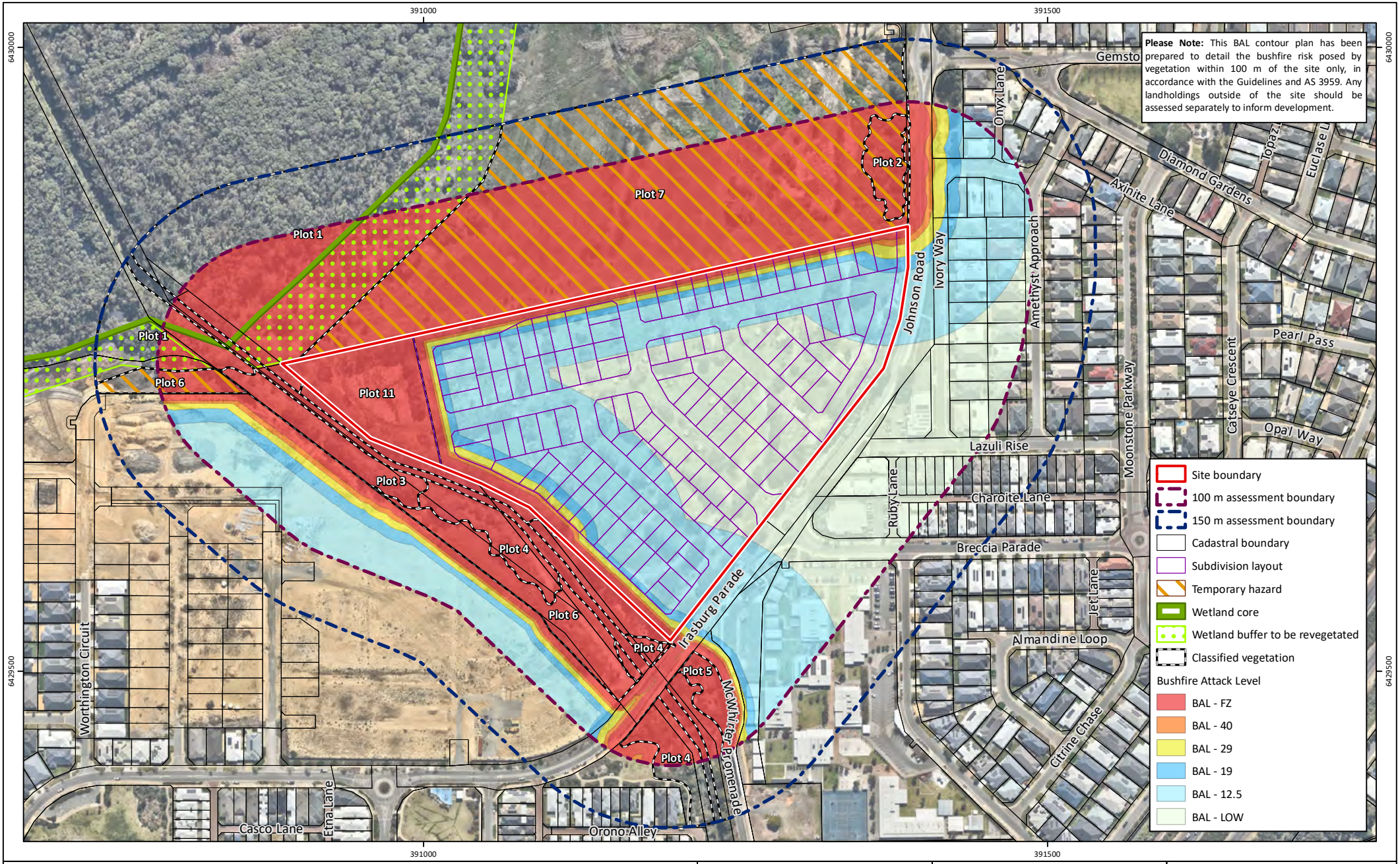


Figure 3: **Bushfire Attack Level Contour Plan**

Project:	Bushfire Management Plan Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(04)--F13b

Drawn:	CTH
Date:	31/07/2024
Checked:	KK
Approved:	AJR
Date:	31/07/2024

N

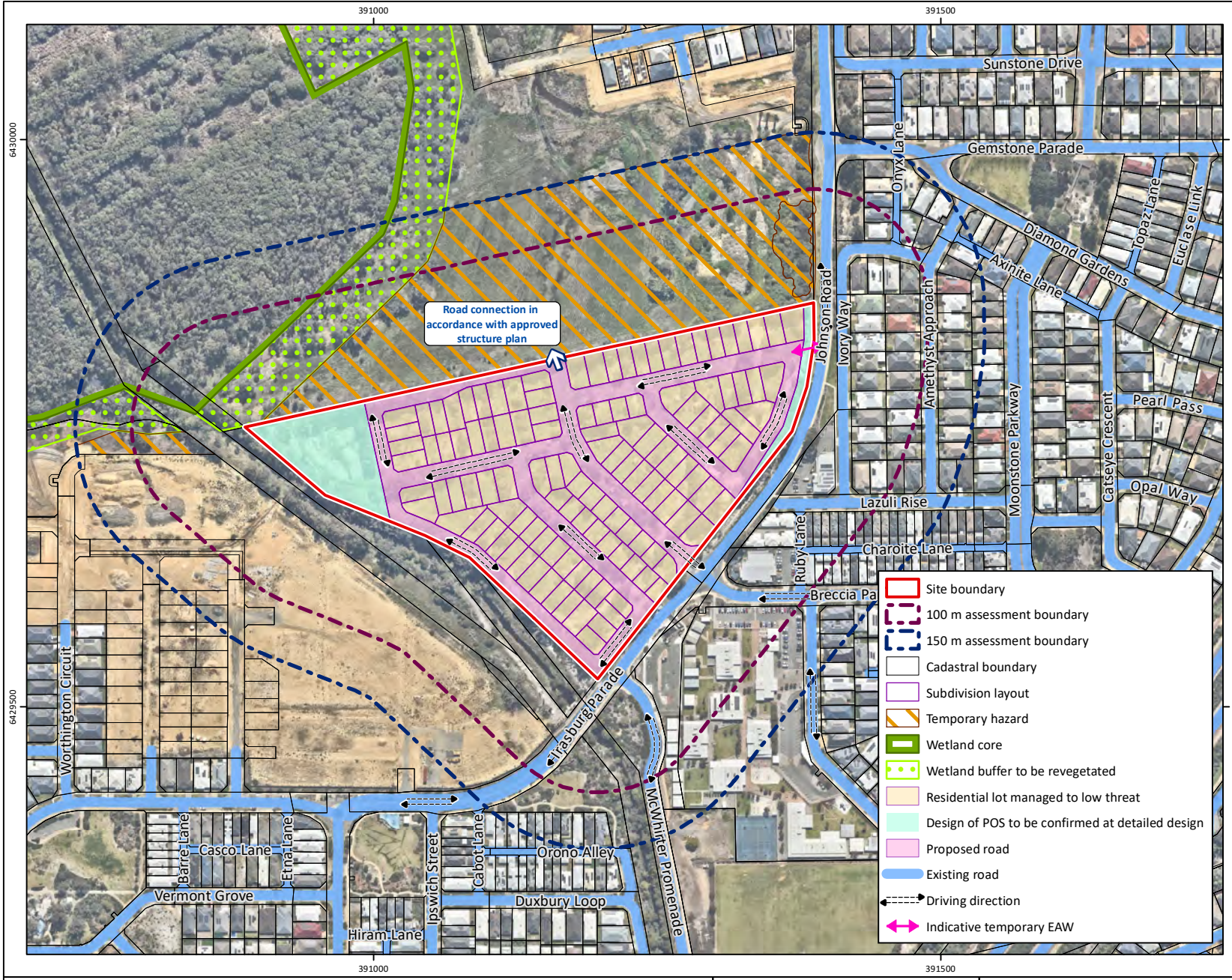
0 50 100 150
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2024). Nearmap Imagery date: 30/08/2023



Habitable buildings

All habitable buildings must be located in an area that achieves BAL-29 or less in accordance with AS 3959.

Building construction requirements

Where designated bushfire prone, future Class 1, 2, 3 and associated 10a buildings will need to beconstructed in accordance with BAL ratings determined in accordance with AS 3959.

Vehicle access

- All future lots are to acheive a minimum two different access routes. As part of future subdivsion,if development to the north is not progressed, a temporary emergency access way (EAW) should be provided to Irasburg Parade/Johnson Road or another public road to provide for two access routes. This should comply with the requirements in Appendix Four of the Guidelines.
- All roads should achieve the public road requirements as per A3.2 of Appendix Four of the Guidelines, unless agreed otherwise with the City of Kwinana.
- All no-through roads (including temporary no-through roads as part of staged development) are to meet the requirements of Appendix Four of the Guidelines, including:
  + Will be a maximum length of 200 m , unless the exemptions in Appendix Four of the Guidelines apply.
  + Will achieve the public road requirements as per A3.2 of Appendix Four of the Guidelines, unless agreed otherwise with the City Kwinana.
  + The turnaround areas will achieve the dimensions outlined in Figure 24 of Appendix Four of the Guidelines, or as agreed.

Water supply

The development will be serviced by a reticulated water supply and a network of hydrants.

Figure 4: Spatial Representation of Bushfire Management Strategies

Project:	Bushfire Management Plan Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(04)--F14a

Drawn:	CTH
Date:	24/07/2024
Checked:	KK
Approved:	AJR
Date:	29/07/2024

N

0 50 100 150
Metres
Scale: 1:5,000@A4
GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2024). Nearmap Imagery date: 30/08/2023

Appendix A

Structure plan and subdivision plan

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

LATTUGE DRIVE
CAROTA VIEW
NAVET STREET
POS
30
60
54.5
16m Reserve
13m Reserve
15m Reserve
60
506
40
55
53
45
54
16m Reserve
15m Reserve
13m Reserve
13m Reserve
15m Reserve
13m Reserve
ROAD
JOHNSON
BRECCIA
PARADE
IRASBURG
PARADE
58
59
353
360
359
358
357
356
805
804
803
801
802
800
886
722
835 834 833 832 831 830 829 828 827 826
721 720 719 718 717 716 715 714 713 71
665
666
667
668
664
663
691
692
69

LEGEND
SUBJECT SITE

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

CONCEPT PLAN
Lot 506 Johnson Road, Wellard

DRAFT

plan no: **2263-186C-01**
date: 12 October 2022
scale: 1:1,500 @A3, 1:750 @A1

N

LATTUGE DRIVE

CAROTA VIEW

NAVET STREET

(7.5m)

(7.5m)

Ultimate road width will be 15m, the balance to be provided by others

FUTURE SUBDIVISION BY OTHERS

POS
6727m²

POS
1462m²

13m Reserve

15m Reserve

16m Reserve

ROAD

JOHNSON

BRECCIA PARADE

IRASBURG PARADE

WAPC APPROVAL 162053

LOT SUMMARY (Residential)

Residential	No. Lots
235m² - 319m²	29
320m² - 449m²	57
450m² - 499m²	19
500m² - 549m²	14
550m² - 599m²	3
600m² - 699m²	1
Total Resi Lots	**123**

Minimum Lot Size	-	269m²
Maximum Lot Size	-	621m²
Average Lot Size	-	394m²
Total Lot Area		- 4.8506ha

Total Fee Payable Lots	**123**

LOT SUMMARY (Form 1A)

Type	No. Lots
Fee payable lots	123
Non-fee payable lots	
Road Reserve	9
POS	2
Total Lots	**134**

LEGEND

Lot 506 (7.8510ha)

Subject Area - 7.8510ha

All road carriageway detail where depicted on this subdivision plan including road pavements, road treatments, medians or parking, are for illustrative purposes only and are subject to final engineering design and separate approval processes. The detail reflects the preferred urban design intent for the road network standards.

For corner lots, vehicular access from the primary street will be subject to compliance with *clause 5.3.5, C5.3 of the R-Codes Volume 1* to the satisfaction of the Local Government. Non-compliance with *clause 5.3.5* may require vehicular access to be obtained from the secondary street.

All dimensions and areas depicted on this plan are subject to pre-cal and final survey and will vary from the figures shown. This plan remains the property of CLE.

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

PROPOSED FREEHOLD SUBDIVISION

362 (L 506) Johnson Road, Wellard

DRAFT

plan no: **2263-201-01**
date: 4 July 2024
scale: 1:1,500 @A3, 1:750 @A1

N

Appendix B

Landscape Masterplan

Lot 506 Johnson Rd
Wellard WA

PRELIMINARY LANDSCAPE DESIGN REPORT

EASTCOURT

emerge ASSOCIATES

December 2023

Contents

1.0 Landscape Concepts 3

1.1 Overall Masterplan..... 3

1.2 POS 1 Detailed Plan 4

2.0 Typical Site Sections 5

2.1 POS 1: Section A..... 5

2.2 POS 1: Section B 5

2.3 POS 2: Section C..... 6

3.0 Street Tree Masterplan 7

4.0 Planting Palette..... 8

4.1 Indicative Planting Palette..... 8

REVISION	DATE	ISSUE OR AMENDMENT	BY	REVIEWED
A	05.12.23	Issue for Comment	JW	MM
B	07.12.23	Issue for Approval	JW	MM

1.0 Landscape Concepts

1.1 Overall Masterplan

1.2 POS 1 Detailed Plan

LEGEND

- EXTENT OF WORKS
- BRA (FIRST 15mm RAINFALL)
- 1% AEP (100 YEAR STORM)
- DUAL USE CONCRETE PATHS
- 2.5 WIDE RED ASPHALT DUAL USE PATH
- NATIVE SHRUB PLANTING
- TURF
- BIORETENTION BASIN
- SHADE STRUCTURE AND PICNIC AREA
- FITNESS EQUIPMENT NODE
- INDICATIVE PLAY SPACE
- EXISTING TREES TO BE RETAINED WHERE POSSIBLE (SUBJECT TO DETAILED DESIGN)

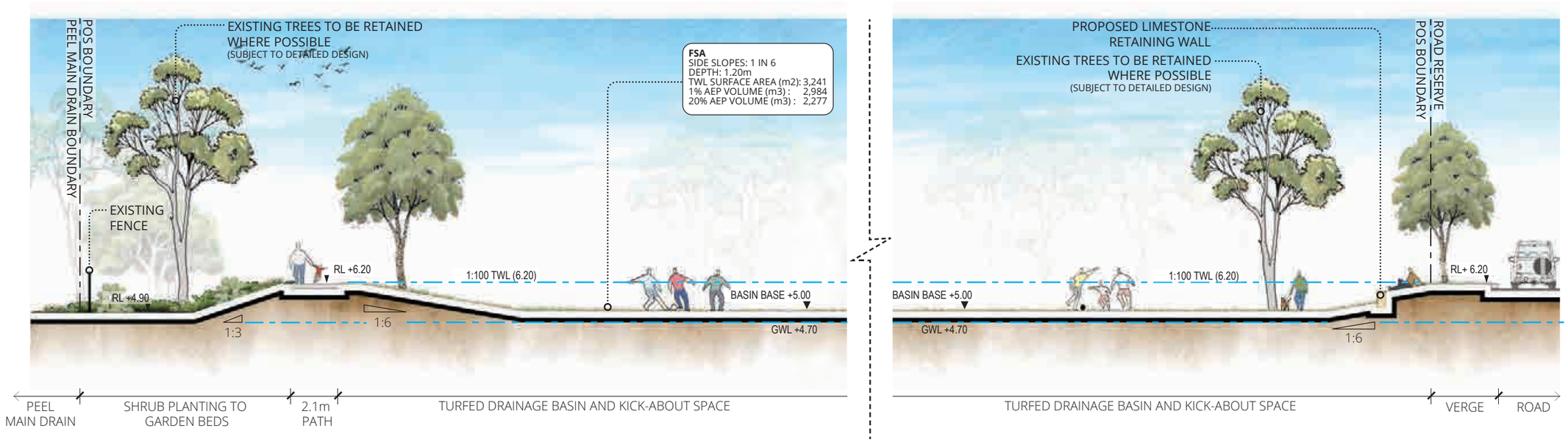
LEGEND

01 EXISTING PEEL MAIN DRAIN
02 FEATURE HARDSTAND WITH SHADE STRUCTURE AND SEATING OPPORTUNITIES OVERLOOKING PLAYSPACE
03 PROPOSED PLAYSPACE
04 PROPOSED DUAL USE PATH
05 DUP CROSSING TO PEEL MAIN DRAIN BY OTHERS
06 PROPOSED FITNESS NODE
07 LARGE TURF KICK-ABOUT AREA
08 PLANTED BIORETENTION BASIN
09 OVERFLOW SPILLWAY WITH ROCKWORK
10 PLANTED BATTER TO TIE INTO EXISTING LEVELS
11 RUBBISH BINS
12 FUTURE DUP BY OTHERS
13 LIMESTONE RETAINING WALLS
14 PARK BENCH
15 INDICATIVE ON STREET PARKING TO POS

2.0 Typical Site Sections

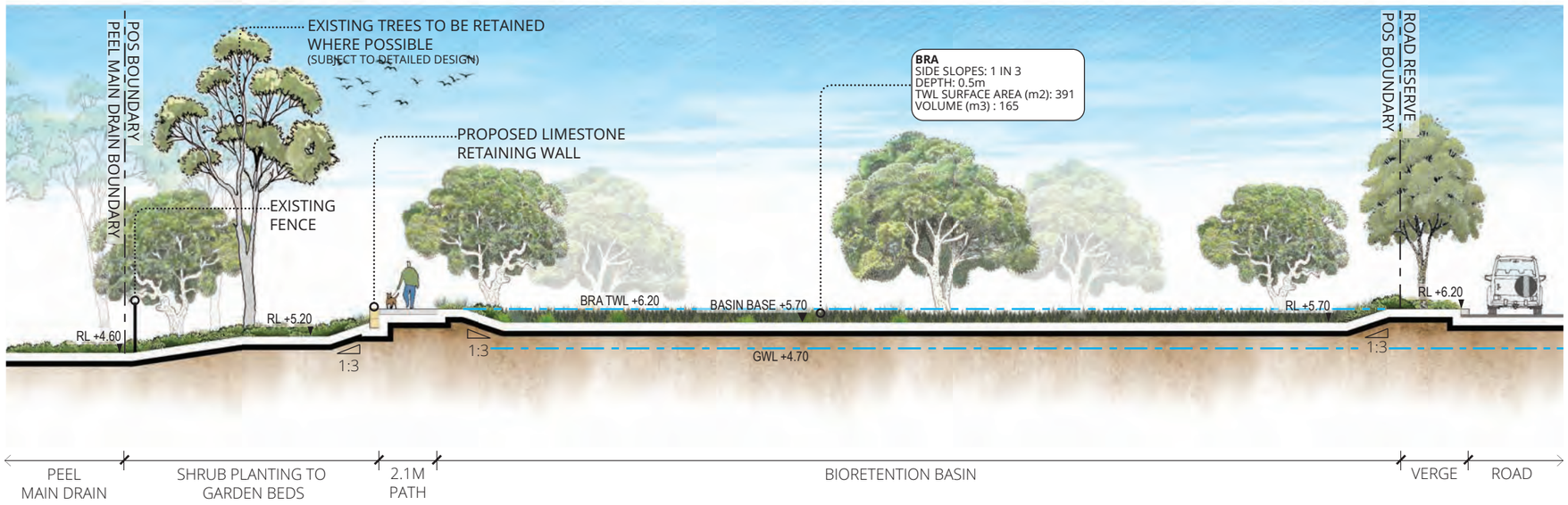
2.1 POS 1: Section A

Scale 1:100



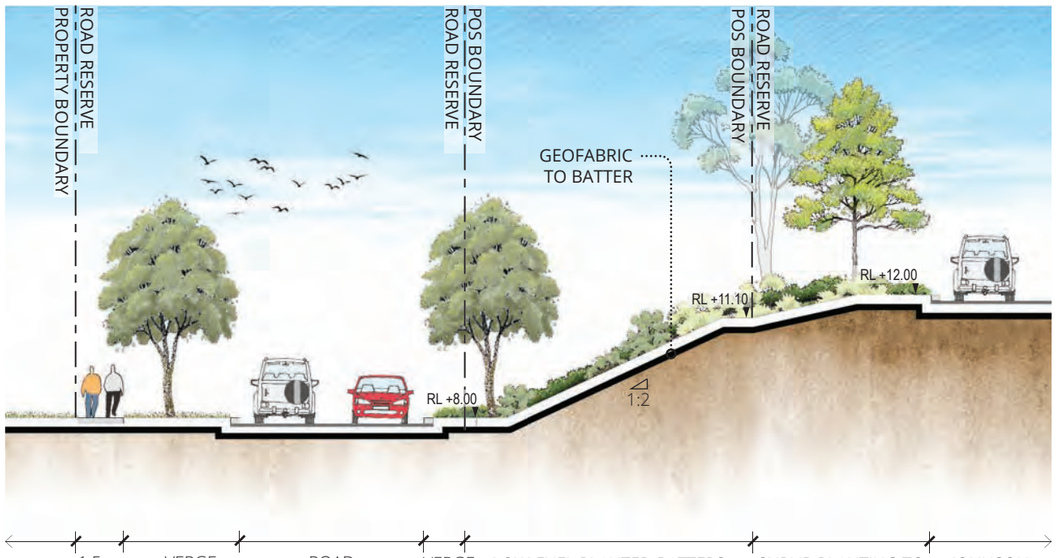
2.2 POS 1: Section B

Scale 1:100



2.3 POS 2: Section C

Scale 1:100



3.0 Street Tree Masterplan

Pyrus ussuriensis
Manchurian Pear

Cupaniopsis anacardioides
Tuckeroo

Melaleuca leucadendra
Weeping Paperbark

4.0 Planting Palette

4.1 Indicative Planting Palette

Trees (>3m)
Agonis flexuosa WA Peppermint
Banksia littoralis Swamp Banksia
Eucalyptus gomphocephala Tuart
Eucalyptus rudis Flooded Gum
Melaleuca preissiana Stout Paperbark
Melaleuca rhaphiophylla Swamp Paperbark
Pyrus calleryana Ornamental Pear

Large Shrubs (>1.5m) Golden Wreath Wattle
Acacia saligna Wooley Bush
Adenanthos sericeus One-Sided Bottlebrush
Calothamnus quadrifidus Yellow-spotted Emu Bush
Eremophila maculata 'Aurea' Olive Grevillea
Grevillea olivacea Chenille Honeymyrtle
Melaleuca huegelii Dwarf Melaleuca
Melaleuca 'Little Nessie' Coastal Daisy-Bush
Olearia axillaris

Medium Shrubs (1 - 1.5m) Grevillea
Grevillea crithmifolia upright Elegant beaufortia
Beaufortia elegans Club Rush
Ficinia nodosa Boobialla
Myoporum insulare Pom-Pom Myrtle
Melaleuca conothamnoides Heart Leaf Flame Pea
Chorizema cordatum Coastal Rosemary
Westringia fruticosa 'Grey Box'

Small Shrubs (0.5 - 1m) Red & Green Kangaroo Paw
Anigozanthos manglesii Grey Cottonhead
Conostylis candicans Stalked Guinea Flower
Hibbertita racemosa White myrtle
Hypocalymma angustifolium Cushion Bush
Leucophyta brownii Lomandra
Lomandra tanika Wingarra
Lomandra wingarra Native Iris
Patersonia occidentalis

Groundcovers (<0.5m) Prostrate Golden Wreath Wattle
Acacia saligna prostrate Honeypot Dryandra
Banksia Nivea Common Clematis
Clematis pubescens Creeping Boobialla
Myoporum parvifolium Eremophila
Eremophila glabra 'Roseworthy' Grevillea
Grevillea crithmifolia prostrate

Trees

Agonis flexuosa
WA Peppermint

Melaleuca rhaphiophylla
Swamp Paperbark

Eucalyptus gomphocephala
Tuart

Banksia littoralis
Swamp Banksia

Large Shrubs

Acacia saligna
Golden Wreath Wattle

Eremophila maculata 'Aurea'
Yellow-spotted Emu Bush

Melaleuca huegelii
Chenille Honeymyrtle

Calothamnus quadrifidus
One-Sided Bottlebrush

Medium Shrubs

Eremophila nivea
Spring Mist

Chroizema cordatum
Heart Leaf Flame Tree

Melaleuca conothamnoides
Pom-Pom Myrtle

Westringia fruticosa 'Grey Box'
Coastal Rosemary

Small Shrubs

Conostylis candicans
Grey Cottonhead

Leucophyta brownii
Cushion Bush

Lomandra wingarra
Wingarra

Patersonia occidentalis
Native Iris

Groundcovers

Acacia saligna prostrate
Prostrate Golden Wreath Wattle

Eremophila glabra 'Roseworthy'
Eremophila

Myoporum parvifolium
Creeping Boobialla

Banksia Nivea
Honeypot Dryandra

ATTACHMENT 5

Landscape Masterplan [Emerge Associates]

Lot 506 Johnson Rd
Wellard WA

PRELIMINARY LANDSCAPE DESIGN REPORT

EASTCOURT

emerge ASSOCIATES

December 2023

Contents

1.0 Landscape Concepts 3

1.1 Overall Masterplan..... 3

1.2 POS 1 Detailed Plan 4

2.0 Typical Site Sections 5

2.1 POS 1: Section A..... 5

2.2 POS 1: Section B 5

2.3 POS 2: Section C..... 6

3.0 Street Tree Masterplan 7

4.0 Planting Palette..... 8

4.1 Indicative Planting Palette..... 8

REVISION	DATE	ISSUE OR AMENDMENT	BY	REVIEWED
A	05.12.23	Issue for Comment	JW	MM
B	07.12.23	Issue for Approval	JW	MM

1.0 Landscape Concepts

1.1 Overall Masterplan

1.2 POS 1 Detailed Plan

LEGEND

- EXTENT OF WORKS
- BRA (FIRST 15mm RAINFALL)
- 1% AEP (100 YEAR STORM)
- DUAL USE CONCRETE PATHS
- 2.5 WIDE RED ASPHALT DUAL USE PATH
- NATIVE SHRUB PLANTING
- TURF
- BIORETENTION BASIN
- SHADE STRUCTURE AND PICNIC AREA
- FITNESS EQUIPMENT NODE
- INDICATIVE PLAY SPACE
- EXISTING TREES TO BE RETAINED WHERE POSSIBLE (SUBJECT TO DETAILED DESIGN)

LEGEND

01 EXISTING PEEL MAIN DRAIN

02 FEATURE HARDSTAND WITH SHADE STRUCTURE AND SEATING OPPORTUNITIES OVERLOOKING PLAYSPACE

03 PROPOSED PLAYSPACE

04 PROPOSED DUAL USE PATH

05 DUP CROSSING TO PEEL MAIN DRAIN BY OTHERS

06 PROPOSED FITNESS NODE

07 LARGE TURF KICK-ABOUT AREA

08 PLANTED BIORETENTION BASIN

09 OVERFLOW SPILLWAY WITH ROCKWORK

10 PLANTED BATTER TO TIE INTO EXISTING LEVELS

11 RUBBISH BINS

12 FUTURE DUP BY OTHERS

13 LIMESTONE RETAINING WALLS

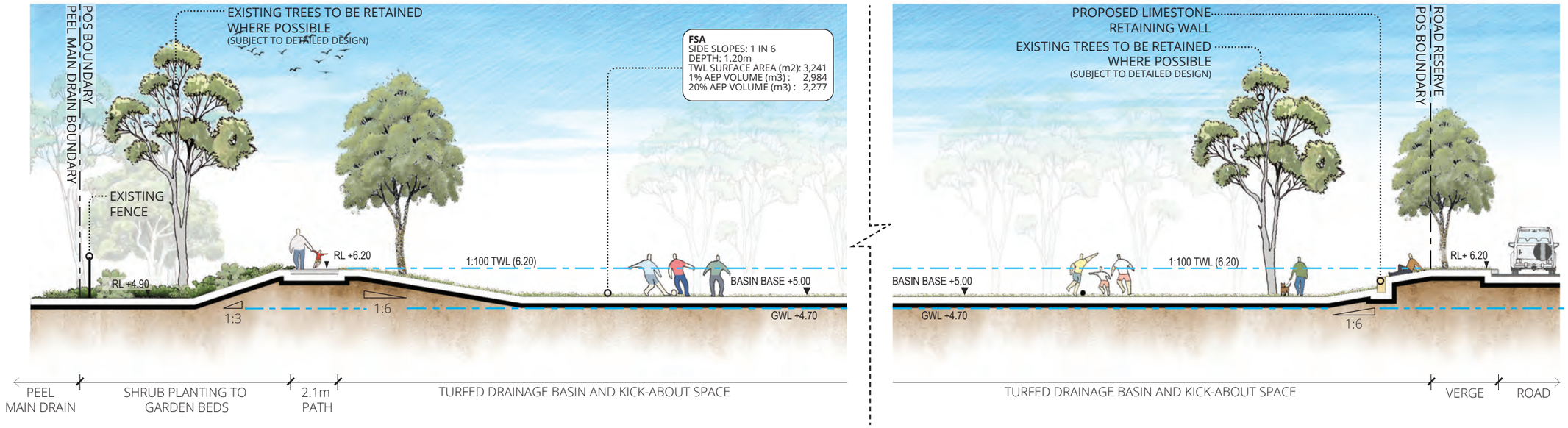
14 PARK BENCH

15 INDICATIVE ON STREET PARKING TO POS

2.0 Typical Site Sections

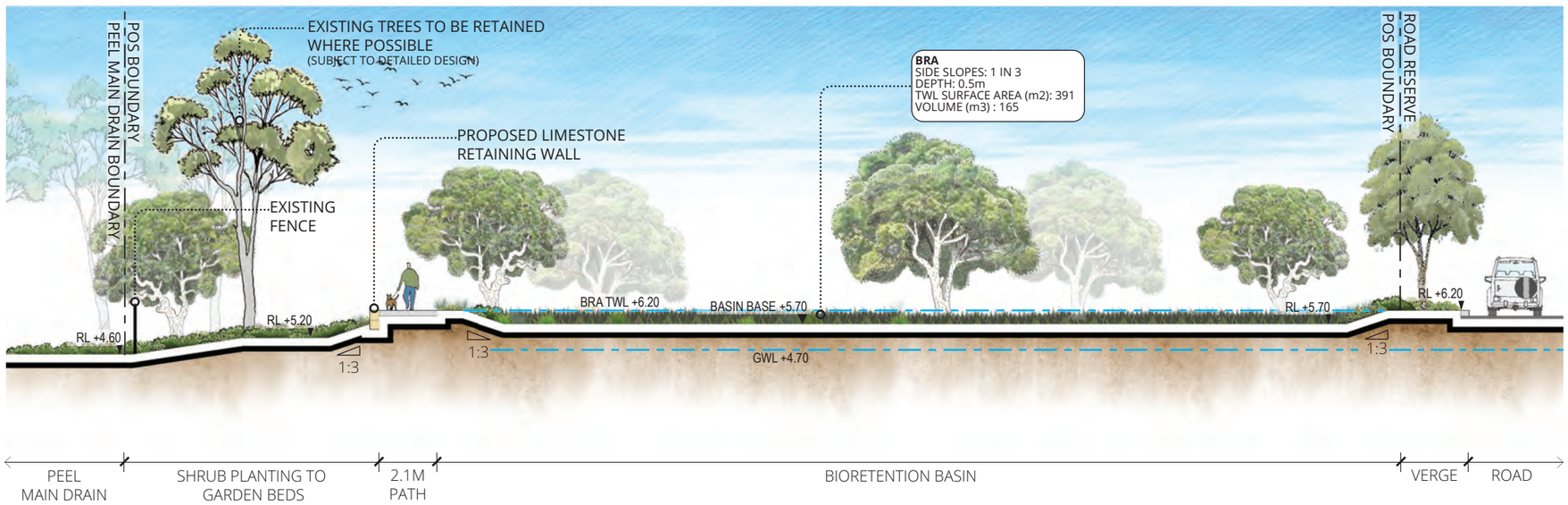
2.1 POS 1: Section A

Scale 1:100



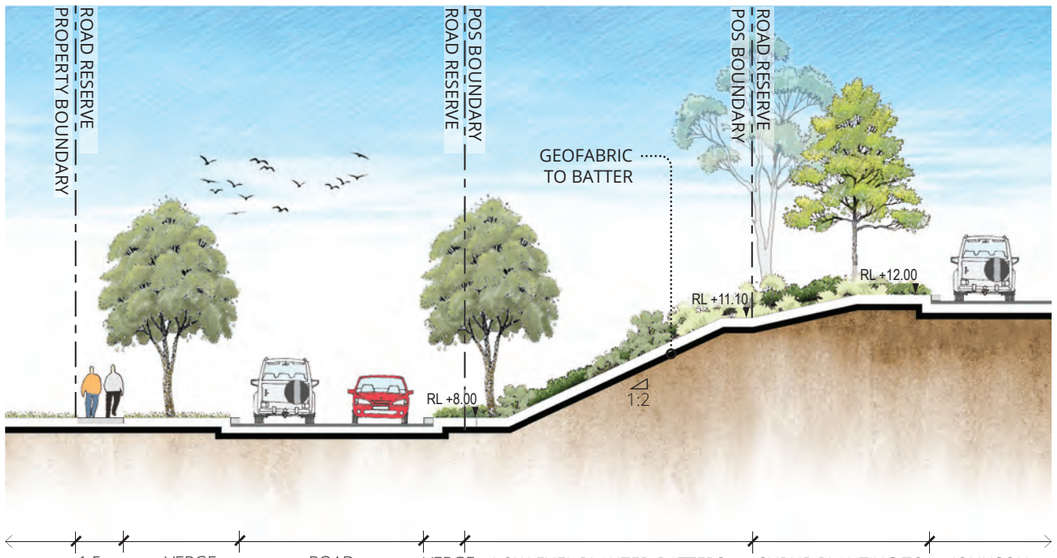
2.2 POS 1: Section B

Scale 1:100



2.3 POS 2: Section C

Scale 1:100



3.0 Street Tree Masterplan

Pyrus ussuriensis
Manchurian Pear

Cupaniopsis anacardioides
Tuckeroo

Melaleuca leucadendra
Weeping Paperbark

4.0 Planting Palette

4.1 Indicative Planting Palette

Trees (>3m)
Agonis flexuosa WA Peppermint
Banksia littoralis Swamp Banksia
Eucalyptus gomphocephala Tuart
Eucalyptus rudis Flooded Gum
Melaleuca preissiana Stout Paperbark
Melaleuca rhaphiophylla Swamp Paperbark
Pyrus calleryana Ornamental Pear

Large Shrubs (>1.5m) Golden Wreath Wattle
Acacia saligna Wooley Bush
Adenanthos sericeus One-Sided Bottlebrush
Calothamnus quadrifidus Yellow-spotted Emu Bush
Eremophila maculata 'Aurea' Olive Grevillea
Grevillea olivacea Chenille Honeymyrtle
Melaleuca huegelii Dwarf Melaleuca
Melaleuca 'Little Nessie' Coastal Daisy-Bush
Olearia axillaris

Medium Shrubs (1 - 1.5m) Grevillea
Grevillea crithmifolia upright Elegant beaufortia
Beaufortia elegans Club Rush
Ficinia nodosa Boobialla
Myoporum insulare Pom-Pom Myrtle
Melaleuca conothamnoides Heart Leaf Flame Pea
Chorizema cordatum Coastal Rosemary
Westringia fruticosa 'Grey Box'

Small Shrubs (0.5 - 1m) Red & Green Kangaroo Paw
Anigozanthos manglesii Grey Cottonhead
Conostylis candicans Stalked Guinea Flower
Hibbertita racemosa White myrtle
Hypocalymma angustifolium Cushion Bush
Leucophyta brownii Lomandra
Lomandra tanika Wingarra
Lomandra wingarra Native Iris
Patersonia occidentalis

Groundcovers (<0.5m) Prostrate Golden Wreath Wattle
Acacia saligna prostrate Honeypot Dryandra
Banksia Nivea Common Clematis
Clematis pubescens Creeping Boobialla
Myoporum parvifolium Eremophila
Eremophila glabra 'Roseworthy' Grevillea
Grevillea crithmifolia prostrate

Trees

Agonis flexuosa
WA Peppermint

Melaleuca rhaphiophylla
Swamp Paperbark

Eucalyptus gomphocephala
Tuart

Banksia littoralis
Swamp Banksia

Large Shrubs

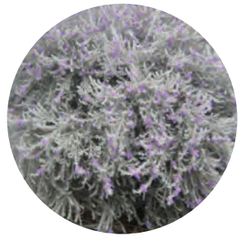
Acacia saligna
Golden Wreath Wattle

Eremophila maculata 'Aurea'
Yellow-spotted Emu Bush

Melaleuca huegelii
Chenille Honeymyrtle

Calothamnus quadrifidus
One-Sided Bottlebrush

Medium Shrubs



Eremophila nivea
Spring Mist

Chroizema cordatum
Heart Leaf Flame Tree

Melaleuca conothamnoides
Pom-Pom Myrtle

Westringia fruticosa 'Grey Box'
Coastal Rosemary

Small Shrubs

Conostylis candicans
Grey Cottonhead

Leucophyta brownii
Cushion Bush

Lomandra wingarra
Wingarra

Patersonia occidentalis
Native Iris

Groundcovers

Acacia saligna prostrate
Prostrate Golden Wreath Wattle

Eremophila glabra 'Roseworthy'
Eremophila

Myoporum parvifolium
Creeping Boobialla

Banksia Nivea
Honeypot Dryandra

ATTACHMENT 6

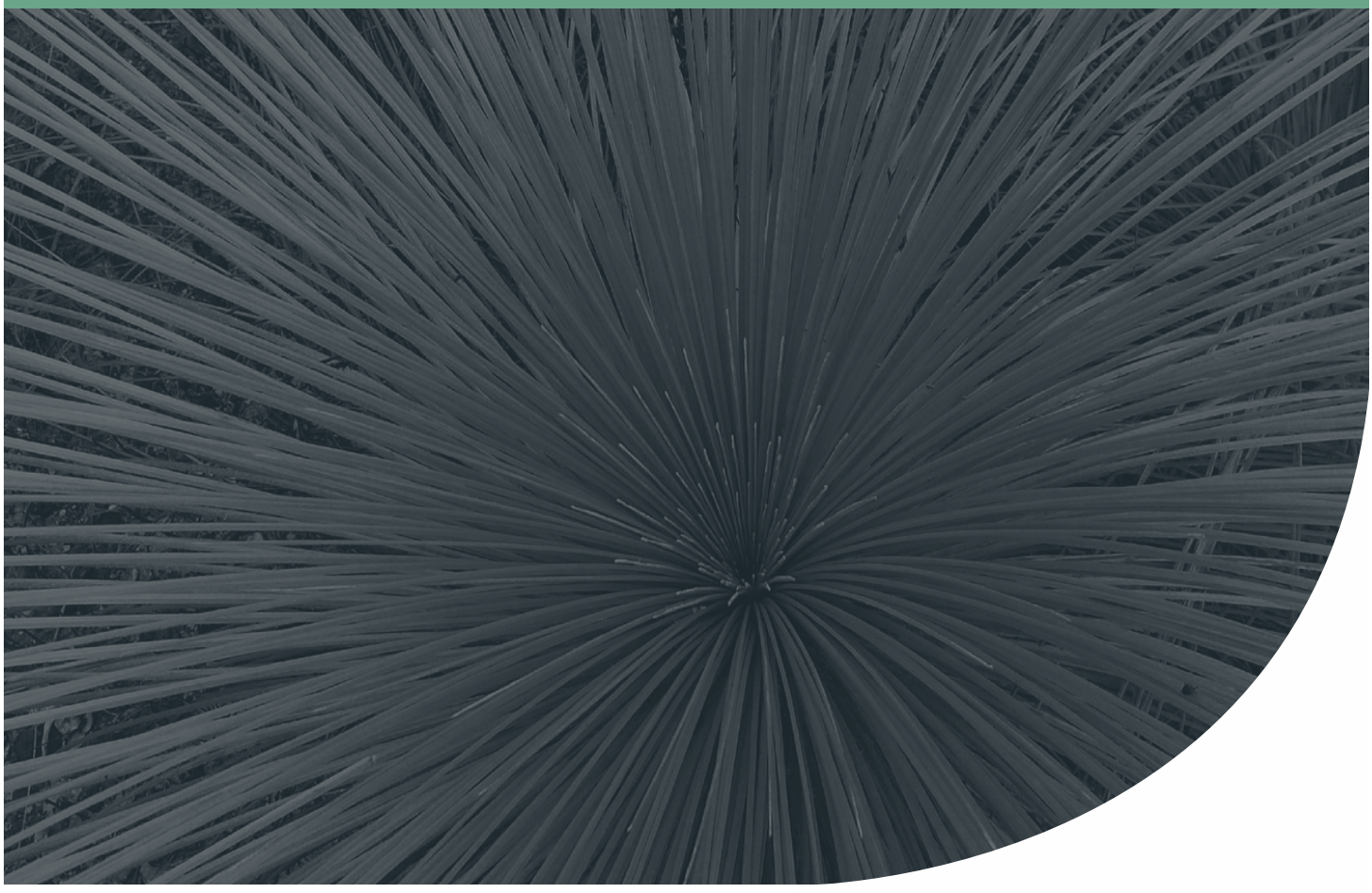
Environmental Assessment & Management Strategy [Emerge Associates]

Environmental Assessment and Management Strategy

Lot 506 Johnson Road, Wellard

Project No: EP22-062(05)

Prepared for Wellard Residential Pty Ltd
December 2023



Document Control

Doc name:	Environmental Assessment and Management Strategy Lot 506 Johnson Road, Wellard				
Doc no.:	**EP22-062(05)—015a**				
Version	**Date**	**Author**		**Reviewer**	
1	December 2023	Daniel Bussell	DVB	Kirsten Knox	KK
	Issued to client for review				
A	December 2023	Daniel Bussell	DVB	Kirsten Knox	KK
	Minor updates following client review				

© 2023 Emerge Associates All Rights Reserved. Copyright in the whole and every part of this document belongs to Emerge Associates and may not be used, sold, transferred, copied or reproduced in whole or in part in any manner or form or in or on any media to any person without the prior written consent of Emerge Associates.

Executive Summary

This *Environmental Assessment and Management Strategy* (EAMS) has been prepared on behalf of Wellard Residential Pty Ltd (the proponent) to support the progression of a structure plan and future subdivision within Lot 506 Johnson Road, Wellard (herein referred to as 'the site') to facilitate residential development. The site is located within the City of Kwinana (CoK) located approximately 38 km south of the Perth central business district (CBD). The site is approximately 7.85 hectares (ha) in size and is currently zoned 'Urban' under the *Metropolitan Region Scheme* (WAPC 2023a) and 'Development' under the CoK Local Planning Scheme No. 2 (LPS No. 2) (DPLH 2023b).

The site is generally bounded by Johnson Road and Irasburg Parade to the east (with residential areas further east), residential areas currently under development to the south and north, the Peel Main Drain to the west (with residential areas further west) and Bollard Bulrush Swamp to the north-west.

This EAMS has been prepared to address the requirements of the Western Australian Planning Commission's (WAPC) *WA Planning Manual Guidance for Structure Plans* (WAPC 2023b) to support the preparation and implementation of the structure plan. This report provides a synthesis of information from a range of sources regarding the environmental features, attributes and values of the site and provides an outline of the management strategies that can be adopted as part of the future subdivision and development process to address environmental values and minimise impacts.

The relevant environmental attributes and values of the site are summarised as follows:

- Topography within the site is predominantly flat, with a gentle slope in the eastern portion of the site raising from 4 m (m AHD) to 10 m AHD at Johnson Road.
- The majority of the site is mapped as having a 'high to moderate risk' of acid sulfate soils (ASS) occurring within 3 m of the natural soil surface. The easternmost portion of the site is mapped as having a 'moderate to low risk '.
- A review of publicly available historical aerial imagery indicates the site was cleared of native vegetation prior to 1965 and maintained as such to support agricultural land uses (WALIA 2023). Vegetation within the site currently comprises of cleared paddock areas with planted non-native windbreak/shelter trees (planted between 2000 and 2003) and some remnant native scattered paddock trees. Based on the available history and the outcomes of a site visit undertaken by an environmental scientist, no threatened or priority flora species, threatened or priority ecological communities or habitat important for conservation significant fauna species is likely to occur within the site.
- Groundwater monitoring within the site has been used to determine site specific groundwater contours, which show levels vary from 4.4 m AHD in the west to 7 m AHD in the east. Depth to the calibrated maximum groundwater level (MGL) varies from approximately 5.5 m separation at the eastern end of the site near Johnson Road to being at the surface at the western portion of the site.
- Peel Main Drain, a modified drainage canal, is located directly adjacent to the western boundary of the site.
- Based on the *Geomorphic Wetlands of the Swan Coastal Plain*, a multiple use wetland (MUW) (unique feature identification (UFI) 13327) is mapped across the majority of the site. A

conservation category wetland (CCW) (UFI 15866) and a resource enhancement wetland (REW) (UFI 15867) are identified to the north and north-west of the site and are associated with 'Bollard Bulrush Swamp'. These wetlands and their associated buffers do not extend into the site.

- No registered, lodged or historic Aboriginal heritage sites were mapped within or adjacent to the site. The nearest 'Registered Aboriginal Site', Site 3568, is described as a 'Camp' type feature and is located approximately 760 m to the south of the site.
- No non-indigenous heritage sites were identified within the site.
- A small portion of the site (north-western corner) is designated as a bushfire prone area within the state-wide *Map of Bush Fire Prone Areas* (OBRM 2021). Areas of permanent bushfire hazard have been identified to the west and north of the site, associated with the Peel Main Drain and Bollard Bulrush Swamp (and buffer), respectively. Temporary bushfire hazards have been identified to the north associated with the undeveloped portions of Oakebella Estate residential development.

As part of future development, a number of the identified environmental attributes/values will require management to minimise potential impacts in accordance with the relevant federal, state and local requirements. The key requirements of future management for the site as part of subdivision and/or future development are summarised as follows:

- **Acid sulfate soils**: ASS is not considered to pose a significant constraint to the proposed future residential development. It is only likely to require management where services extend below the permanent groundwater table and/or dewatering is required. Given the fill material required across the site to address groundwater levels, services may not be installed below the permanent groundwater table. ASS can be managed in accordance with the WAPC and Department of Water and Environmental Regulation (DWER) guidelines.
- **Flora, vegetation and fauna values**: The site has been historically cleared of native vegetation to support agricultural land uses. Vegetation within the site now comprises of planted windbreak trees and scattered remnant paddock trees amongst areas of pasture grasses. While significant trees have not been identified based on the City's policies, existing trees are still proposed to be retained within the western public open space (POS) area and has been discussed with the City of Kwinana as part of preparing the structure plan. The removal and retention of paddock trees can be appropriately managed through the standard subdivision process.
- **Hydrology**: The overarching objective for the site is to maintain the pre-development hydrological regime and is based on an at source infiltration approach to minimise the potential for nutrient impacts on Bollard Bulrush Swamp. This is further detailed within the Local Water Management Strategy (LWMS) prepared by Emerge Associates (2023). Future development will be supported by an Urban Water Management Plan(s) as per standard planning and development processes.
- **Bushfire risks**: The proposed structure plan layout accommodates the required setbacks (through public roads, public open space or within the lots) to achieve a bushfire attack level (BAL) rating of BAL-29 or less (as per *State Planning Policy 3.7 Planning in Bushfire Prone Areas*). The layout provides for access to multiple destinations based on the connection to Oakebella Estate to the north. A temporary emergency access ways may be required to manage access as part of staged development.

Overall, the environmental attributes and values of the site have been accommodated within the structure plan design (in particular, management of surface water and groundwater, retention of trees where possible and separation from bushfire risks), or can be managed appropriately through the future subdivision and development phases in line with standard subdivision processes (e.g. acid sulfate soils) and the relevant state and local government legislation, policies and guidelines and best management practices.

Table of Contents

1 Introduction 1

1.1 Background 1
1.2 Purpose of this report 1
1.3 Scope of work 1

2 Planning Framework and Proposal 3

2.1 Historic planning context 3
2.2 Proposed structure plan 4
2.3 Future planning approval process 5

3 Existing Environment 6

3.1 General location and site context 6
3.2 Landform and soils 7
3.2.1 Topography 7
3.2.2 Landform, soils and geology 7
3.2.2.1 Regional geology 7
3.2.2.2 Site specific investigations 8
3.2.3 Acid sulfate soils 8
3.3 Biodiversity and natural area assets 9
3.3.1 Flora and vegetation 9
3.3.1.1 Regional context 9
3.3.1.2 Vegetation condition 10
3.3.2 Significant trees 13
3.3.3 Landscape features 13
3.3.3.1 Threatened and priority ecological communities 14
3.3.3.2 Threatened and priority flora 15
3.3.4 Bush Forever 17
3.3.5 Ecological linkages 17
3.3.6 Environmental sensitive areas 18
3.3.7 Terrestrial fauna 18
3.3.7.1 Species of conservation significance 18
3.4 Hydrology 21
3.4.1 Groundwater 21
3.4.2 Surface water 22
3.4.3 Wetlands 23
3.4.4 Public drinking water source area 24
3.5 Heritage 24
3.5.1 Aboriginal heritage 24
3.5.2 Non-Indigenous heritage 24
3.6 Other land use considerations 25
3.6.1 Historic and existing land uses 25
3.6.2 Potential site contamination 25
3.6.3 Surrounding land uses 25
3.7 Bushfire hazard 25
3.8 Summary of relevant environmental factors 27

4 Impact Assessment and Management Approach 29

4.1 Acid sulfate soils 29
4.1.1 Policy framework, site context and management objectives 29
4.1.2 Structure plan layout considerations for acid sulfate soils 29
4.1.3 Future management requirements 29

4.2 Flora and vegetation 30
4.2.1 Policy framework, site context and management objectives 30
4.2.2 Structure plan layout considerations for flora and vegetation 31
4.2.3 Future management requirements 31
4.3 Native fauna 32
4.3.1 Policy framework, site context and management objectives 32
4.3.2 Structure plan layout considerations for terrestrial fauna 32
4.3.3 Future management requirements 32
4.4 Hydrology 33
4.4.1 Policy framework, site context and management objectives 33
4.4.2 Structure plan layout considerations for hydrology 34
4.4.3 Future management requirements 34
4.5 Bushfire management 36
4.5.1 Policy framework, site context and management objectives 36
4.5.2 Structure plan layout considerations for bushfire management 37
4.5.3 Future management requirements 37

5 Implementation Framework 39

6 Conclusions 41

7 References 43

7.1 General references 43
7.2 Online references 47

List of Tables

Table 1: Summary of threatened and priority ecological communities with potential to occur in general area surrounding the site. 15
Table 2: Threatened and priority flora occurring within 5 km of the site based on relevant database searches. 16
Table 3: Threatened and priority fauna occurring within 5 km of the site based on relevant database searches. 19
Table 4: Annual winter peak (mAHD), collected between June 2022 and November 2023 (Emerge Associates 2023c). 22
Table 5: Geomorphic Wetlands of the Swan Coastal Plain management categories (Hill et al. 1996) 23
Table 6: Relevant environmental values/factors and considerations for the site 27
Table 7: Environmental management framework implementation table 39

List of Plates

Plate 1:MRS zones and reserves within and surrounding the site. 4
Plate 2: Vegetation Complex within the site (DBCA 2018b) 9
Plate 3: Scattered trees and planted windbreak trees amongst paddock grasses in the southern portion of the site. 11
Plate 4: Planted windbreak trees amongst paddock grasses throughout the central portion of the site. 11
Plate 5: Planted Agonis flexuosa (P\peppermint) trees amongst paddock grasses and weeds in the northern portion of the site. 12
Plate 6: Rows of Eucalyptus trees in the western portion of the site interfacing with the Peel Main Drain. 12
Plate 7: Areas within and surrounding the site identified as “bushfire prone areas” (as indicated in purple) under the state-wide Map of Bush Prone Areas (OBRM 2021). 26

Figures

Figure 1: Site Location and Topographic Contours
Figure 2: Soil Landscape Features
Figure 3: Acid Sulfate Soil Risk
Figure 4: Geormorphic Wetlands and Hydrological Features
Figure 5: Key Management Considerations

Appendices

Appendix A

Structure Plan

Appendix B

Landscape Design Report

Abbreviation Tables

Table A1: Abbreviations – Organisations

Organisations	
CoK	City of Kwinana
DBCA	Department of Biodiversity Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water (federal)
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
OBRM	Office of Bushfire Risk Management
WALGA	Western Australian Local Government Association
WAPC	Western Australian Planning Commission

Table A2: Abbreviations – General terms

General terms	
AEP	Annual exceedance probability
AHIS	Aboriginal Heritage Inquiry System
ASS	Acid Sulfate Soil
BMP	Bushfire Management Plan
CCW	Conservation category wetland
DWMS	District Water Management Strategy
EAMS	Environmental Assessment and Management Strategy
ESA	Environmentally sensitive area
LWMS	Local Water Management Strategy
MGL	Maximum groundwater level
MUW	Multiple use wetland
P	Priority flora or fauna
PEC	Priority ecological community
PDWSA	Public drinking water source area
PMD	Peel Main Drain
REW	Resource enhancement wetland

Table A2: Abbreviations – General terms (continued)

General terms	
T	Threatened flora or fauna
TEC	Threatened ecological community
UWMP	Urban Water Management Plan
WSUD	Water sensitive urban design

Table A3: Abbreviations –Legislation, policy and guidelines

Legislation	
AH Act	*Aboriginal Heritage Act 1972*
AS 3959	*Australian Standard 3959-2018 Construction of buildings in bushfire prone areas*
BC Act	*Biodiversity Conservation Act 2016*
EP Act	*Environmental Protection Act 1986*
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
LPP No. 1	*City of Kwinana Local Planning Policy No. 1 – Landscape Feature and Tree Retention*
LPP No. 3	*City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan*
PD Act	*Planning and Development Act 2005*
SPP 3.7	*State Planning Policy 3.7 – Planning in bushfire prone areas*

Table A4: Abbreviations – units of measurement

Units of measurement	
ha	hectare
km	kilometre
m	metre
m^2	square metre
m AHD	metres in relation to the Australian height datum
M BGL	metres below ground level

Table A5: Abbreviations – Planning terms

Units of measurement	
LPS	Local Planning Scheme
SP	Structure Plan
SPP	State Planning Policy

1 Introduction

1.1 Background

Wellard Residential Pty Ltd (the proponent) have prepared a structure plan to support residential development within Lot 506 Johnson Road, Wellard (herein referred to as 'the site'). A copy of the proposed structure plan is provided in **Appendix A**. The site is located approximately 38 km south of the Perth central business district (CBD), within the City of Kwinana (CoK). It is approximately 7.85 ha in size and is bounded by Johnson Road and Irasburg Parade to the east (with residential areas further east), residential areas currently under development to the south and north, Peel Main Drain to the west (with residential development further west), and Bollard Bulrush Swamp to the north-west. The location of the site is shown in **Figure 1**.

1.2 Purpose of this report

The purpose of this Environmental Assessment and Management Strategy (EAMS) is to provide a synthesis of information regarding the environmental values and attributes of the site. Specifically, this report:

- Discusses the environmental planning context for the structure plan area (**Section 2**).
- Identifies the existing environmental values and attributes of the site (**Section 3**).
- Discusses how the structure plan layout responds to the existing environmental features and values, and outlines environmental management requirements as part of the future planning and development process (**Section 4**).
- Provides an implementation framework for environmental management requirements as part of the future planning and development process (**Section 5**).

The EAMS is the key supporting environmental document for the structure plan, to ultimately facilitate consideration of relevant environmental issues by the City of Kwinana and various state government agencies and authorities. It is consistent with the requirements for environmental reporting as outlined in the Western Australian Planning Commission's (WAPC) *WA Planning Manual Guidance for Structure Plans* (WAPC 2023b).

1.3 Scope of work

Emerge Associates (Emerge) was engaged by the proponent to undertake an environmental assessment for the site, to understand the existing environmental attributes and values o and ensure any relevant environmental values can be considered and where necessary accommodated within the structure plan. Emerge have conducted a number of site-specific investigations, as well as a comprehensive desktop review and site assessment of the available information on environmental conditions within and surrounding the site. The outcomes of these findings have provided context for the following within the site:

- Landforms, topography and soils
- Flora and vegetation

- Terrestrial fauna
- Hydrology
- Aboriginal and non-indigenous heritage
- Historical and existing land uses within and surrounding the site
- Bushfire hazards.

The site specific investigations undertaken to support the proposed development which include: a *Local Water Management Strategy* (Emerge Associates 2023c), and a *Bushfire Management Plan* (Emerge Associates 2023a). No site-specific vegetation and tree assessment has occurred for the site, however values have been considered based on a detailed desktop assessment and detailed site walkthrough undertaken by an environmental scientist. Due to the historical clearing and lack of native trees occurring across the site and consultation with the City of Kwinana, this approach is considered sufficient.

2 Planning Framework and Proposal

This section outlines the planning framework applicable to the site, and how this informs the structure plan and subsequent development stages including subdivision. The current subdivision process in Western Australia provides a robust framework that enables management of most environmental values.

2.1 Historic planning context

In 2014, Metropolitan Region Scheme (MRS) Amendment 1188/57 for the Wellard Urban East Precinct, which included the site, rezoned approximately 70 ha of land from 'Rural' to 'Urban deferred', retaining the Bollard Bullrush Swamp in the 'Rural' zone. The amendment proposed to delineate the boundary between future urban development and Bollard Bulrush Swamp, which was protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) at the time and mapped as a conservation category wetland (CCW).

As part of this process, MRS amendment 1188/57 was referred to the Environmental Protection Authority (EPA) (in March 2010) and was formally assessed. This assessment provided guidance for the extent of Bollard Bulrush Swamp (UFI 15866) to be retained and protected and the required wetland buffer. The EPA recommended a buffer of 50 metres (m) consistent with the *WAPC draft Guideline for the Determination of Wetland Buffer Requirements* (2005) and the *EPA's Guidance Statement No. 33 Environmental Guidance for Planning and Development* (2008). This has informed the underlying scheme provisions and subsequent local planning polices (discussed further below).

The site was subsequently rezoned from 'Urban Deferred' to its current 'Urban' MRS zoning in 2015 under MRS Amendment 1296/27. The current zoning for the site is shown in **Plate 1.** Upon Gazettal of the urban zone, the site was concurrently zoned 'Development' under the *City of Kwinana Town Planning Scheme No. 2*, by resolution of the WAPC and notice in the Government Gazette.

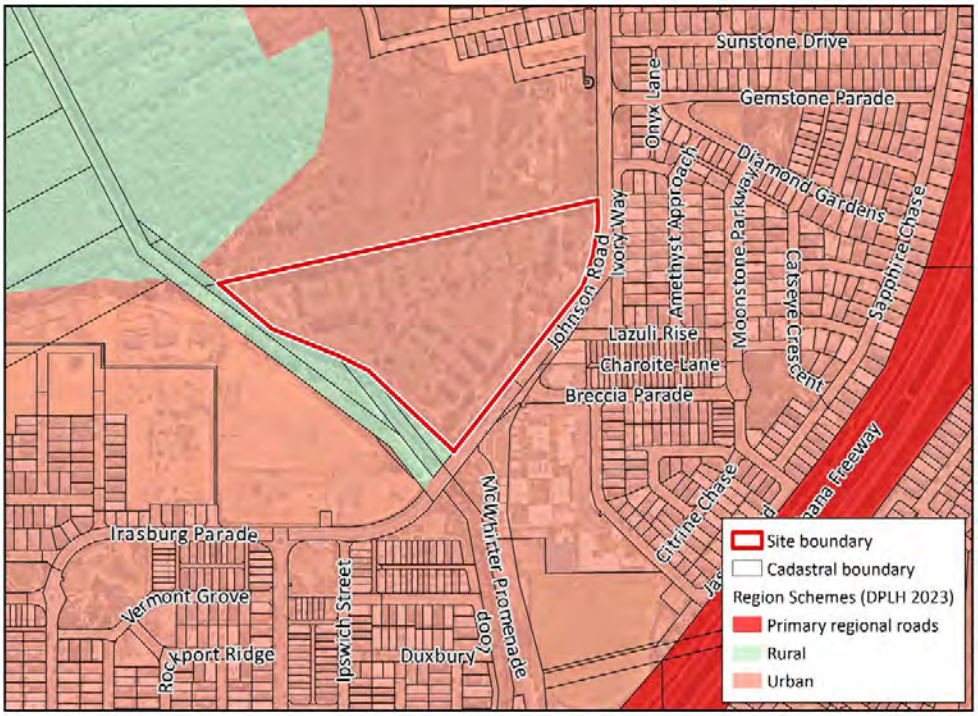


Plate 1:MRS zones and reserves within and surrounding the site.

2.2 Proposed structure plan

As discussed, the site is zoned 'Development' under the *City of Kwinana Town Planning Scheme No. 2* (TPS 2). In accordance with the provisions of the 'Development' zone under the Scheme, a structure plan is required as a precursor to subdivision and development. The proposed structure plan has therefore been prepared in accordance with provisions of Clause 6.17 of the Scheme.

Overall, the proposed structure plan for the site will facilitate the future subdivision and development of the site for residential purposes and is provided in **Appendix A**. The structure plan is intended to support:

- Residential lots of varying density.
- A number of public open space (POS) areas, which will support recreation, stormwater management and the retention of existing trees.
- An interconnected road network with connections to Johnson Road and Irasburg Parade to the east as well as future connections through the adjacent Oakebella Estate to the north of the site.

The proposed structure plan and development has been designed in consideration of various local policies, with the most relevant from an environmental perspective namely:

- *City of Kwinana Local Planning Policy No. 1 -Landscape Feature and Tree Retention (LPP No. 1)* (City of Kwinana 2016). This policy sets out requirements to identify and strategically retain (where possible) significant trees and landscaping features as part of structure planning and future stages of development. Tree retention addressing the policy considerations of *LPP No. 1* are outlined in Section **4.2.2.** *City of Kwinana Local Planning Policy No. 3 – Bollard Bulrush East Landscape Masterplan (LPP No. 3)* (City of Kwinana 2022). This policy provides for an integrated approach to the treatment of the interface for Bollard Bulrush Swamp which intersects with a

number of different structure plan areas. *LPP No.3* applies to all land within the Bollard Bulrush West urban cell zoned 'Development' under the *City of Kwinana Town Planning Scheme No. 2* (*TPS No.2*) which includes the site. The policy is intended to be applied during the preparation and assessment at the local structure planning stage as well as subsequent stages of development.

With regard to Bollard Bulrush Swamp, the proposed structure plan is supported by a Landscape Concept Plan (see **Appendix B**) which outlines the landscape approach. No portion of the site is located within the Bollard Bullrush Swamp CCW or 50 m buffer. The landscape plan identifies social, recreational and drainage facilities within the POS area adjacent to the wetland buffer and is aligned to balance needs of the future residents and the ecological values of the Bollard Bulrush Wetland.

2.3 Future planning approval process

Following the endorsement and approval of the structure plan by the WAPC, urban development of the site would be progressed through subdivision and/or development approvals (collectively referred to as 'future planning stages').

The key environmental values and attributes that require further consideration within the structure plan area and as part of future planning stages have been outlined in **Section 3** and **Section 4** of this report and include:

- Acid sulfate soils
- Flora and vegetation, including tree protection/retention and landscape enhancement
- Native fauna
- Hydrological function associated with groundwater and surface water
- Bushfire risk.

The WAPC can impose conditions on subdivision applications to ensure subdivision incorporates the relevant/appropriate environmental management measures. These conditions are usually determined in accordance with WAPC's *Model Subdivision Conditions Schedule* (WAPC and DPLH 2022) (or as updated) and include those relating to environmental considerations. It is envisaged that there would be future subdivision conditions applied for any subdivision within the site, that would be the mechanism to manage environmental, hydrological and bushfire related requirements identified through the state planning process.

3 Existing Environment

This section describes the environmental characteristics present within the site and considers a range of information sources, including local and regional reports, databases, mapping and site-specific investigations/reporting. Existing investigations that have informed the preparation of this report include (but are not limited to):

- Review of various publicly available databases and information sources.
- Site assessment of conditions.
- *Bushfire Management Plan* (BMP) (Emerge Associates 2023a).
- *Local Water Management Strategy* (LWMS) (Emerge Associates 2023c).

3.1 General location and site context

The site is located within the central-western portion of the Swan Coastal Plain (SCP), approximately 38 km south of the Perth CBD and 2.5 km south-east of the Kwinana Town Centre. The site is within an area which has historically supported agricultural activities and is situated adjacent to a wetland feature known as the 'Bollard Bullrush Swamp'. Based on publicly available historic aerial imagery, clearing of native vegetation occurred across the majority of the site prior to 1953 and further clearing occurring prior to 1965 which removed all remaining native vegetation with exception of a small patch of trees to the central-eastern portion of the site (WALIA 2023). It is understood the site has been utilised for various agricultural land uses; which more recently has included a horse agistment facility. Various shelters and single row windbreak tree plantings that separate cleared paddocks are present across the site.

The land uses surrounding the site include:

- Vacant land to the immediate north of the site which is currently in the process of being developed for residential purposes through implementation of the approved *Lots 503 and 504 Tamblyn Place and Lots 505, 507 and 900 Johnson Road, Wellard Local Structure Plan* (Taylor Burrell Barnett 2016).
- Bollard Bulrush Swamp (UFI 15866) and associated remnant native vegetation to the north and north-west of the site.
- The Peel Main Drain to the west of the site , a Water Corporation drain discharging to the Serpentine River at Kerulup Pool further south. Further to the west of the site is Providence Estate a residential development with ongoing subdivision being progressed.
- Johnson Road/Irasburg Parade and existing urban areas to the east.

3.2 Landform and soils

3.2.1 Topography

A review of the available topographic contours indicates the site has an elevation ranging from around 4 m Australian height datum (mAHD) to 10 mAHD (DoW 2008), with the high point within the road reserves of Johnson Road/Irasburg Parade to the far east of the site. The site has a variation in elevation of approximately six metres, and whilst is predominantly flat, gently increases in slope toward the east of the site. Topographic contours are shown in **Figure 1**.

3.2.2 Landform, soils and geology

3.2.2.1 Regional geology

Landforms and soils influence vegetation types at regional and local scales. The site occurs on the Swan Coastal Plain, which is separated into several broad geomorphic units. These geomorphic units are defined by (McArthur and Bettenay 1974) from west to east as: Quindalup Dunes; Spearwood Dunes; Bassendean Dunes Pinjarra Plain; and Ridge Hill Shelf.

The site is identified within the Bassendean Dunes landform which formed as shoreline deposits and coastal dunes between the Spearwood Dune System and the Pinjarra Plain (Bob Gozard 2007). The system is characterised by dunes consisting of low hills of quartz sand with sandy swamps in depressions (swales) between the dunes.

Within each geomorphic unit, more detailed soil-landform mapping provides regional level assessment for soil resources and offers valuable information for planning and natural resource management. Based on a review of the regional soil mapping (DPIRD 2023), three soil-landform types are identified within the site (as shown in **Figure 2**) and include:

- 'Vasse V9 phase' (211Va__V9) which is identified across the majority of the site and is associated with the low-lying portions of the site. This soil unit is described as '*areas of former swamps which have been artificially drained, with uniform loamy or peaty sands*'.
- 'Bassendean B1 phase' (212Bs__B1) which is identified within the easternmost portion of the site, largely associated with the more elevated area. This soil unit is described as '*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*'.
- Bassendean B2 phase' (212Bs__B2) which is identified within the south-easternmost portion of the site, largely associated with the more elevated area. This soil unit is described as '*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*'.

One (1) soil morphology investigation area from historical DPIRD investigations, which have informed the soil-landscape mapping dataset, occurred approximately 370 m south of the site. These investigations identified WA soil group 444 'pale deep sands' at a depth of 1 m.

3.2.2.2 Site specific investigations

A geotechnical investigation conducted by Geotechnical and Geological Consultants (GGC) (GGC 2022) was undertaken for the site and indicates that the observed subsurface soils generally align with the published regional soil-landscape information (described above).

Geotechnical investigation included excavation of 12 investigative soil pits and 25 cone penetrometer tests. The results indicate that the site predominantly comprises organic silt or organic sand (approximately up to 1.1m) over sand layers which are underlain by clayey soils (generally below approximately 3.2 m). The underlying soils identified during the geotechnical investigation within the site are summarised below (GGC 2022):

- **Fill Sand:** which is described as fine to coarse grained, subangular to subrounded, grey mottled orange, dark grey; trace nonplastic fines. Containing occasional deleterious materials. Present from the ground surface extending to 1.6 m over portions of the site, likely associated with previous buildings.
- **Organic Sand:** which is described as fine to coarse grained, subangular to subrounded, dark grey black, present from the ground surface extending to 0.4 m depth over portions of the site.
- **Organic Silt:** which is described as low plasticity, black mottled dark grey; trace sand, fine to coarse grained, subangular to subrounded. This soil extends to depths of 1.1 m where encountered. It was encountered over the majority of test locations.
- **Clay, sandy clay:** which is described as having low to medium plasticity, black mottled dark grey/yellow/grey-orange. This soil is firm and stiff, generally extending below 3.2 m, and was only encountered in the north and west portions of the site.
- **Silty clay, clay, clayey silt:** which is described as being firm to stiff with a thin layer of sensitive fine-grained material. This soil is encountered from 3.5 m to 4.8 m across portions of the site and is considered possibly diatomaceous.
- **Sand:** which is described as very dense sand typically at depths below 5 m.

3.2.3 Acid sulfate soils

Acid sulfate soils (ASS) is the name commonly given to naturally occurring soils and sediment containing iron sulphide (iron pyrite) materials. In their natural state, ASS are generally present in waterlogged and/or anoxic conditions and do not present any risk to the environment. ASS can pose issues when oxidised, producing sulphuric acid, which can present a range of risks for the surrounding environment, infrastructure and human health.

The Department of Water and Environment Regulation (DWER) provides broad-scale mapping indicating areas of potential ASS risk (DWER 2017a). A review of the DWER mapping indicates that the majority of the site is classified as having a ‘high to moderate risk’ of ASS occurring within 3 m of the natural ground surface, with a small area in the eastern corner of the site classified as having a ‘moderate to low risk’ of ASS occurring within 3 m of the natural ground surface. Both of these areas align with the soil-landscape phases (e.g. Vasse vs Bassendean) described above and are shown in **Figure 3**.

3.3 Biodiversity and natural area assets

3.3.1 Flora and vegetation

3.3.1.1 Regional context

Native vegetation is described and mapped at different scales in order to illustrate patterns in its distribution. At a continental scale, the *Interim Biogeographic Regionalisation of Australia* (IBRA) divides the Swan Coastal Plain into two floristic subregions (Environment Australia 2000). The site is located within the Perth subregion of the Swan Coastal Plain, which is characterised as mainly containing *Banksia* low woodland on leached sands with *Melaleuca* swamps where ill-drained; and woodland of *Eucalyptus gomphocephala* (tuart), *E. marginata* (jarrah) and *Corymbia calophylla* (marri) on less leached soils (Beard *et al.* 2013). This subregion is recognised as a biodiversity hotspot and contains a wide variety of endemic flora and vegetation types.

At a finer scale, native vegetation within the site and adjacent land can be classified based on regional vegetation associations. Vegetation complex mapping undertaken by Department of Biodiversity, Conservation and Attractions (DBCA) (DBCA 2018b) within the Swan Coastal Plain indicates the site is found within the Bassendean Complex-Central and South, the description of which is described as '*Woodland of Eucalyptus marginata – Casuarina fraseriana – Banksia spp. to low woodland of Melaleuca spp. and sedgelands on the moister sites*.' In 2018 (the most recent review publicly available), there was estimated to be 26.87% of the pre-European extent of the Bassendean Complex-Central and South remaining on the Swan Coastal Plain (Government of Western Australia 2018). The mapped extent of this complex is illustrated in **Plate 3**.

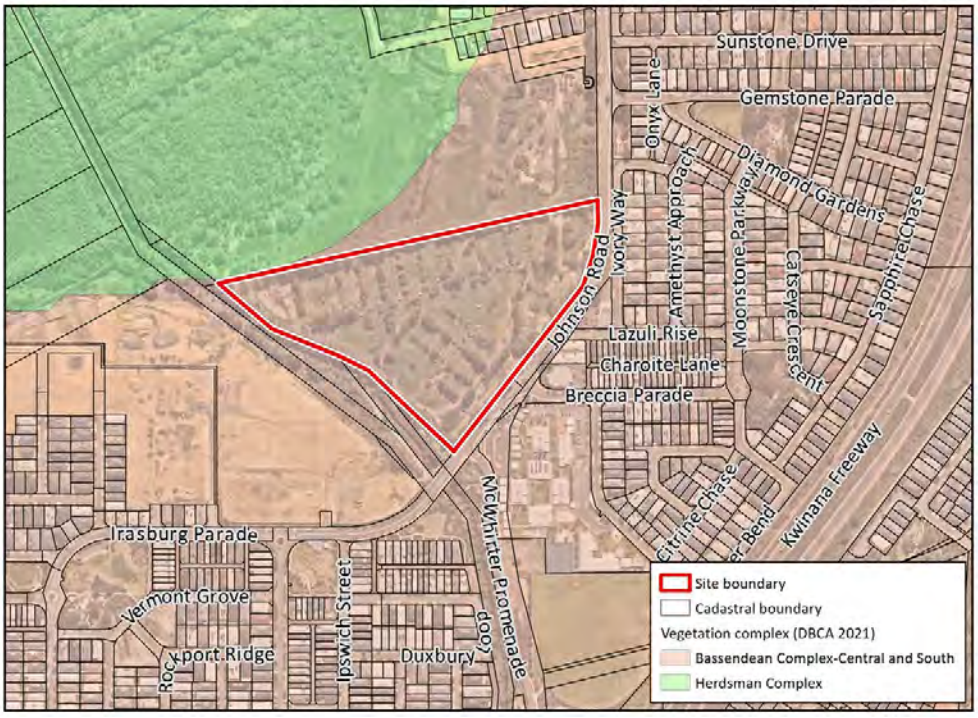


Plate 2: Vegetation Complex within the site (DBCA 2018b)

The EPA'S *Guidance Statement No. 10. Guidance for the Assessment of Environmental Factors – Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal*

Plain Portion of the System 1 Region (EPA 2006) outlines the following objectives for regional vegetation complexes:

- Retain at least 10% of the original extent of vegetation complexes within 'constrained areas', which the EPA (2008) define as '*an area where there is a reasonable expectation that development will be able to proceed. This may include urban, urban deferred or industrial zoned land or land with existing development approvals*.'
- Retain at least 30% of the original extent of vegetation complexes within 'unconstrained areas', the Darling Plateau and rural zoned land of the Peel region.

On the Swan Coastal Plain, which is considered a 'constrained area', the EPA has previously applied an objective of retaining 10% of each vegetation complex (EPA 2006). Based on the 2018 extent, the Bassendean Complex-Central and South remains above the EPA's retention objective.

Intact vegetation determined to be in 'good' or better condition is considered to be representative of the overarching vegetation complex. Based on a detailed walkover assessing conditions within the site, vegetation within the site is no longer representative of the mapped regional vegetation complex. These observations align with the desktop evaluation findings which show extensive historical clearing and planting of non-native windbreak vegetation.

3.3.1.2 Vegetation condition

No site-specific flora and vegetation surveys have been undertaken within the site, however as outlined, a detailed site walkover assessing vegetation identified that the site is predominantly cleared of native vegetation and is composed of planted non-native trees (wind break and shelter plantings) and some scattered native trees remaining amongst extensive areas of paddock grasses and weeds. Examples of the vegetation values within the site are illustrated in **Plate 3, Plate 4, Plate 5** and **Plate 6**. This is consistent with the native vegetation mapping for Western Australia dataset (DPIRD 2020) which identifies no native vegetation within the site.

The site would likely be in a 'completely degraded condition in accordance with the (Keighery 1994) scale. 'Completely degraded' vegetation is described as "*structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs".* The site has been grazed historically (since at least 1953 based on publicly available historic aerial imagery) and lacks an intact native vegetation understorey apart from paddock grasses and weeds. The trees present are predominantly planted non-native species and acted as windbreak and privacy screening for livestock and the previous house structure which is no remains longer within the site.

The vegetation type across the entire site would be described as 'parkland cleared' with windbreak plantings, comprising predominately non- native tree (to Western Australia) species. Some occasional remnant scattered *Eucalyptus rudis* over non-native grassland occur in the central eastern portions of the site, with regrowth flooded gums where the public open space is located.

Plate 3: Scattered trees and planted windbreak trees amongst paddock grasses in the southern portion of the site.

Plate 4: Planted windbreak trees amongst paddock grasses throughout the central portion of the site.

Plate 5: Planted Agonis flexuosa (P\peppermint) trees amongst paddock grasses and weeds in the northern portion of the site.

Plate 6: Rows of Eucalyptus trees in the western portion of the site interfacing with the Peel Main Drain.

3.3.2 Significant trees

The City of Kwinana *LPP No. 1* defines a significant tree as: *"A tree with a diameter at breast height (DBH) of 0.5 metres or greater."* Under *LPP No. 1*, a tree may also be considered as culturally significant if it is: *"A tree which has special significance because of its aesthetic, historic, scientific or social significance."*

As outlined, a desktop assessment and detailed site walkover was undertaken to confirm the nature and extent the of the trees present within the site. Extensive clearing has occurred throughout the entire site since at least the 1950s. This clearing removed all native vegetation from the site with exception of a small patch of scattered trees within the central portion of the site. The site has largely remained free of vegetation until around 2000 when rows of windbreak trees were planted dividing empty paddocks and providing shelter for farm animals housed within the site (WALIA 2023).

The predominant tree species across the majority site were planted non-native (non-native to Western Australia), including:

- *Eucalyptus saligna* (Sydney blue gum);
- *Eucalyptus sideroxylon* (Iron bark);
- *Eucalyptus robusta* (Swamp mahogany); and
- *Eucalyptus camaldulensis* (River redgum).

A number of native tree species including *Agonis flexuosa* (peppermint) and some patches of *Eucalyptus rudis* (flooded gum) were planted within the site or have since regrown. These species were largely present in the western portion of the site interfacing with the Peel Main Drain or Bollard Bulrush Wetland (see **Plate 6** above). While not specifically measured, the majority of the trees were observed to generally have a DBH less than 0.5 m and therefore would not be considered significant trees. This would be reflective of the age of the trees, which are generally around 20 years old.

In consideration of the CoK *Local Planning Policy No.1 – Landscape Feature and Tree Retention*, numerous existing trees within the western most POS have been proposed to be retained. The location for the trees proposed for retention are identified in the Landscape Concept Plan in **Appendix B** and discussed further in **Section 4.2.2.1**. The tree species in this area include planted Eucalyptus species as well as some regrowth *Eucalyptus rudis*. It is noted that due to the servicing and development requirements (including separation to groundwater), fill sand will be required to be introduced across the majority of the site and due to the change in levels existing trees could not be retained. This was discussed with the City of Kwinana as part of consultation for the development. Management of trees identified for retention is considered further in **Section 4.2.2.1**.

3.3.3 Landscape features

In accordance with *LPP No. 1*, a landscape feature is defined as:

"A unique or identifiable feature of the landscape including ridgelines, rocky outcrops, vegetation, creek lines and wetlands."

No unique landscape features were identified during the detailed site walkover or are expected to be present given the historical clearing and recent agricultural land uses for the site. As discussed, the site is not located within the area identified as a CCW or REW or associated wetland buffers.

3.3.3.1 Threatened and priority ecological communities

An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat. An ecological community's structure, composition and distribution are determined by a range of environmental factors such as soil type, position in the landscape, altitude, climate and water availability (DBCA 2020). 'Threatened ecological communities' (TECs) are ecological communities that are recognised as rare or under threat and therefore warrant special protection.

Selected TECs are afforded statutory protection at a federal level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). TECs listed under the EPBC Act are assigned a conservation status and categorised as either 'critically endangered', 'endangered' or 'vulnerable'. Any action likely to have a significant impact on a TEC listed under the EPBC Act (either critically endangered or endangered TECs) requires Ministerial approval.

TECs are also listed within Western Australia under the *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Conservation Regulations 2018 (BC Regulations). Their significance is also acknowledged through other state environmental approval processes such as 'environmental impact assessment' pursuant to Part IV of the *Environmental Protection Act 1986* (EP Act) and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

A plant community that is under consideration for listing as a TEC in Western Australia but does not yet meet survey criteria or has not been adequately defined, may be listed as a 'priority ecological community' (PEC). Listing as a PEC is similarly considered during state approval processes.

A review of the publicly available datasets, NatureMap (DBCA 2023b) and Protected Matters Search Tool (PMST) (DCCEEW 2023), indicates eight (8) known TECs or PECs occur in the general area and are outlined in **Table 1** below.

Table 1: Summary of threatened and priority ecological communities with potential to occur in general area surrounding the site.

Community based on database search	Conservation status	
	State	Federal
Assemblages of plants and invertebrate animals of tumulus (organic mound) springs of the Swan Coastal Plain	-	Endangered
Banksia Woodlands of the Swan Coastal Plain	Priority 3	Endangered
Clay Pans of the Swan Coastal Plain	Vulnerable	Critically Endangered
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Critically Endangered	Endangered
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of the Swan Coastal Plain	Endangered	Endangered
Empodisma peatlands of southwestern Australia	-	Endangered
Sedgelands in Holocene dune swales of the southern Swan Coastal Plain	Critically Endangered	Endangered
Tuart (*Eucalyptus gomphocephala*) Woodlands and Forest of the Swan Coastal Plain	Priority 3	Critically Endangered

While no detailed flora and vegetation surveys have been completed, based on the site conditions (discussed above), no threatened or priority ecological communities would occur within the site given it has remained cleared of native vegetation since the 1960s, apart from planted windbreak trees and scattered paddock trees, dominated by the non-native species described above.

3.3.3.2 Threatened and priority flora

Certain flora species that are considered to be rare or under threat warrant special protection under federal and/or state legislation. At a federal level, flora species may be listed as 'threatened' pursuant to the EPBC Act. Threatened flora species listed under the EPBC Act are assigned a conservation status according to attributes such as population size and geographic distribution. Any action likely to have a significant impact on a listed threatened species under the EPBC Act requires approval from the federal Minister for the Environment.

In Western Australia flora species may also be classed as 'threatened' under the BC Act. Flora species that do not currently meet the criteria for listing as threatened but are potentially rare or threatened may be added to the DBCA *Priority Flora List*. These species are classified into 'priority' levels based on threat. Whilst priority species are not under direct statutory protection, they are considered during state approval processes. It is an offence to 'take' or 'disturb' threatened flora listed under the BC Act without Ministerial approval. Section 5(1)1 of the Act defines to take as including "*… to gather, pluck, cut, pull up, destroy, dig up, remove, harvest or damage flora by any means*" or to cause or permit the same to be done.

To understand the extent of significant flora species that are likely to occur within the local area, searches were undertaken of the DBCA's NatureMap database (DBCA 2022) and the Protected Matters Search Tool database (DCCEEW 2022b). A total of 21 threatened and priority flora species were identified as having potential to occur in the general area. These results are shown in **Table 2**

below. It is important to note that these searches do not take into account the types and conditions of habitat occurring within the site, but are based on the proximity of the site to know occurrences of significant species.

Table 2: Threatened and priority flora occurring within 5 km of the site based on relevant database searches.

Threatened and priority flora species based on database searches	Conservation status		Habitat
	Federal	State	
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	-	Priority 1	Grey or black sand over clay. Swampy areas, winter wet lowlands.
Andersonia gracilis (Slender Andersonia)	Endangered	Threatened	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps
Aponogeton hexatepalus (Stalked water ribbons)	-	Priority 4	Freshwater: ponds, rivers, claypans.
Boronia juncea subsp. juncea	-	Priority 1	Occurs in sand in low scrub.
Caladenia huegelii	Endangered	Threatened	Grey or brown sand, clay loam
Cyathochaeta teretifolia	-	Priority 3	Grey sand, sandy clay. Swamps, creek edges.
Dillwynia dillwynioides	-	Priority 3	Sandy soils. Winter-wet depressions.
Dodonaea hackettiana	-	Priority 4	Sand. Outcropping limestone.
Drakaea elastica (Glossy-leafed Hammer-orchid)	Endangered	Threatened	White or grey sand. Low-lying situations adjoining winter-wet swamps
Diuris micrantha (Dwarf Bee-orchid)	-	Threatened	Winter-wet swamps, in shallow water.
Diuris purdiei (Purdie's Donkey-orchid)	Endangered	Threatened	Grey-black sand, moist. Winter wet swamps
Eleocharis keigheryi (Keighery's Eleocharis)	Vulnerable	Threatened	Clay, sandy loam. Emergent in freshwater: creeks, claypans.
Eucalyptus foecunda subsp. foecunda	-	Priority 4	White, grey, yellow, brown, orange or red sand over limestone. Sand dunes and plains, limestone ridges, cliffs & hills, road verges.
Pimelea calcicole (Coastal Banjine)	-	Priority 3	Sand. Coastal limestone ridges.
Synaphea sp. Fairbridge Farm (D. Papenfus 696).	Critically endangered	Threatened	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses.

Table 2: Threatened and priority flora occurring within 5 km of the site based on relevant database searches.

Threatened and priority flora species based on database searches	Conservation status		Habitat
	Federal	State	
Synaphea sp. Serpentine (G.R. Brand 103)	Critically endangered	Threatened	Grey/brown sandy loams or clay in seasonally wet areas.
Stylidium ireneae	-	Priority 4	Sandy loam in valleys near creek lines, woodland, often with *Agonis*.
Stylidium longitubum (Jumping Jacks)	-	Priority 4	Sandy class, clay. Seasonal wetlands.
Stylidium paludicola	-	Priority 3	Peaty sand over clay in winter wet habitats in Marri and Melaleuca woodland, Melaleuca shrubland.
Thelymitra variegate (Queen of Sheba)	-	Threatened	Sandy clay, sand, laterite.
Verticordia lindleyi subsp. lindleyi	-	Priority 4	Sand, sandy clay. Winter-wet depressions.

As previously outlined, while no detailed flora and vegetation surveys have been completed, based on the observed condition of the site, it is unlikely that any occurrences of threatened or priority flora species identified in the database searches would be found within the site.

3.3.4 Bush Forever

The Government of Western Australia's *Bush Forever Policy* (Government of WA 2000) is a strategic plan for conserving regionally significant bushland within the Swan Coastal Plain portion of the Perth Metropolitan Region. The objective of Bush Forever is to protect comprehensive representations of all original vegetation complexes by targeting a minimum of 10% of each for protection. Bush Forever sites are representative of regional ecosystems and habitat and have a role in the conservation of Perth's biodiversity.

The site contains no Bush Forever sites and no Bush Forever sites have been identified either adjacent or within immediate proximity (DPLH 2019). The nearest Bush Forever site (342) is approximately 550 m to the south west and is separated by existing urban areas.

3.3.5 Ecological linkages

Ecological linkages are areas of native vegetation which provide a corridor or linkage (typically linear) which allow the movement of fauna, flora and genetic material between areas of remnant habitat. This exchange of genetic material between vegetation remnants improves the viability of those remnants by allowing greater access to breeding partners and food sources, refuge from disturbances such as fire and maintenance of genetic diversity of plant communities and populations. Ecological linkages are ideally continuous or near continuous as the more fractured a linkage is, the less ease flora and fauna have in moving within the corridor (Alan Tingay and Associates 1998).

The Perth Biodiversity Project, supported by the Western Australia Local Government Association (WALGA), have identified and mapped regional ecological linkages within the Perth metropolitan

region (WALGA and PBP 2004), which is intended to rate areas based on closeness to areas with existing vegetation cover.

One ecological linkage (Linkage No. 75) (noting these do not have a defined width and are more an indication that the land contains or is in proximity to vegetated areas) is mapped to occur across the southern boundary of the site. The linkage generally extends in an east-west alignment and is associated with areas of native vegetation occurring further south of the site including vegetation within Leda Reserve. The site itself has limited connection to vegetation in the broader area and is considered to provide limited functionality from a linkage perspective due to lack of environmental values.

3.3.6 Environmental sensitive areas

'Environmentally sensitive areas' (ESAs) are prescribed under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 and have been identified to protect native vegetation values of areas surrounding significant, threatened or scheduled flora, vegetation communities or ecosystems. Exemptions under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 do not apply within ESAs. However, exemptions under Schedule 6 of the EP Act still apply, including any clearing in accordance with a subdivision approval under the *Planning and Development Act 2005* (a recognised exemption under the Schedule 6 of the EP Act).

No ESAs occur within the site based upon a review of the *Clearing Regulations – Environmentally Sensitive Areas* dataset (DWER 2023a). The nearest ESA is mapped approximately 35 m north-west of the site and is associated with the Bollard Bulrush Swamp.

3.3.7 Terrestrial fauna

No fauna surveys have been conducted for the site, and consideration of fauna values have been based on the habitat that may be present within the site, which is closely linked with native vegetation extent and condition. As discussed in **Section 3.3.1** the site has been historically cleared of native vegetation and is largely composed of planted windbreak trees separating cleared areas of paddock grasses. The trees are generally less than 500 mm DBH. The site offers very limited and poor quality fauna habitat, particularly when compared to the broader area (within Bollard Bulrush Swamp to the north) which contains extensive areas of intact and connected remnant native vegetation.

3.3.7.1 Species of conservation significance

Fauna species that are considered to be rare or under threat warrant special protection under state and/or federal legislation. At a federal level, fauna species may be listed as 'threatened' pursuant to the EPBC Act and any action likely to have a significant impact on a listed threatened species requires approval from the federal Minister for the Environment.

At a state level, fauna species are listed as 'threatened' under sections 13, 19 and 26(2) of the BC Act. It is an offence to 'take' or 'disturb' threatened fauna without Ministerial approval. In addition to this, the DBCA maintains a list of priority fauna species which, while not considered threatened under the BC Act and therefore not protected directly, involve some concern over their long-term survival.

To understand the extent of significant fauna species that are likely to occur within the local area, searches were undertaken of the DBCA's NatureMap database (DBCA 2023b) and the Protected Matters Search Tool database (DCCEEW 2023). A total of 26 conservation significant species were identified as having potential to occur in the site or local area with the results shown in **Table 3**. It is important to note that these searches do not take into account the types and condition of fauna habitat occurring on the site, but are based on the proximity of the site to known occurrence of significant species. Comments on likelihood of occurrence have been provided in **Table 3**.

Table 3: Threatened and priority fauna occurring within 5 km of the site based on relevant database searches.

Species		Conservation status		Likelihood to be present based on habitat within the site
Common name	Scientific name	State	Federal	
Birds				
Australasian Bittern	*Botaurus poiciloptilus*	Endangered	Endangered	No
Australian Fairy Tern	*Sternula nereis nereis*	Vulnerable	Vulnerable	No
Australian Painted-snipe	*Rostratula australis*	Endangered	Endangered	No
Baudin's Cockatoo	*Calyptorhynchus baudinii*	Endangered	Endangered	Possible. Isolated individuals of *Eucalyptus rudis* are unlikely to provide significant roosting or breeding habitat give the tree sizes.
Blue-billed duck	*Oxyura australia*	Priority 4	-	Unlikely. No permanent vegetated lakes occur within the site
Carnaby's cockatoo	*Calyptorhynchus latirostris*	Endangered	Endangered	Possible. Isolated individuals of *Eucalyptus rudis* are unlikely to provide significant foraging, roosting or breeding habitat and would be less than 1 ha.
Curlew Sandpiper	*Calidris ferruginea*	Critically endangered	Critically endangered and migratory	No
Eastern Curlew	*Numenius madagascariensis*	Critically endangered	Critically endangered and migratory	No
Forest Red-tailed Black Cockatoo	*Calyptorhynchus banksii naso*	Vulnerable	Vulnerable	Possible. Isolated individual *Eucalyptus rudis* are unlikely to provide significant roosting or breeding habitat given the tree sizes.
Fork-tailed Swift	*Apus pacificus*	Migratory	Migratory	Possible. May occur in airspace over the site or in transit whilst in search of prey.
Grey wagtail	*Motacilla cinereal*	Migratory	Migratory	No

Table 3: Threatened and priority fauna occurring within 5 km of the site based on relevant database searches. (continued)

Species		Conservation status		Habitat likely to be present within the site
Common name	Scientific name	State	Federal	
Birds (continued)				
Osprey	*Pandion haliaetus*	Migratory	Migratory	No
Painted snipe	*Rostratula benghalensis (sensu lato)*	-	Endangered	No
Pectoral Sandiper	*Calidris melanotos*	Migratory	Migratory	No
Peregrine falcon	*Falco peregrinus*	Other specially protected	-	Possible. May fly over site in search of prey.
Rainbow Bee-eater	*Merops ornatus*	Migratory	Migratory	Habitat widespread in region.
Red Knot	*Calidris canutus*	Endangered	Endangered and migratory	No
Sharp-tailed Sandpiper	*Calidris acuminata*	Migratory	Migratory	No
Red-necked stint	*Calidris ruficollis*	Migratory	Migratory	No
Mammals				
Chudtich	*Dasyurus geoffroii*	Vulnerable	Vulnerable	No. Is reliant on large patches of connect vegetation.
Water Rat	*Hydromys chrysogaster*	Priority 4	-	Unlikely. No permanent lakes occur within the site.
Quenda	*Isoodon obesulus fusciventer*	Priority 4	-	Unlikely. Is reliant on dense understory vegetation which doesn't occur within the site.
South-western brush-tailed phascogale, wambenger	*Phascogale tapoatafa wambenger*	Critically endangered	-	Unlikely. Is reliant on intact forest or woodland vegetation which does not occur within the site.
Tammar wallaby	*Notamacropus eugenii derbianus*	-	Priority 4	Unlikely. Only one record is present within 5km of the site. The species Is reliant on intact sclerophyll forest or coastal scrub vegetation which doesn't occur within or nearby the site.
Western Ringtail Possum	*Pseudocheirus occidentalis*	Critically endangered	Critically endangered	Unlikely. Western ringtail possum are restricted to the southern portions of the Swan Coastal Plain and lower South West region. Vegetation within the site does not contain preferred habitat in any density that would support a home range for the species.

Table 3: Threatened and priority fauna occurring within 5 km of the site based on relevant database searches. (continued)

Species		Conservation status		Habitat likely to be present within the site
Common name	Scientific name	State	Federal	
Invertebrate/other				
Carters freshwater mussel	*Westralunio carteri*	Vulnerable	Vulnerable	No. A waterway or water body with water year round is not identified within the site.
Black-striped snake	*Neelaps calonotos*	Priority 3	-	Unlikely. Associated with Banksia woodlands (not present) and sandy areas.
Graceful sunmoth	*Synemon gratiosa*	Priority 4	Endangered	Unlikely. Associated with Banksia woodlands and Coastal heathlands which provide host plants for the species. The site is not associated with either of these habitat types.

With regard to black cockatoos, the site is partly mapped within the buffer for a known roosting site for Carnaby's Black Cockatoo (DBCA 2019), and therefore they may occur within the site or nearby. Emerge Associates identified that the planted rows of trees and scattered paddock trees within the site (predominantly *Eucalypt spp.*) would be unlikely to provide important habitat for the three black cockatoo species given they are predominantly non-native species and the trees are not advanced to a stage likely to support breeding.

Current distribution of western ringtail possum is considered to be restricted to areas south of Dawesville, with main populations occurring between Binningup and Dunsborough (E. Shedley and Williams 2014). Given the site is outside of the current distribution range for western ringtail possum and the lack of understorey and connectivity between the scattered paddock trees found within the site, it is considered unlikely that western ringtail possums would be present.

The site is considered to have overall low biodiversity value from a fauna perspective due to the lack of native vegetation within the site, when compared to surrounding remnant vegetation within Bollard Bulrush Swamp, particularly given the lack of understorey and connectivity between the planted windbreak trees and scattered remnant native trees. Whilst fauna can exist in areas of poor quality vegetation, the fauna identified in the searches are typically associated with intact habitat and therefore based on the fauna habitat values identified within the site are likely restricted to more common and/ or avian species.

3.4 Hydrology

3.4.1 Groundwater

A review of the Water Register (DWER 2023b) indicates the site is found within the 'Jandakot' groundwater area. This groundwater area is composed of three aquifers, the superficial Swan (unconfined), Leederville (confined) and the Yarragadee North (confined).

Five groundwater monitoring bores were installed in June 2022 and have been subject to a levels monitoring program by Emerge Associates from June to November in both 2022 and 2023. The location of the bores is shown in **Figure 4**, and includes two wells made available from the development to the north. The monitoring results are outlined in **Table 4**.

The maximum groundwater level (MGL) throughout the site occurred from months July to August and varied from 3.75 to 6.12 mAHD. When compared to ground surface levels, results suggest that groundwater may be located close to the surface (particularly during winter) across the majority of the western portion of the site and be 5.5 m below the surface at Johnson Road.

The maximum groundwater level (MGL) contours have been determined for the site by calibrating the measured maximum level to the nearest regional DWER bore (ID 61410095) and are shown in **Figure 4**. They indicate maximum groundwater level contours vary from 4.4 m AHD in the west to 7 m AHD in the east. Depth to the calibrated maximum groundwater level (MGL) varies from approximately 5.5 m separation at the eastern end of the site near Johnson Road to being at the surface at the western portion of the site.

The proponent has secured a groundwater allocation of 43,500 kL/year from the Superficial Swan to support irrigation within the site.

Further information pertaining to groundwater conditions within the site can be found within the Local Water Management Strategy (Emerge Associates 2023c).

Table 4: Annual winter peak (mAHD), collected between June 2022 and November 2023 (Emerge Associates 2023c).

Monitoring location (Bore ID)	Depth to groundwater (mAHD)											
	June		July		August		September		October		November	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
MB01	4.26	4.29	4.3	4.41	4.66	4.42	4.53	4.40	4.40	4.29	4.25	
MB02	4.17	4.17	4.2	4.31	4.69	4.34	4.44	4.29	4.32	4.23	4.19	4.02
MB03	4.46	4.44	4.54	4.67	5.3	4.85	4.96	4.75	4.83	4.68	4.83	4.49
MB04	4.76	4.73	4.77	4.89	5.4	4.98	5.16	4.88	5.02	4.82	5.02	4.64
MB05	5.03	5.05	5.14	5.29	6.12	5.51	5.71	5.43	5.53	5.35	5.53	5.13
MB-1		4.35	4.38	4.46	4.62	4.46	4.58		4.58	4.36	4.31	3.75
MB-2			4.51		4.9		4.75		4.75		4.48	

Highlighted values – Indicates the groundwater level monitoring round where the annual winter peak was recorded. Black cells – Indicate that groundwater level could not be obtained as wells were inaccessible.

3.4.2 Surface water

The site is located within the Serpentine River catchment, which drains to the south-east before meeting the Peel-Harvey estuary further south. A review of the DWER *Hydrography Linear dataset* indicates the presence of the perennial Bollard Bulrush Swamp (discussed previously and below) which has a 'subject to inundation' buffer placed around it that covers the majority of the site. This would correlate with the observation of groundwater at the surface during winter.

The Peel Main drain is located adjacent to the western boundary of the site and is managed by the Water Corporation. The Peel Main Drain flows through the Bollard Bulrush Swamp in a southerly direction connecting to the Serpentine River and discharges to the Peel-Harvey estuary. Surface water flows from the site with discharge to the Peel Main Drain.

3.4.3 Wetlands

Wetlands are areas which are permanently, seasonally or intermittently waterlogged or inundated with water. Naturally occurring wetland features are common across the Swan Coastal Plain and can contain fresh or salty water, which may be flowing or still. Wetlands can be further categorised based on their hydrological characteristics and physical structure.

A review of the Ramsar sites dataset (DBCA 2017) indicates that no Ramsar wetlands are located within or nearby the site.

At a state level, the location, mapped boundaries and management categories of wetlands across the Swan Coastal Plain were originally identified in the *Wetlands of the Swan Coastal Plain: Wetland Mapping, Classification and Evaluation* (Hill et al. 1996). This information was subsequently converted into the publicly available *Geomorphic Wetlands of the Swan Coastal Plain* database, which is maintained by the DBCA. The management categories of wetlands are conservation, resource enhancement and multiple use, and are detailed in **Table 5**.

Table 5: Geomorphic Wetlands of the Swan Coastal Plain management categories (Hill et al. 1996)

Management category	Description of wetland	Management objectives
Conservation (CCW)	Support high levels of attributes	Preserve wetland attributes and functions through reservation in national parks, crown reserves and state-owned land. Protection provided under environmental protection policies.
Resource Enhancement (REW)	Partly modified but still supporting substantial functions and attributes	Restore wetland through maintenance and enhancement of wetland functions and attributes. Protection via crown reserves, state or local government owned land, environmental protection policies and sustainable management on private properties.
Multiple Use (MUW)	Few wetland attributes but still provide important hydrological functions	Use, development and management considered in the context of water, town and environmental planning through land care.

Based on the *Geomorphic Wetlands of the Swan Coastal Plain* mapping (DBCA 2023a), a multiple use wetland (MUW) (unique feature identification (UFI) 13327) is mapped across the majority of the site.

To the north of the site, a conservation wetland (CCW) (UFI 15866) and resource enhancement wetland (REW) (UFI 15867) have been identified and are associated with 'Bollard Bulrush Swamp' (as discussed in **Section 2.1**). Neither the CCW or REW (or potential buffers) extend within the site. The existing geomorphic wetland mapping is shown in **Figure 4**.

It is noted that the *Geomorphic Wetlands of the Swan Coastal Plain* (DBCA 2023a) wetland boundary varies slightly from the wetland boundaries specified by the Bollard Bulrush Landscape Masterplan identified in the CoK *Local Planning Policy No. 3* (LPP. No 3) (City of Kwinana 2022). The boundary within LPP. No. 3 represents the agreed boundary through the scheme amendment process

(discussed in **Section 2.1**) and is shown in **Figure 4** as 'core wetland' and 'wetland buffer'. These are the wetland and buffer extents relevant for the development of the structure plan.

3.4.4 Public drinking water source area

Public drinking water source areas (PDWSAs) are proclaimed by the DWER to protect identified drinking water sources, including surface water and groundwater sources (DoW 2009). They are proclaimed under the *Metropolitan Water Supply, Sewerage and Drainage Act 1909* or the *Country Areas Water Supply Act 1947* as Water Reserves, Catchment Areas or Underground Water Pollution Control Areas. PDWSAs provide the population with the majority of its drinking water supplies and can be vulnerable to contamination from a range of land uses. Once an area is identified as a PDWSA, consideration needs to be given to the intended land use and associated activities to ensure that they are appropriate in meeting the water protection quality objectives of the area.

The site is not within or in proximity to a PDWSA or wellhead protection zone. The nearest PDWSA is approximately 2.9 km to the north east of the site (DWER 2020b).

3.5 Heritage

3.5.1 Aboriginal heritage

The Aboriginal Heritage Inquiry System (AHIS) is maintained pursuant to Section 38 of the *Aboriginal Heritage Act 1972* (AH Act) by the Department of Planning, Lands and Heritage, containing information on registered, lodged or historic Aboriginal Heritage Sites and Heritage Places throughout Western Australia. In accordance with the *Aboriginal Heritage Act 1972 Guidelines November2023* (DPLH 2023) a search of the AHIS online database (DPLH 2023a) was undertaken.

No registered, lodged or historic Aboriginal Heritage Sites or Aboriginal Heritage Places have been identified within or adjacent to the site. A 'Registered Aboriginal Site', Site: 3568, described as a 'Camp' is located approximately 760 m to the south of the site.

3.5.2 Non-Indigenous heritage

In order to determine the actual or potential presence of sites or features of non-indigenous heritage significance within the site, a review of readily available information at a federal, state and local government level was undertaken to determine if any of the following occur within the site:

- World Heritage Sites.
- National Heritage Places.
- Commonwealth Heritage Places.
- Sites listed in the State Register of Heritage Places.

A search of the State Heritage Office database, which includes state and local lists (Heritage Council WA 2022) and the Australian Heritage Database, which includes the National and Commonwealth Heritage Lists (DCCEEW 2022a), indicates that the site and adjacent areas do not contain any non-indigenous heritage sites.

3.6 Other land use considerations

3.6.1 Historic and existing land uses

As outlined previously a review of available historical aerial imagery indicates that a majority of the site was cleared of native vegetation prior to 1953. The site has been used for grazing and horse agistment. No significant excavation or similar was observed in available aerials, nor visible based on current land form features. Houses and sheds previously present within the site were removed between 2015 and 2018 based on historic aerials.

3.6.2 Potential site contamination

A review of the DWER *Contaminated Sites Database* (DWER 2022) indicates that the site is not registered as a contaminated site pursuant to the *Contaminated Sites Act 2003*, nor are any other registered sites located nearby. In addition, a review of the Department of Defence Unexploded Ordinance (UXO) search tool did not identify any potential risk of UXO occurring within the site (Department of Defence 2022).

The historic agricultural (grazing) land use across the site is not identified as a potentially contaminating land use, and therefore in accordance with *Assessment and management of contaminated sites: Contaminated sites guidelines* (DER 2014), is not considered to represent any significant risk of potential for contamination within the site.

3.6.3 Surrounding land uses

As outlined in **Section 3.1**, a review of surrounding land uses and observations during the site visit indicate the land uses surrounding the site include residential development (i.e. public open space, footpaths, roads, dwellings, commercial enterprises to the north-east, east, south and west, with a wetland feature (Bollard Bulrush Swamp) with extensive areas of native vegetation present to the north. None of these land uses raise concerns with regard to potential impacts on amenity (noise, vibration, odour, dust etc.) either from or on the proposed development. Any potential amenity impacts during construction can be managed through the subdivision process and would be typical for residential development.

3.7 Bushfire hazard

The a small portion of the site is designated bushfire prone under the *Map of Bush Fire Prone Areas* (OBRM 2021), as shown in **Plate 7**. This area generally aligns with the location of the proposed western POS area.

A *Bushfire Management Plan* (BMP) (Emerge Associates 2023a)has been prepared in conjunction with the structure plan to support the proposed development and considers the potential mitigation and management of the bushfire risks to the site in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015a) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.4* (the Guidelines) (DPLH & WAPC 2021).

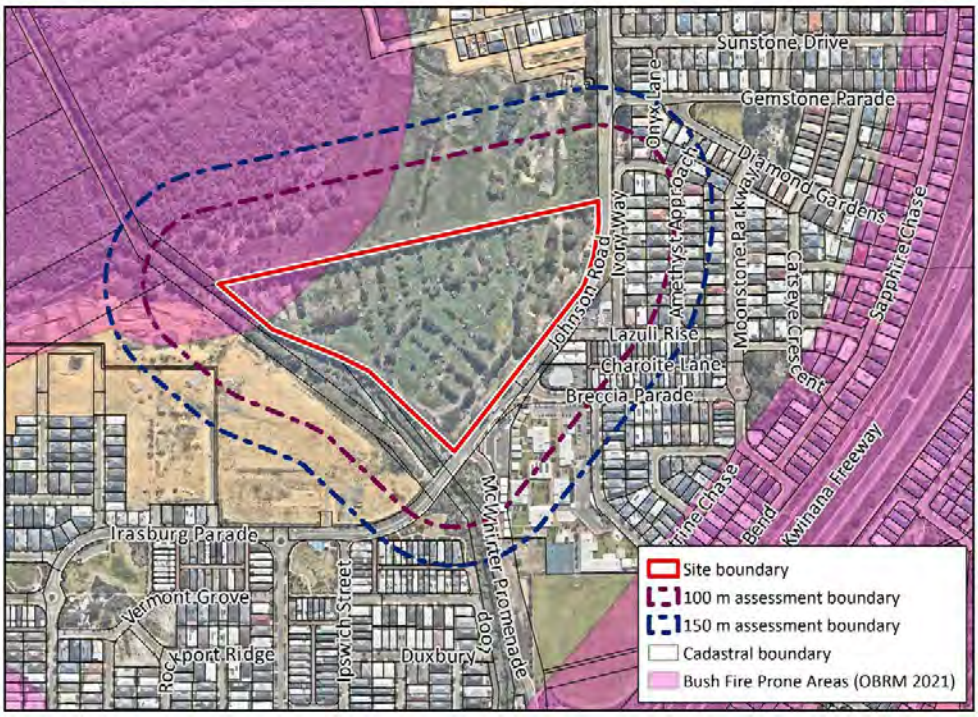


Plate 7: Areas within and surrounding the site identified as "bushfire prone areas" (as indicated in purple) under the state-wide Map of Bush Prone Areas (OBRM 2021).

In accordance with SPP 3.7 and the Guidelines. Bushfire hazards within and/or nearby to the site post development have been identified in accordance with *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2018). The areas of bushfire hazard include:

- Temporary grassland vegetation, identified to the north of the site, associated with the Oakebella Estate development that is under construction.
- Woodland and scrub vegetation within the Peel Main Drain reserve to the west of the site. This vegetation is a narrow strip but is connected to Bollard Bulrush Swamp.
- Forest vegetation to the north of the site associated with Bollard Bulrush Swamp (the core wetland) and the anticipated revegetation of the associated wetland buffer area.

The identification of bushfire hazards within 100 m of the site means bushfire attack level (BAL) ratings are likely to apply to the site, and the structure plan layout and development process will need to consider how appropriate separation can be provided. This is discussed further in **Section 4.6**.

3.8 Summary of relevant environmental factors

Table 6 provides a summary of the environmental values/factors that have been investigated for the site and outlines those that will require further specific consideration (and management) as part of future development within the site, and if applicable these are discussed further in **Section 4**.

Table 6: Relevant environmental values/factors and considerations for the site

Environmental value/factor	Relevant considerations
Landform and soils	Regional ASS risk mapping indicates the majority of the site is mapped as having a 'high to moderate' risk of ASS occurring within 3 m of the natural soil surface. The management of ASS as part of the development process is addressed in **Section 4.1**.
Flora and vegetation	No conservation significant flora and vegetation values have been identified within the site. However, the retention of trees and improvement of vegetation values within the site is a relevant consideration and is addressed further in **Section 4.2**.
Ecological linkages	A portion of a regional ecological linkage has been identified across the southern boundary of the site. The site itself has limited connection to vegetation in the broader area and is considered to provide limited functionality from a linkage perspective due to lack of environmental values. No further consideration of this factor is required as part of this EAMS.
Environmentally sensitive areas (ESAs)	There are no ESAs mapped as being present within the site or surrounding land. Development within the site is not proposed to impact on any identified ESAs, and accordingly no further consideration of this factor is required as part of this EAMS.
Terrestrial fauna	The site is predominantly cleared of native vegetation and comprises rows of planted trees and scattered paddock trees amongst cleared areas. Accordingly, the site has low fauna habitat value and is unlikely to impact conservation signification fauna species. However, as common fauna species may be present, management of fauna and improvement of habitat values is addressed further in **Section 4.3**.
Groundwater	Groundwater monitoring results indicate groundwater is close to the surface throughout the western portions of the site with the depth ranging between 3.75 to 6.12 mAHD. Management of groundwater is considered as part of the LWMS (Emerge Associates 2023b) and is discussed further in **Section 4.5.**
Surface water	No surface water features are within the site (except for wetlands, discussed below). Stormwater within the site is currently generally directed towards the west and the Peel Main Drain. Management of flooding and stormwater will be a consideration for future development and is discussed further in the LWMS (Emerge Associates 2023b) and summarised in **Section 4.5.**
Wetlands	A MUW wetland feature occurs within the western portion of the site. This wetland feature has not been identified as requiring retention or specific protection. The nearby CCW and REW (and associated buffers) do not extend into the site. Therefore, management or conservation or buffer values is are not relevant. The hydrological function of the MUW feature will need to be considered/maintained and is discussed further in the LWMS (Emerge Associates 2023b) and summarised **Section 4.5**.
Public Drinking Source Areas (PDWSA)	The site is not located within a PDSWA nor are there any wellhead protection zones in the vicinity of the site, and accordingly no further consideration of this factor is required as part of this EAMS.

Table 6: Relevant environmental values/factors and considerations for the site (continued).

Environmental value/factor	Relevant considerations
Aboriginal heritage	No registered, lodged or known historic Aboriginal sites were identified within the site. The nearest registered site (Site: 3568) has been identified 760m to the south and is described as a 'Camp'. Under the *Aboriginal Heritage Act 1972*, all Aboriginal sites are protected whether they are known or not. Therefore, as part of future ground disturbing activities, if Aboriginal artefacts or sites (not previously identified) are uncovered, works will need to cease and a suitably qualified expert be brought in to survey the potential site, with additional consent pursuant to the *Aboriginal Heritage Act 1972* sought if necessary. This can be managed throughout the standard development process. No further consideration is required as part of this EAMS.
Non-indigenous heritage	No non-indigenous heritage values have been identified within, or in close proximity to the site and therefore no further consideration of the factor is provided as part of the EAMS.
Historical and existing land uses	The site has been identified to have historically been used for agricultural land uses including grazing and horse agistment which hare low risk activities. No further consideration of this factor is provided as part of this EAMS.
Potential site contamination	No registered contaminated sites were identified within or in proximity to the site, and previous land uses are not likely to have resulted in contamination. No further consideration of this factor is required as part of the EAMS.
Bushfire hazard	The site is identified as bushfire prone by the *Map of Bush Fire Prone Areas* (OBRM 2021), and classified vegetation has been identified nearby to the site (Emerge Associates 2023a). Management of these hazards is further considered in the BMP and summarised **Section 4.6**.

4 Impact Assessment and Management Approach

This section outlines spatial layout considerations that should be (or have been) accommodated within the structure plan to respond to the relevant environmental attributes and values within the site, as well as any future environmental management requirements that will need to be accommodated within future planning and development stages. Only those environmental values and attributes that require specific consideration based on their presence within the site, and/or the applicable legislation and policy requirements have been included in this section (as summarised in **Table 6**).

4.1 Acid sulfate soils

4.1.1 Policy framework, site context and management objectives

The DWER, through the WAPC, ensures ASS are adequately managed during the land use planning and development process. The objective of the DWER's ASS policy framework is to manage ASS appropriately to prevent the release of metals, nutrients and acidity into the soil and groundwater system that may adversely affect the natural and built environment and human health.

The DWER mapping indicates that the majority of the site is classified as having a 'high to moderate risk' of ASS occurring within 3 m of the natural soil, with a small area in the eastern portion of the site classified as having 'moderate to low risk', of ASS occurring within 3 m of the natural soil surface. This is shown within **Figure 3.**

The principal management objective for ASS within the site is to ensure that any future development that may disturb ASS is appropriately managed to avoid impacts on the environment.

4.1.2 Structure plan layout considerations for acid sulfate soils

ASS management does not require any spatial consideration within the structure plan, and any ASS risk can be appropriately managed through the future development process.

4.1.3 Future management requirements

While the risk of ASS is 'high to moderate' within the site, ASS is only likely to be a consideration if excavation (primarily for services) extends below the permanent groundwater table and or dewatering is required.

Once detailed earthworks designs and depths of trenching/excavation are known, and therefore the likelihood of disturbance below 3 m of the natural soil as part of the construction process is known, an investigation to determine the actual presence of ASS can be undertaken. If ASS is likely to be disturbed due to the proposed works an ASS and dewatering management plan (ASSDMP) can be prepared and implemented to support future subdivision or development.

This is addressed through the subdivision process as a standard consideration. For subdivision applications where the subject land is identified as having a high to moderate risk of ASS occurring

within 3 m of the natural soil surface (based on regional ASS risk mapping), the WAPC typically imposes model subdivision condition EN8 (WAPC and DPLH 2022) which states:

"An acid sulphate soils self-assessment form and, if required as a result of the self-assessment, an acid sulphate soils report and an acid sulphate soils management plan shall be submitted to and approved by the Department of Water and Environmental Regulation before any subdivision works or development are commenced. Where an acid sulphate soils management plan is required to be submitted, all subdivision works shall be carried out in accordance with the approved management plan. (Department of Water and Environmental Regulation)"

The requirement for further ASS management will be confirmed and managed in accordance with any subdivision conditions as part of detailed design.

4.2 Flora and vegetation

4.2.1 Policy framework, site context and management objectives

In the context of environmental impact assessment (and applied to the land use planning process), the EPA objective for flora and vegetation is '*to protect flora and vegetation so that biological diversity and ecological integrity are maintained*' (EPA 2016). Where a proposal may potentially impact upon flora and vegetation values, the following mitigation hierarchy should be applied to minimise potential impacts:

1. Avoid impacts
2. Minimise impacts
3. Offset impacts.

The City of Kwinana also identifies objectives for the retention and enhancement of significant trees and landscape features through LPP No. 1. As outlined in **Section 3.3.2**, significant trees are defined as *"a tree with a diameter at breast height (DBH) of 0.5 metres or greater".* Under LPP No. 1, a tree may also be considered as Culturally significant if it is: *"A tree which has special significance because of its aesthetic, historic, scientific or social significance."*

The site is largely cleared of remnant native vegetation and is composed of non-native grasses/weeds with windbreak plantings (predominantly non-native Eucalypt species) and a number of scattered remnant native trees (predominantly *Eucalyptus rudis*). No vegetation within the site has been identified as containing conservation significant values (i.e. TEC or threatened flora) given the highly disturbed nature of the site and no significant trees as defined by LPP No. 1 have been identified (with trees generally around 20 years old).

The objective for future management of flora and vegetation within the site will be principally focused around maximising the retention of existing trees within public open space areas which will be subject to future detailed design. This will need to be balanced with the significant sand fill required across the site to address hydrological and engineering considerations.

4.2.2 Structure plan layout considerations for flora and vegetation

The spatial layout of the structure plan has considered the CoK LPP No. 1 with the POS located to maximise retention of existing trees, which are a mix of planted non-native trees and regrowth natives (Eucalyptus rudis) which have grown in the last 20 years. This was discussed with the City of Kwinana as part of consultation for the structure plan. Locations of trees to be retained (where possible, subject to detailed design) are shown in **Figure 5**.

Due to the civil engineering requirements, which require changes in levels and the importation of fill, it is not possible to retain all trees throughout the site.

4.2.3 Future management requirements

Planted and/or remnant scattered paddock trees proposed to be retained within the westernmost POS area (where possible, subject to detailed design), are shown in **Figure 5**. Retained trees will be protected as part of future development.

It is expected a tree protection zone (TPZ) will be defined and maintained for the duration of the works surrounding any retained trees, ven though none of the trees are currently identified as 'significant trees' as per LPP No.1. This is a requirement of LPP No.1, to ensure the appropriate protection of retained vegetation. Within the TPZ tree protection measures should include:

- Retaining the existing ground levels,
- Limit excavations and ground disturbance,
- Monitoring tree health and structure during works.

Where works are proposed within the TPZ, activities should be supervised and documented by a suitably qualified arborist in keeping with the Australian Standard (AS) 4970-2009 '*Protection of Trees and Development Sites*'. Where canopy pruning is required for retained trees, all works should be completed in accordance with AS 4373-2007 'Pruning of Amenity Trees' by a suitably qualified arborist.

Furthermore, extensive new planting will occur within the proposed POS areas which based on the current landscape concept plan (**Appendix B**) which will contain overstorey tree species over grass/low planting and occasional shrubs. This area will be sued for a mix of recreation and drainage purposes.

It is expected that a number of future subdivision approval conditions will ensure protection of the remnant vegetation proposed for retention, including model subdivision condition EN1 and EN2 (WAPC and DPLH 2022), which requires:

EN1 - Prior to the commencement of subdivisional works a foreshore/ environmental/ bushland/tree/ wetland/wildlife protection [DELETE AS APPLICABLE] management plan for [INSERT VALUE] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. Department of Water and Environmental Regulation) OR (Local Government) OR (Department of Biodiversity, Conservation and Attractions) [DELETE AS APPLICABLE]

EN2 - Prior to the commencement of subdivisional works, measures being taken to ensure the identification and protection of any vegetation on the site worthy of retention that is not impacted by subdivisional works, prior to commencement of subdivisional works. (Local Government)

This is also addressed through the application of LPP No. 1.

4.3 Native fauna

4.3.1 Policy framework, site context and management objectives

In the context of environmental impact assessment (and applied to the land use planning process), the EPA's objective for terrestrial fauna is *'to protect fauna so that biological diversity and ecological integrity are maintained' (EPA 2016).* The application of the mitigation hierarchy should be applied to avoid or minimise impacts to terrestrial fauna where possible.

The EPBC Act also provides protection for listed 'threatened' species, including black cockatoos. Any proposed action which is considered likely to result in a 'significant' impact upon these species, which are identified as Matters of National Environmental Significance (MNES), should be referred to the Commonwealth Department of Agriculture, Water and Environment (DAWE). The habitat within the site is not significant and EPBC Act requirements are highly unlikely to be relevant.

While conservation significant fauna species are known to occur in the broader area, none are likely to utilise the site to any important or significant level given appropriate habitat is generally not present (e.g. completely degraded vegetation condition, predominantly non-native species and the general age of the trees that are present e.g. around 20 years old).

The management objective for fauna within the site will be principally focused around maximising retention of existing vegetation values within public open space and ensuring development works are undertaken in a manner that minimises harm to native fauna.

4.3.2 Structure plan layout considerations for terrestrial fauna

As per **Section 4.2**, the spatial layout of the structure plan has considered LPP No.1 with the POS located to maximise tree retention. The POS area is located in proximity to Bollard Bulrush Swamp and the proposed buffer area that will be revegetated. The interface between the POS and wetland buffer can be designed sensitively to maximise habitat connection, with additional planting proposed which will enhance the structure and quality of fauna habitat available within the site.

4.3.3 Future management requirements

The location of proposed public open space areas within the site maximises the retention of existing paddock trees, particularly larger groupings of trees to increase fauna habitat values within the site.

In addition to increasing fauna habitat values within the site, the management of fauna as part of the detailed design and construction for the proposed development will be based on minimising harm to fauna (such as birds visiting the area, or fauna that might be present utilising existing areas such as kangaroos or similar. Measures to be implemented may include:

- Bunting/flagging of trees to be retained so that it is clear which trees are to be avoided.

- Undertaking pre-clearing inspection of tree/vegetation proposed for removal/modification.
- Using a fauna spotter during clearing works to avoid impacts to fauna wherever possible and to rescue trans-locatable fauna that are disturbed during clearing works to assist them to disperse safely or capture them for later translocation as appropriate.
- Application of correct fauna handling procedures to reduce stress on any captured animals.

It is likely that this will be a condition of future subdivision approval, based on application of model subdivision condition EN1 (WAPC and DPLH 2021), which requires:

EN1 - Prior to the commencement of subdivisional works a foreshore/ environmental/ bushland/ tree/wetland/wildlife protection [DELETE AS APPLICABLE] management plan for [INSERT VALUE] is to be prepared and approved to ensure the protection and management of the sites environmental assets with satisfactory arrangements being made for the implementation of the approved plan. (Department of Water and Environmental Regulation) OR (Local Government) OR (Department of Biodiversity, Conservation and Attractions) [DELETE AS APPLICABLE]

4.4 Hydrology

4.4.1 Policy framework, site context and management objectives

In the context of environmental impact assessment, the EPA's objective for inland waters (and applied to the land use planning process) is *'to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected'* (EPA 2018).

In addition, the *State Water Strategy for Western Australia* (Government of WA 2003) and *Better Urban Water Management* (WAPC 2008) endorses the promotion of integrated water cycle management and application of water sensitive urban design (WSUD) principles to provide improvements in the management of stormwater, and to increase the efficient use of other existing water supplies. Of particular relevance to the nearby CCW and REW features to the north is the *Better Urban Water Management* criteria for ecological protection, which requires management to maintain or restore desirable environmental flows and/or hydrological cycles.

As outlined, based on the *Geomorphic Wetlands of the Swan Coastal Plain* dataset, a MUW (UFI 13327) is mapped across the majority of the site, supporting the groundwater monitoring observations that groundwater occurs at or in proximity to the ground surface. A CCW (UFI 15866) and a REW (UFI 15867) are identified to the north and north-west of the site and are associated with 'Bollard Bulrush Swamp'. These wetlands and their associated buffers do not extend into the site. The Peel Main Drain is located adjacent to the west of the site, with the site having a direct connection/interaction. These features are not in the site and therefore do not require specific management or consideration through buffers or similar, but managing the hydrological function of the site will be important.

The principal management objective for hydrology in the site will be to ensure that groundwater and surface water is appropriately infiltrated and treated to not impact on the broader area, particularly both the Bollard Bulrush Swamp and the Peel Main Drain, based on water sensitive design. Separation to groundwater will also be relevant and will require final lot levels to be at least 1.2 m above the MGL.

4.4.2 Structure plan layout considerations for hydrology

In accordance with the LWMS (Emerge Associates 2023b) that has been prepared for the site, the structure plan has accommodated flood mitigation, flow management and treatment of surface water by providing appropriately sized road reserves to convey, treat and store stormwater, as well as POS areas of a suitable width to accommodate required bioretention areas and flood storage areas, to manage water quality and to enable the predevelopment hydrology conditions to be maintained.

The management strategies proposed to protect hydrology of the Bollard Bulrush Swamp and Peel Main Drain include:

- Maintaining the existing hydrology of the Bollard Bulrush Swamp by directing major event stormwater runoff as overland flow to the bio-retention area which interfaces the Peel Main Drain in the existing environment and will support groundwater control and maintaining pre-development flows.
- Minimising pollutant loads within stormwater runoff and infiltrating to shallow groundwater.
- Treating the small event stormwater runoff within the developable portion of the site.

The road network, footpaths and opens space areas will be graded towards bioretention areas integrated into the POS in the western portion of the site. No drainage from the site will be directly connected or piped into the wetland, and no drainage infrastructure from the site will be located within the wetland buffer.

4.4.3 Future management requirements

The LWMS provides a framework for the future delivery of a best practice approach to integrated water cycle management utilising water sensitive urban design (WSUD) principles and provides for the management of groundwater and surface water within the site. It has been prepared in accordance with relevant DWER requirements, the previous DWMS, and considers the site-specific values. The LWMS will be a key document guiding future development and can be referred to for further detail, particularly with regard to determined water management criteria and water quality management objectives.

The LWMS (Emerge Associates 2023b) proposes water supply and conservation, stormwater management and groundwater management strategies to ensure water values are managed appropriately within the site. The principal elements of the LWMS have been summarised below.

Water supply and conservation

The overall approach to water supply is to utilise scheme water provided via Water Corporation for all in-house uses and implement best practise water conservation measures (e.g. water efficient fixtures, use of WSUD measures, and planting of water wise plant species) to reduce water demand. POS areas are predicted to require approximately 6,141 kL/year, which is below the existing groundwater allocation of up to 43,500 kL.

Stormwater management

The underlying principles of the stormwater management strategy for the site are to retain and treat runoff from small events (first 15 mm) as close to the source as possible. Runoff from roof, impervious areas within lots and road reserves will be treated as close to source as possible using a treatment train approach, which incorporates soakwells, and vegetated bio retention areas (BRA). Treatment will occur via contact with vegetation and the underlying soil profile (which will absorb nutrients, or through the introduction of high phosphorus retention index (PRI) media).

Water quality and flood detention will be managed at a lot scale and within POS areas adjacent to the Peel Main Drain. While existing connection to the Peel Main Drain is likely, a conservative retention at source approach has been taken within the LWMS. There will be no offsite discharge from the FSA.

Groundwater management

Due to the proximity of the groundwater table to the existing surface, the importation of sand fill will be required over the site, to ensure appropriate separation distances between existing (or future) surface levels and groundwater and allow stormwater to infiltrate at the source where possible. This will also include ensuring the invert level of bioretention area and flood storage areas will have a minimum of 300 mm clearance above the maximum groundwater level.

To maintain groundwater levels and minimise risk of nutrient enrichment further objectives for groundwater management are based on the following:

- Retention of existing trees within POS where possible.
- Minimising fertiliser use to establish and maintain vegetation/turf.
- Utilising drought tolerant turf species that require minimal water and nutrients.
- Roll-on turf will be used within the POS areas and road verges, to prevent the high nutrient input requirement during establishment of the turf.

Further detail on the groundwater and surface water management strategy for the site is provided in the LWMS (Emerge Associates 2023b).

Overall

The WAPC typically apply a standard condition on subdivision approval (model subdivision condition D2 (WAPC and DPLH 2022), requiring the preparation of an Urban Water Management Plan (UWMP) which states:

Prior to the commencement of subdivisional works, an urban water management plan is to be prepared and approved, in consultation with the Department of Water and Environmental Regulation, consistent with any approved Local Water Management Strategy. (Local Government).

Generally, an UWMP will address the following considerations specific to subdivision and development stages in close consideration of the engineering design:

- The detailed drainage design based on civil designs
- Imported fill specifications and requirements
- Implementation of water conservation strategies

- Non-structural water quality improvement measures
- Management and maintenance requirements
- Construction period management strategy
- Monitoring and evaluation program.

The LWMS has been prepared with this requirement in mind, and it is possible that a separate UWMP may not be required.

4.5 Bushfire management

4.5.1 Policy framework, site context and management objectives

State Planning Policy 3.7 Planning in Bushfire Prone Areas (SPP 3.7) (WAPC 2015) stipulates that any development proposal which occurs partly or wholly within a designated bushfire prone area is required to be accompanied by a bushfire management plan (BMP). The preparation of a BMP is required to incorporate the following tasks:

- Classification of existing vegetation and effective slope within the site and surrounding 150 m, in accordance with *Australia Standard 3959-2018 Construction of buildings in bushfire-prone areas* (AS 3959) (Standards Australia 2018).
- Assessment of bushfire hazard levels within the site and surrounding 150 m, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2021).
- Completion of an indicative Bushfire Attack Level (BAL) assessment and preparation of an associated BAL contour plan.
- Assessment of the structure plan design against the bushfire protection criteria, in accordance with the *Guidelines for Planning in Bushfire Prone Areas* (WAPC and DFES 2021) the Guidelines).

Policy objective 5.4 of SPP 3.7 specifies that development is required to:

> *'…achieve an appropriate balance between bushfire risk management measures and biodiversity conservation values, environmental protection and biodiversity management and landscape amenity'*.

This policy objective ensures that future development appropriately considers the bushfire risks and provides appropriate separation from any identified risks without negatively impacting existing environmental values (or introduced values).

The areas of bushfire hazard have been identified within 150 m of the site and include:

- Temporary grassland vegetation, identified to the north of the site, associated with the Oakebella Estate development that is under construction.
- Woodland and scrub vegetation within the Peel Main Drain reserve to the west of the site. This vegetation is a narrow strip but is connected to Bollard Bulrush Swamp.
- Forest vegetation to the north of the site associated with Bollard Bulrush Swamp (the core wetland) and the anticipated revegetation of the associated wetland buffer area.

No management of vegetation/bushfire hazards external to the site has been assumed.

The principal management objective for the bushfire risk to the site is to ensure that the risk to future people, property and infrastructure is appropriately minimised without negatively impacting on environmental values within or surrounding the site that have been identified for retention and/or protection.

4.5.2 Structure plan layout considerations for bushfire management

In accordance with the BMP (Emerge Associates 2023a) prepared for the site, the structure plan has provided an appropriate spatial response to bushfire risk through:

- Ensuring future development areas will be able to accommodate the separation necessary to ensure habitable buildings are able to achieve a bushfire attack level (BAL) rating of BAL-29 or less. This has been achieved through the location of proposed roads and/or ensuring public open spaces areas where specified are managed to low threat, or providing development cells of an appropriate size to accommodate necessary separation. The portions of the site adjacent to the western and northern boundaries have been identified as having areas subject to BAL-FZ and BAL-40, and are shown in in **Figure 5**. These are generated by temporary hazards (to the north) and predicted permanent hazards (Peel Main Drain to the west). **Figure 5** demonstrates that large portions of the site would be available for habitable buildings.
- An integrated internal road network that connects with the existing or proposed external public road network allowing for access to multiple destinations, supporting appropriate emergency evacuation and response.

4.5.3 Future management requirements

The BMP (Emerge Associates 2023a) demonstrates that SPP 3.7 and the bushfire protection criteria (outlined within the Guidelines(WAPC and DFES 2021)) can be satisfied through an 'acceptable solution' approach without compromising environmental values within (retained trees) or nearby (Bollard Bulrush Swamp and the associated buffer; and Peel Main Drain) to the site.

Going forward and based on satisfying the bushfire protection criteria, detailed design and construction will need to consider the following:

- ***Element 1 Location*****:** the site will be subject to a low bushfire hazard level rating (or moderate where within 100 m of extreme hazards in Bollard Bulrush Swamp and the Peel Main Drain). All future habitable buildings can be located in an area subject to a BAL rating of BAL-29 or less.
- ***Element 2 Siting and Design*****:** appropriate separation to ensure habitable buildings can achieve a BAL rating of BAL-29 or less, is achieved through the location of managed public road reserves, the design of POS (see landscape master plan which has considered extent of managed areas in **Appendix B**), and /or provision of appropriately sized lots enabling in-lot setbacks. This can be achieved even though portions of the site are identified to contain areas subject to BAL-FZ or BAL-40 (see **Figure 5**).
- ***Element 3 Vehicular Access*****:** provision of access to multiple destinations, with connections to the existing public road network. This is currently accommodated by the structure plan with connections to Johnson Road/Irasburg Parade and Oakebella Estate to the north. A perimeter road is provided between proposed development cells and permanent bushfire hazards (e.g. Peel Main Drain). Emergency access ways may be required to manage provision of multiple

access and or no through road lengths until the road network within development occurring north of the site is constructed.

- ***Element 4 Water*:** the site will be serviced by a reticulated water supply network with provision of hydrants, meeting water supply requirements dedicated to firefighting purposes.

Further detail on the bushfire management approach for the site is provided in the BMP (Emerge Associates 2023a).

The BMP has been prepared to support both structure planning and subdivision, but a revised BMP may be required to support future subdivision applications, particularly if development to the north is progressed or the development layout changes significantly. Any updated BMP will need to respond to the subdivision design (and/or stage of development). It is likely that the WAPC will include a number of standard conditions on the subdivision approval, including F1, F2 and F3 (WAPC and DPLH 2021) which states:

F1- Information is to be provided to demonstrate that the measures contained in the bushfire management plan [NAME/DATE] that address the following [LIST AS REQUIRED] have been implemented during subdivisional works. This information should include a notice of 'Certification by Bushfire Consultant'.

F2 – Notification, pursuant to Section 165 of the Planning and Development Act 2005, is to be placed on the certificate(s) of title of the proposed lot(s) with a Bushfire Attack Level (BAL) rating of 12.5 or above, advising of the existence of a hazard or other factor. Notice of this notification is to be included on the diagram or plan of survey (deposited plan). The notification is to state as follows:

"This land is within a bushfire prone area as designated by an Order made by the Fire and Emergency Services Commissioner and is/ may be subject to a Bushfire Management Plan [RENAME/DELETE AS APPLICABLE]. Additional planning and building requirements may apply to development on this land" (Western Australian Planning Commission)

F3 – A plan is to be provided to identify areas of the proposed lot(s) that have been assessed as BAL-40 or BAL-Flame Zone.

A restrictive covenant to the benefit of the local government, pursuant to section 129BA of the Transfer of Land Act 1893, is to be placed on the certificate(s) of title of the proposed lot(s) advising of the existence of a restriction on the use of the land within areas that have been assessed as BAL-40 or BAL-Flame Zone. Notice of this restriction is to be included on the diagram or plan of survey (deposited plan). The restrictive covenant is to state as follows:

"No habitable buildings are to be built within areas identified as BAL-40 or BAL-Flame Zone". (Local Government)

5 Implementation Framework

A summary of how the structure plan responds to the environmental values and attributes within the site is provided in **Table 7**. The table also outlines the future management likely to be required as part of the subdivision and development process, including recommended management plans.

Table 7: Environmental management framework implementation table

Factor	Structure plan phase (completed)	Subdivision phase	Development works
Acid sulfate soils	• Consider ASS risk mapping as prepared by DWER. No spatial response in structure plan required.	• If required, completion of the ASS self-assessment form (as prepared by the DPLH). • If required, preparation of an Acid Sulfate Soil and Dewatering Management Plan, only likely where excavation extends below the permanent (not perched) groundwater table or dewatering is required.	• If required, implementation of an Acid Sulfate Soil and Dewatering Management Plan.
Native vegetation	• Assessment of flora and vegetation values and consideration of tree retention opportunities. • Provision for POS areas to maximise retention of vegetation and create recreation opportunities.	• Undertake detailed analysis of final subdivision layout and engineering design to determine further possible tree retention opportunities. • If required, prepare management plans for retention/protection of trees.	• Where required, implement relevant management plan(s). • Ensure trees proposed for retention (in public open space or road reserve) are protected, and are accommodated as part of construction and landscaping works.
Native fauna	• Assessment of fauna habitat and preliminary consideration of habitat retention opportunities.	• Undertake detailed analysis of final subdivision layout and engineering design to determine further potential tree retention opportunities. • If required, prepare management plans for retention/protection of trees and fauna.	• Where require, ensure trees proposed for retention are protected, accommodate these as part of construction and landscaping works. • Implement pre-clearance checks and ensure fauna is managed appropriately to minimise harm. • If required, obtain and implement licences pursuant to the *Biodiversity Conservation Act 2016* to disturb/relocate fauna prior to works commencing.
Hydrology – surface water and groundwater	• Preparation of a Local Water Management Strategy (LWMS). • Spatial provision for drainage features to accommodate stormwater and flood events.	• If required, preparation of an Urban Water Management Plan (UWMP). • Provision for drainage areas and flood storage areas.	• Implementation of the UWMP. • Design and implementation of water management features as per the requirements of the UWMP.

Table 7: Environmental management framework implementation table (continued)

Factor	Structure plan phase (completed)	Subdivision phase	Development phase
Bushfire risk	• Preparation of a Bushfire Management Plan (BMP) in accordance with SPP 3.7 and the Guidelines. • Determining a spatial layout that reduces the bushfire hazard to future development. Including provision for road reserves and appropriately sized development areas to accommodate setbacks to achieve BAL-29 or less. Provision for a road network that connects the site to the existing public road network and provides access to multiple destinations.	• Provision for separation between habitable buildings and identified bushfire hazards (existing and introduced), including through use of road reserves, managed public open space and/or appropriately sized lots. • Provision for an appropriate road network that provides access to at least two destinations. • If required, prepare an updated BMP or BAL assessment to support subdivision application(s).	• Demonstrate compliance with any applicable BMP in accordance with SPP 3.7 and the Guidelines. • Where identified as low threat in the BMP, design, implement and maintain public areas to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. • Where designated bushfire prone, as part of building licence (by future lot owners) ensure buildings are constructed to appropriate BAL requirements.

6 Conclusions

This EAMS has been prepared on behalf of the proponent to support the structure plan prepared for Lot 506 Johnson Road, Wellard (the site), to guide the proposed residential development. This EAMS has been prepared to support the structure plan, together with:

- *Bushfire Management Plan* (BMP) (Emerge Associates 2023a)
- *Local Water Management Strategy* (LWMS) (Emerge Associates 2023b)

The structure plan design has responded to site-specific environmental considerations where necessary and possible, including: retention and protection of existing trees within the POS areas; accommodation of flooding and stormwater management within road reserves and POS areas consistent with the LWMS; and providing appropriate separation between future habitable buildings and areas of bushfire hazard identified external to the site.

This document provides an outline of the management requirements that will need to be considered as part of future subdivision and development stages, which can all be managed in accordance with the typical subdivision and development process with minimal risk to the environment. The key management considerations are summarised as follows:

- **Acid sulfate soils**: ASS is not considered to pose a significant constraint to the proposed future residential development. It is only likely to require management where services extend below the permanent groundwater table and/or dewatering is required. Given the fill material required across the site to address groundwater levels, services may not be installed below the permanent groundwater table. ASS can be managed in accordance with the WAPC and DWER guidelines.
- **Flora, vegetation and fauna values**: the site has been historically cleared of native vegetation to support agricultural land uses. Vegetation within the site now comprises of planted windbreak trees and scattered remnant paddock trees amongst areas of pasture grasses. While significant trees have not been identified based on the City's policies, existing trees are proposed to be retained within the western POS area and has been discussed with the City of Kwinana as part of preparing the structure plan. The removal of paddock trees can be appropriately managed through the standard subdivision process.
- **Hydrology**: The overarching objective for the site is to maintain the pre-development hydrological regime and is based on an at source infiltration approach to minimise the potential for nutrient impacts on Bollard Bulrush Swamp. This is further detailed within the LWMS prepared by Emerge Associates (2023). Future development will be supported by an UWMP as per standard planning and development processes.
- **Bushfire risks**: The proposed structure plan layout accommodates the required setbacks (through public roads, public open space or within the lots) to achieve a bushfire attack level (BAL) rating of BAL-29 or less (as per SPP 3.7). The layout provides for access to multiple destinations based on the connection to Oakebella Estate to the north. A temporary emergency access way may be required to manage access as part of staged development.

Overall, the environmental attributes and values of the site have been accommodated within the structure plan design (in particular, management of surface water and groundwater, retention of

trees where possible and separation from bushfire risks), or can be managed appropriately through the future subdivision and development phases in line with standard subdivision processes (e.g. acid sulfate soils) and the relevant state and local government legislation, policies and guidelines and best management practices.

7 References

7.1 General references

The references listed below have been considered as part of preparing this document.

Alan Tingay and Associates 1998, *A Strategic Plan for Perth's Greenways - Final Report*. December 1998.

Bob Gozard 2007, *Geology and landforms of the Perth Region: Western Australia Geological Survey*, Perth, Western Australia

City of Kwinana 2016, *Local Planning Policy No.1 - Landscape Feature and Tree Retention*.

City of Kwinana 2022, *Local Planning Policy No. 3 - Bollard Bulrush Landscape Masterplan*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2017, *Ramsar Sites (DBCA-010)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018a, *Geomorphic Wetlands Leeuwin Naturaliste Ridge and Donnybrook to Nannup - Unreviewed (DBCA-043)*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2018b, *Vegetation Complexes - South West forest region of Western Australia (DBCA-047)*, Perth, Western Australia.

C. a. A. Department of Biodiviersity (DBCA) 2019, *Black Cockatoo Roosting Sites - Buffered (DBCA-064)*, Perth, Western Australia

Department of Biodiversity Conservation and Attractions (DBCA) 2020, *Priority Ecological Communities for Western Australia Version 30*.

Department of Biodiversity, Conservation and Attractions (DBCA) 2022, *NatureMap*, <https://naturemap.dbca.wa.gov.au/>.

Department of Biodiversity, Conservation and Attractions (DBCA) 2023a, *Geomorphic Wetlands, Swan Coastal Plain (DBCA-019)*, Perth, WA.

Department of Biodiversity, Conservation and Attractions (DBCA) 2023b, *NatureMap*, <https://static.dbca.wa.gov.au/pages/naturemap.html>.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2022a, *Australian Heritage Database*, <https://www.environment.gov.au/cgi-bin/ahdb/search.pl?mode=search_results;list_code=NHL;legal_status=65%3e>.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2022b, *Protected Matters Search Tool*, <https://pmst.awe.gov.au/#/map?lng=131.52832031250003&lat=-28.671310915880834&zoom=5&baseLayers=Imagery>.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2023, *Protected Matters Search Tool*, <https://pmst.awe.gov.au/#/map>.

Department of Defence 2022, *Unexploded Ordnance*, <https://www.whereisuxo.org.au/>.

Department of Water (DoW) 2008, *LiDAR Elevation Dataset, Swan Coastal Plain*, Perth.

Department of Water (DoW) 2009, *Protecting public drinking water source areas*, Government of Western Australia, Perth.

Department of Primary Industries and Regional Development (DPIRD) 2020, *Current Extent of Native vegetation - Western Australia dataset (DPIRD-005)*, Perth, Western Australia.

DPIRD 2023, *Soil Landscape Mapping - Best Available (DPIRD-027)*, Perth, WA, <https://catalogue.data.wa.gov.au/dataset/soil-landscape-mapping-best-available>.

Department of Planning, Lands and Heritage (DPLH) 2019, *Bush Forever Areas 2000 (DPLH-019)*, <https://catalogue.data.wa.gov.au/org/department-of-planning-lands-and-heritage>.

Department of Planning, Lands and Heritage (DPLH) 2023a, *Aboriginal Heritage Places (DPLH-001)*, <https://catalogue.data.wa.gov.au/dataset/aboriginal-heritage-places>.

L. a. H. Department of Planning (DPLH) 2023b, *Town of Kwinana - Local Planning scheme No. 2*, Perth, WA.

Department of Planning, Lands and Heritage, and Western Australian Planning Commission, (DPLH & WAPC) 2021, *Guidelines for Planning in Bushfire Prone Areas Version 1.4*, Perth, Western Australia.

Department of Environment Regulation (DWER) 2017a, *Acid Sulfate Soil Risk Map, Swan Coastal Plain*, Perth.

Department of Water and Environmental Regulation (DWER) 2017b, *Acid Sulfate Soil Risk Map, Swan Coastal Plain (DWER-055)*.

Department of Water and Environmental Regulation (DWER) 2020a, *Hydrography Linear (Heirarchy) (DWER-031)*.

Department of Water and Environmental Regulation (DWER) 2020b, *Public Drinking Water Source Areas (DWER-033)*.

Department of Water and Environmental Regulation (DWER) 2021, *Water Register*, Perth, <https://maps.water.wa.gov.au/#/webmap/register>.

Department of Water and Environmental Regulation (DWER) 2022, *Contaminated Sites Database*, <https://dow.maps.arcgis.com/apps/webappviewer/index.html?id=c2ecb74291ae4da2ac32c441819c6d47>.

Department of Water and Environmental Regulation (DWER) 2023a, *Environmentally Sensitive Areas dataset* <https://catalogue.data.wa.gov.au/dataset/clearing-regulations-environmentally-sensitive-areas-dwer-046/resource/2e8d02fa-b64a-49d9-8faa-d300c768adf2>.

Department of Water and Environmental Regulation (DWER) 2023b, *Water Register*, <https://maps.water.wa.gov.au/#/webmap/register>.

E. Shedley and Williams, K. 2014, *An assessment of habitat for Western Ringtail Possum (Pseudocheirus occidentalis) on the southern Swan Coastal Plain (Binningup to Dunsborough)*, Department of Parks and Wildlife, Bunbury, WA.

Emerge Associates 2023a, *Bushfire Managment Plan - Lot 506 Johnson Road, Wellard*, EP22-062(05)--017 DVB, Version 1.

Emerge Associates 2023b, *Local Water Managment Strategy - Lot 506 Johnson Road, Wellard*, EP22-062(03)--13 JM, Version 1.

Emerge Associates 2023c, *Local Water Managment Strategy - Providence East*, EP22-062(03), Version 1.

Emerge Associates 2023d, *Providence East, Wellard WA - Preliminary Landscape Design Report*

Environmental Protection Authority (EPA) 2016, *Environmental Factor Guideline: Flora and Vegetation*, Perth.

Environmental Protection Authority (EPA) 2018, *Environmental Factor Guideline Inland Waters*, Perth.

G. a. G. Consultants (GGC) 2022, *Geotechnical Investigation Report Proposed Subdivision Development Providence East Estate Wellard WA*.

Government of WA 2000, *Bush Forever - Volume 1: Policies, principles and processes*, Perth.

Government of WA 2003, *A State Water Strategy for Western Australia*, Perth.

Heritage Council WA 2022, *State Heritage Office database*, Perth, Western Australia, <http://www.inherit.stateheritage.wa.gov.au/Public/>.

Hill, A. L., Semeniuk, C. A., Semeniuk, V. and Del Marco, A. 1996, *Wetlands of the Swan Coastal Plain: Volume 2A - Wetland Mapping, Classification and Evaluation*, Water and Rivers Commission and the Department of Environmental Protection, Perth.

Keighery, B. 1994, *Bushland Plant Survey: A guide to plant community survey for the community*, Wildflower Society of WA (Inc), Nedlands.

Western Australia Land Information Authority (Landgate) 2022, *Landgate Map Viewer Plus*, <https://map-viewer-plus.app.landgate.wa.gov.au/index.html>.

McArthur, W. M. and Bettenay, E. 1974, *The Development and Distribution of the Soils of the Swan Coastal Plain, Western Australia*, CSIRO, Melbourne, Australia.

Office of Bushfire Risk Management (OBRM) 2021, *Map of Bush Fire Prone Areas*, Landgate, https://maps.slip.wa.gov.au/landgate/bushfireprone/.

Standards Australia 2018, *AS 3959:2018 Construction of buildings in bushfire-prone areas*, Sydney.

Taylor Burrell Barnett 2016, *Lots 503 and 504 Tamlyn Place and Lots 505, 507 and 900 Johnson, Wellard*, Version 3.

Western Australian Local Government Association and Perth Biodiversity Project (WALGA and PBP) 2004, *Local Government Biodiversity Planning Guidelines for the Perth Metropolitan Region*, Perth.

Western Australian Land Information Authority (WALIA) 2023, *Landgate Map Viewer Plus*.

Western Australian Planning Commission (WAPC) 2008, *Better Urban Water Management*, Perth.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

Western Australian Planning Commission (WAPC) 2023a, *Metropolitan Regional Scheme*, Western Australia.

(WAPC) 2023b, *WA Planning Manual - Guidance for Structure Plans*, Perth, WA

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2021, *Guidelines for Planning in Bushfire Prone Areas Version 1.4*, Western Australian Planning Commission, Western Australia.

Western Australian Planning Commission and Department of Planning, Lands and Heritage (WAPC and DPLH) 2021, *Model Subdivision Conditions Schedule*.

Western Australian Planning Commission and Department of Planning, Lands and Heritage, (WAPC and DPLH) 2022, *Model Subdivision Conditions Schedule*.

7.2 Online references

The online resources that have been utilised in the preparation of this report are referenced in **Section 8.1**, with access date information provided in **Table R1**.

Table R 1 Access dates for online references

Reference	Date accessed	Website or dataset name
(DWER 2022)	9 November 2023	Contaminated sites (DWER-059)
(DWER 2021)	9 November 2023	Water Register
(DCCEEW 2023)	9 November 2023	Protected Matters Search Tool
(DBCA 2017)	9 November 2023	Wetland Ramsar sites
(Landgate 2022)	9 November 2023	Landgate Historical maps
(DWER 2017b)	9 November 2023	Acid Sulfate Soils (DWER-055)
(DBCA 2023b)	9 November 2023	NatureMap search
(Department of Defence 2022)	9 November 2023	Unexploded Ordnance
(DWER 2020b)	9 November 2023	Public Drinking Water Source (DWER-033)
(DWER 2020a)	9 November 2023	Hydrography linear (hierarchy)
(DBCA 2019)	9 November 2023	Black Cockatoo Roosting Sites – Buffered (DBCA-064)
(DBCA 2018a)	9 November 2023	Geomorphic Wetlands Swan Coastal Plain (DBCA-019)
(DBCA 2018b)	9 November 2023	Vegetation Complex's – Swan Coastal Plain (DBCA-046)
(DPLH 2019)	9 November 2023	Bush Forever Areas
(OBRM 2021)	9 November 2023	Bush fire prone areas map
(DPLH 2023a)	9 November 2023	Aboriginal Heritage Inquiry System

Figures

Figure 1: Site Location and Topographic Contours

Figure 2: Soil Landscape Features

Figure 3: Acid Sulfate Soil Risk

Figure 4: Geormorphic Wetlands and Hydrological Features

Figure 5: Key Management Considerations

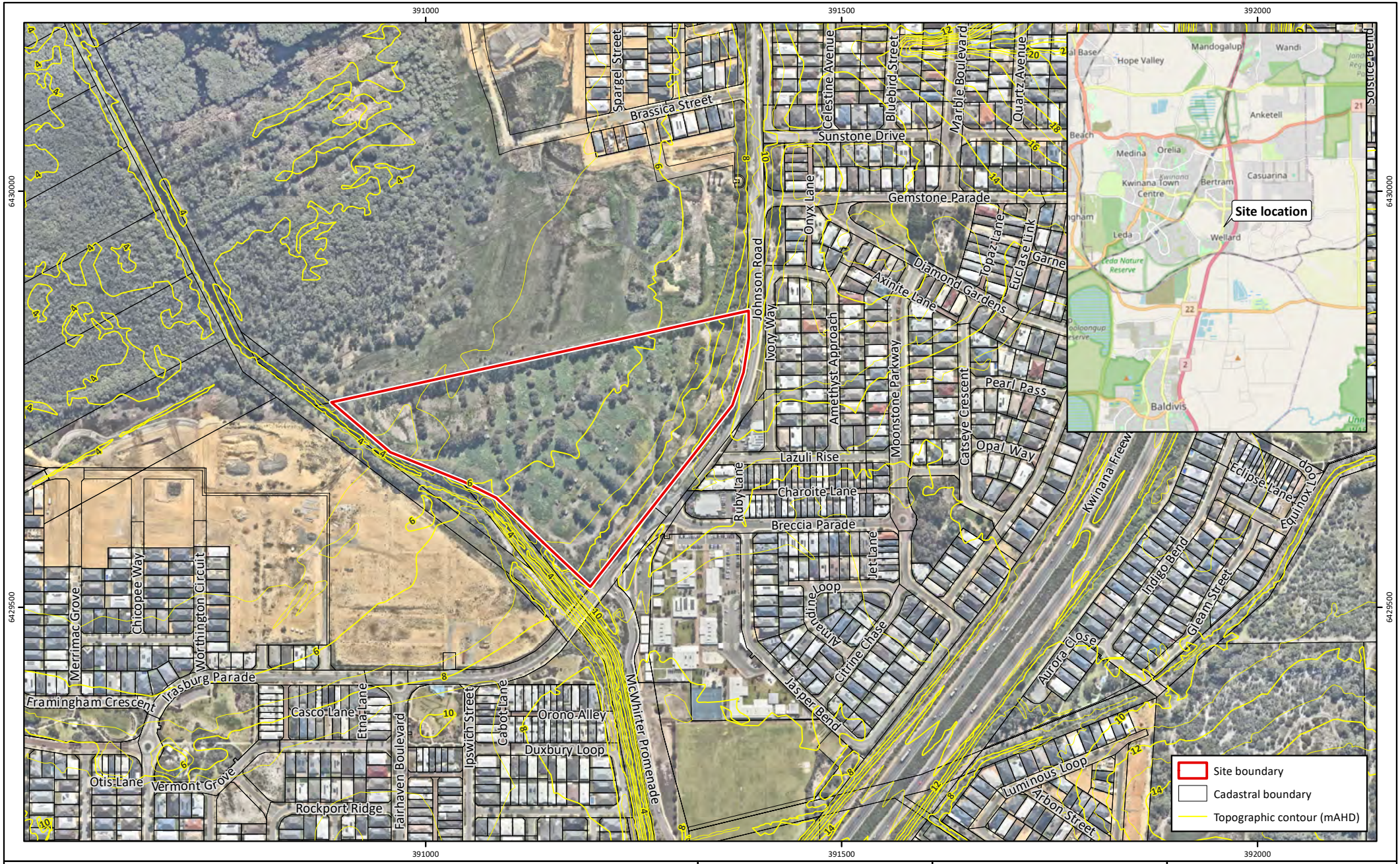


Figure 1: Site Location and Topographic Contours

Project:	Environmental Assessment and Management Stratergy Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(05)--F17

Drawn:	GAR
Date:	04/12/2023
Checked:	DVB
Approved:	KK
Date:	15/12/2023

N

0 100 200
Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

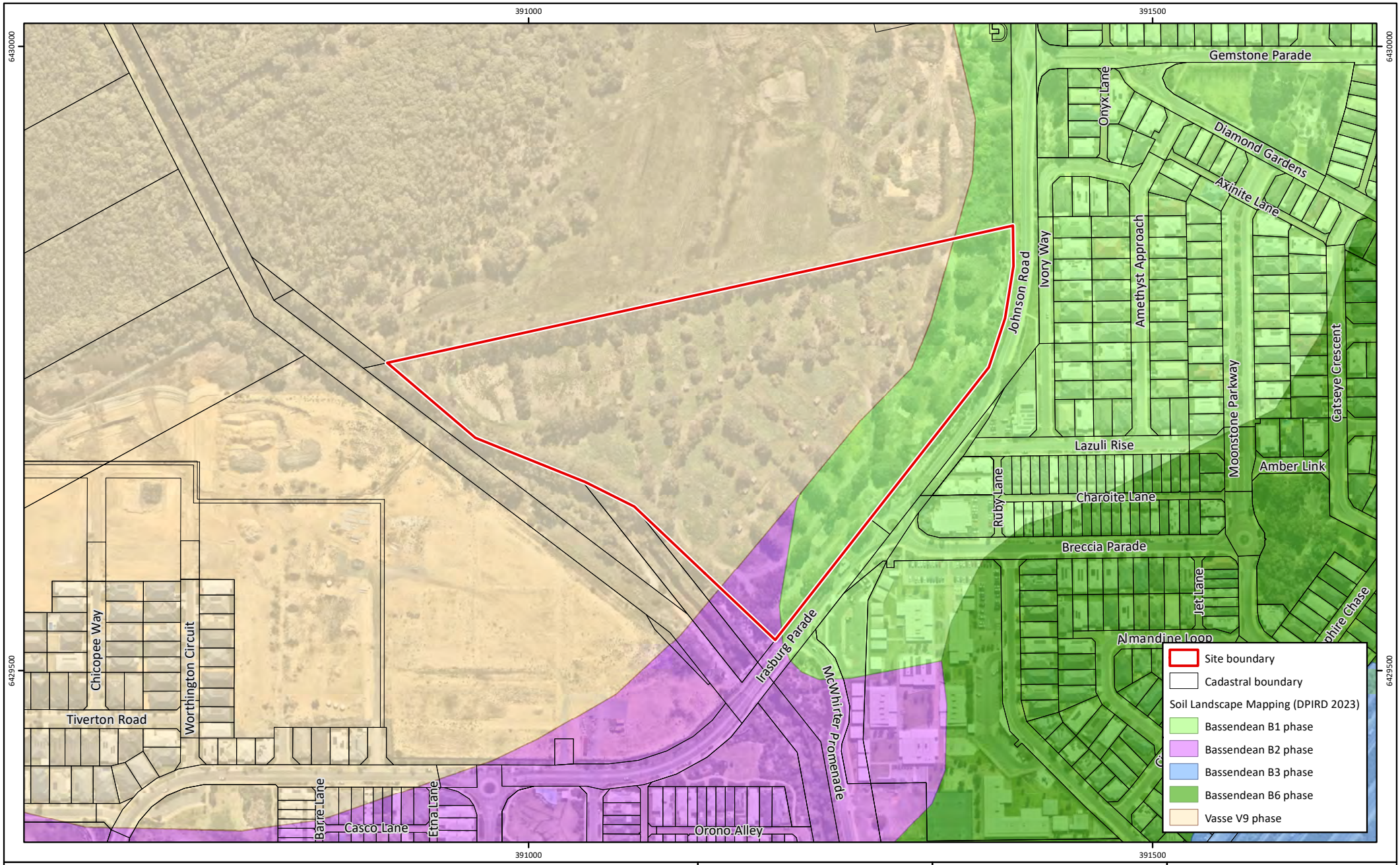


Figure 2: Soil Landscape Features

Project:	Environmental Assessment and Management Stratergy Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(05)--F18

Drawn:	GAR
Date:	04/12/2023
Checked:	DVB
Approved:	KK
Date:	15/12/2023

N

0 60 120
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

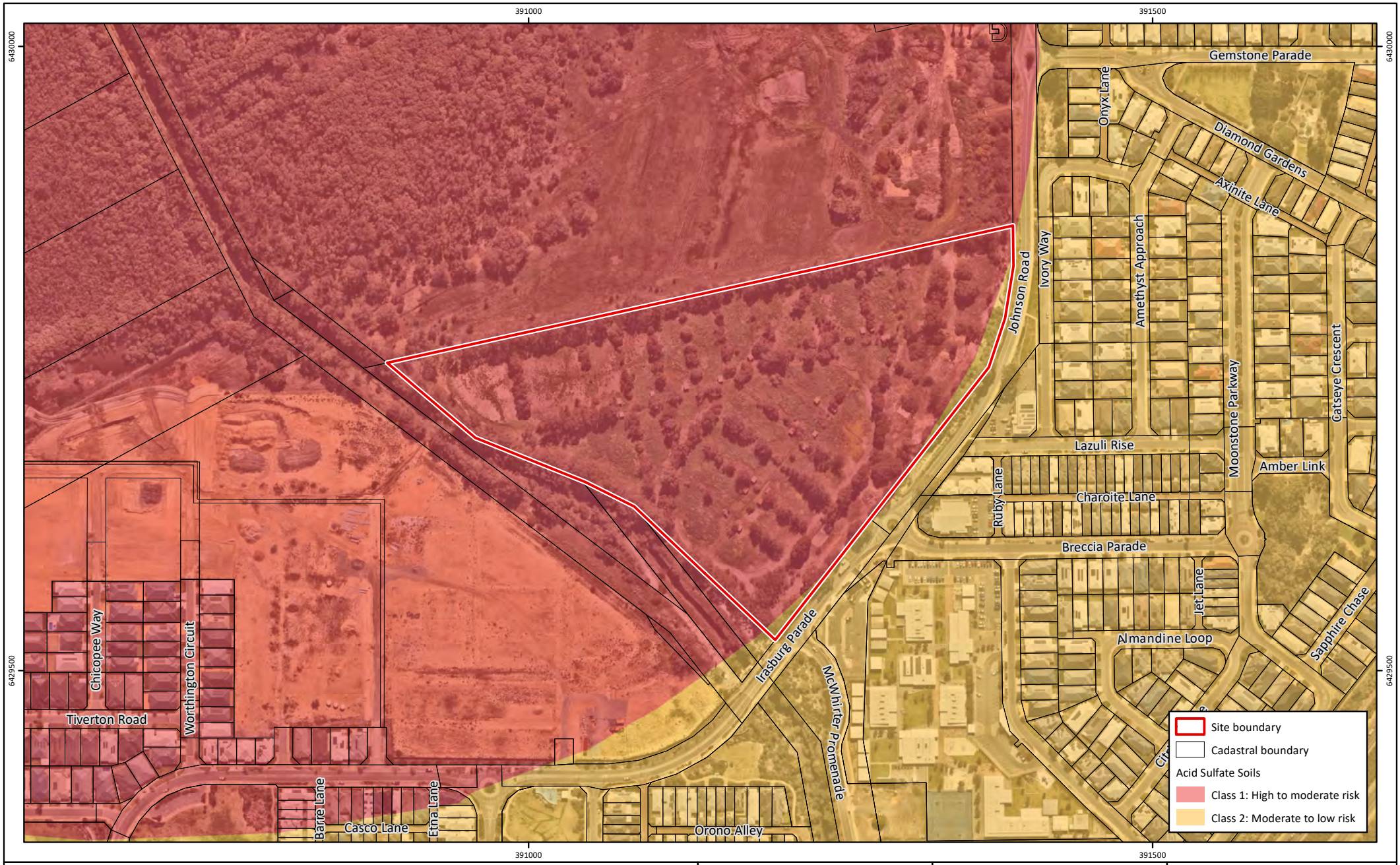


Figure 3: Acid Sulfate Soil Risk

Project:	Environmental Assessment and Management Stratergy Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(05)--F19

Drawn:	GAR
Date:	04/12/2023
Checked:	DVB
Approved:	KK
Date:	15/12/2023

N

0 60 120
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

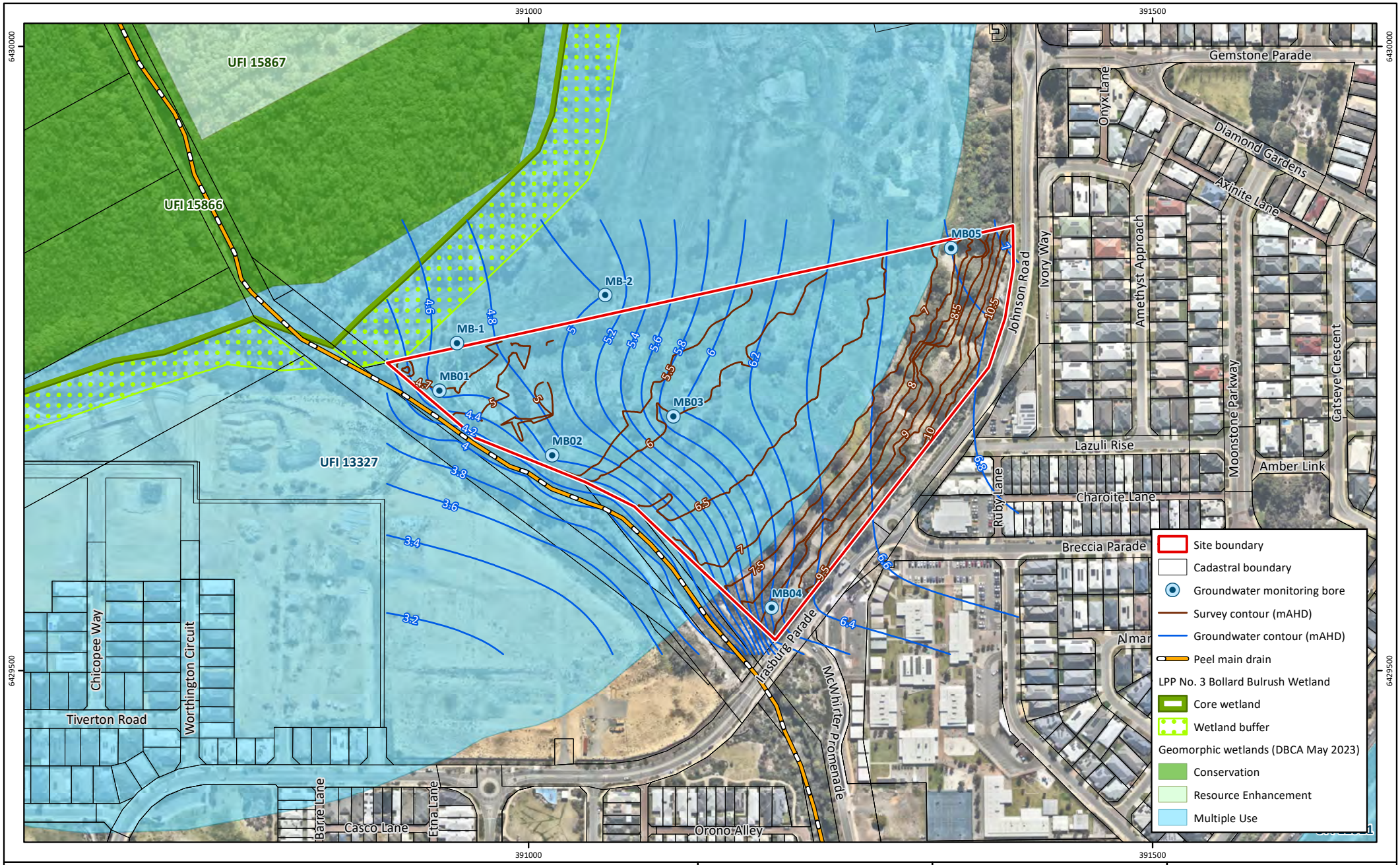


Figure 4: Geomorphic Wetlands and Hydrological Features

Project:	Environmental Assessment and Management Stratergy Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(05)--F20

Drawn:	GAR
Date:	04/12/2023
Checked:	DVB
Approved:	KK
Date:	15/12/2023

N

0 60 120
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

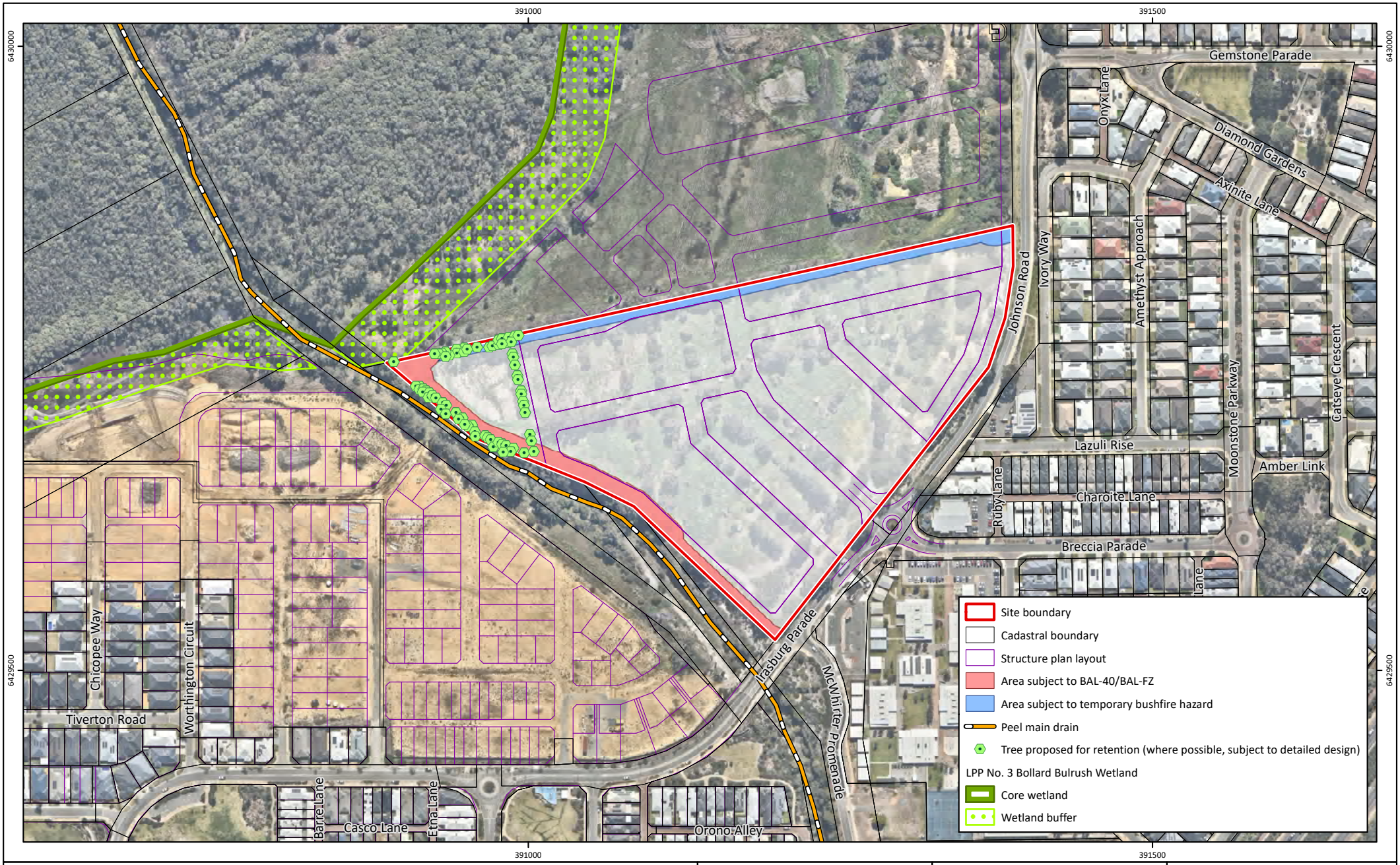


Figure 5: Key Management Considerations

Project:	Environmental Assessment and Management Stratergy Lot 506 Johnson Road, Wellard
Client:	Wellard Residential Pty Ltd

Plan Number:
EP22-062(05)--F21a

Drawn:	GAR
Date:	19/12/2023
Checked:	DVB
Approved:	KK
Date:	19/12/2023

N

0 60 120
Metres

Scale: 1:4,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

While Emerge Associates makes every attempt to ensure the accuracy and completeness of data, Emerge accepts no responsibility for externally sourced data used
©Landgate (2023). Nearmap Imagery date: 30/08/2023

Appendix A

Structure Plan

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

LATTUGE DRIVE
CAROTA VIEW
NAVET STREET
POS
30
60
54.5
16m Reserve
13m Reserve
15m Reserve
60
506
40
55
53
45
54
16m Reserve
15m Reserve
13m Reserve
13m Reserve
15m Reserve
13m Reserve
ROAD
JOHNSON
BRECCIA
PARADE
IRASBURG
PARADE
58
59
353
360
359
358
357
356
805
804
803
801
802
800
886
722
835 834 833 832 831 830 829 828 827 826
721 720 719 718 717 716 715 714 713 71
665
666
667
668
664
663
691
692
69

LEGEND
SUBJECT SITE

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

CONCEPT PLAN
Lot 506 Johnson Road, Wellard

DRAFT

plan no: **2263-186C-01**
date: 12 October 2022
scale: 1:1,500 @A3, 1:750 @A1

N

Appendix B

Landscape Design Report

Lot 506 Johnson Rd
Wellard WA

PRELIMINARY LANDSCAPE DESIGN REPORT

EASTCOURT

emerge ASSOCIATES

December 2023

Contents

1.0 Landscape Concepts 3

1.1 Overall Masterplan..... 3

1.2 POS 1 Detailed Plan 4

2.0 Typical Site Sections 5

2.1 POS 1: Section A..... 5

2.2 POS 1: Section B 5

2.3 POS 2: Section C..... 6

3.0 Street Tree Masterplan 7

4.0 Planting Palette..... 8

4.1 Indicative Planting Palette..... 8

REVISION	DATE	ISSUE OR AMENDMENT	BY	REVIEWED
A	05.12.23	Issue for Comment	JW	MM
B	07.12.23	Issue for Approval	JW	MM

1.0 Landscape Concepts

1.1 Overall Masterplan

1.2 POS 1 Detailed Plan

LEGEND

- EXTENT OF WORKS
- BRA (FIRST 15mm RAINFALL)
- 1% AEP (100 YEAR STORM)
- DUAL USE CONCRETE PATHS
- 2.5 WIDE RED ASPHALT DUAL USE PATH
- NATIVE SHRUB PLANTING
- TURF
- BIORETENTION BASIN
- SHADE STRUCTURE AND PICNIC AREA
- FITNESS EQUIPMENT NODE
- INDICATIVE PLAY SPACE
- EXISTING TREES TO BE RETAINED WHERE POSSIBLE (SUBJECT TO DETAILED DESIGN)

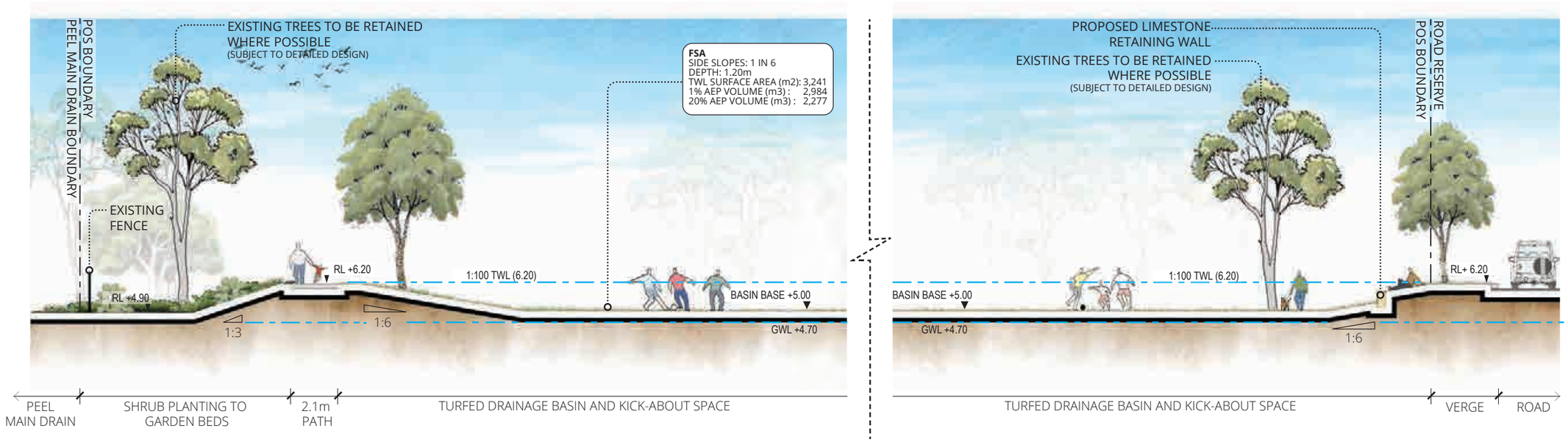
LEGEND

01 EXISTING PEEL MAIN DRAIN
02 FEATURE HARDSTAND WITH SHADE STRUCTURE AND SEATING OPPORTUNITIES OVERLOOKING PLAYSPACE
03 PROPOSED PLAYSPACE
04 PROPOSED DUAL USE PATH
05 DUP CROSSING TO PEEL MAIN DRAIN BY OTHERS
06 PROPOSED FITNESS NODE
07 LARGE TURF KICK-ABOUT AREA
08 PLANTED BIORETENTION BASIN
09 OVERFLOW SPILLWAY WITH ROCKWORK
10 PLANTED BATTER TO TIE INTO EXISTING LEVELS
11 RUBBISH BINS
12 FUTURE DUP BY OTHERS
13 LIMESTONE RETAINING WALLS
14 PARK BENCH
15 INDICATIVE ON STREET PARKING TO POS

2.0 Typical Site Sections

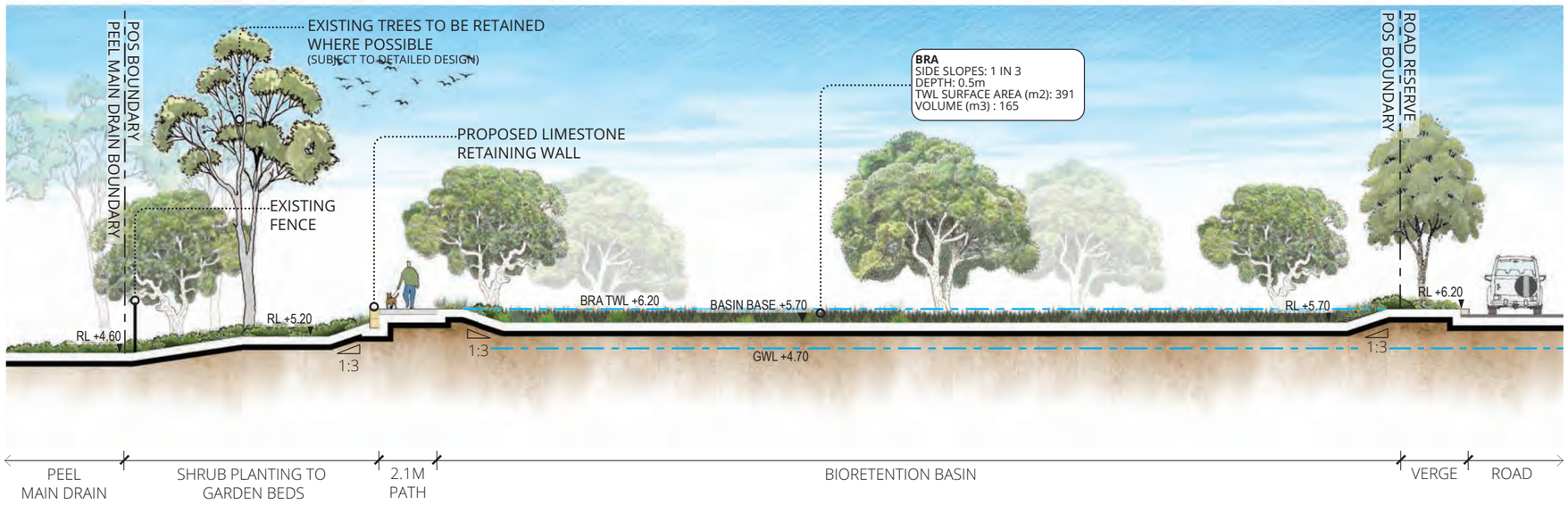
2.1 POS 1: Section A

Scale 1:100



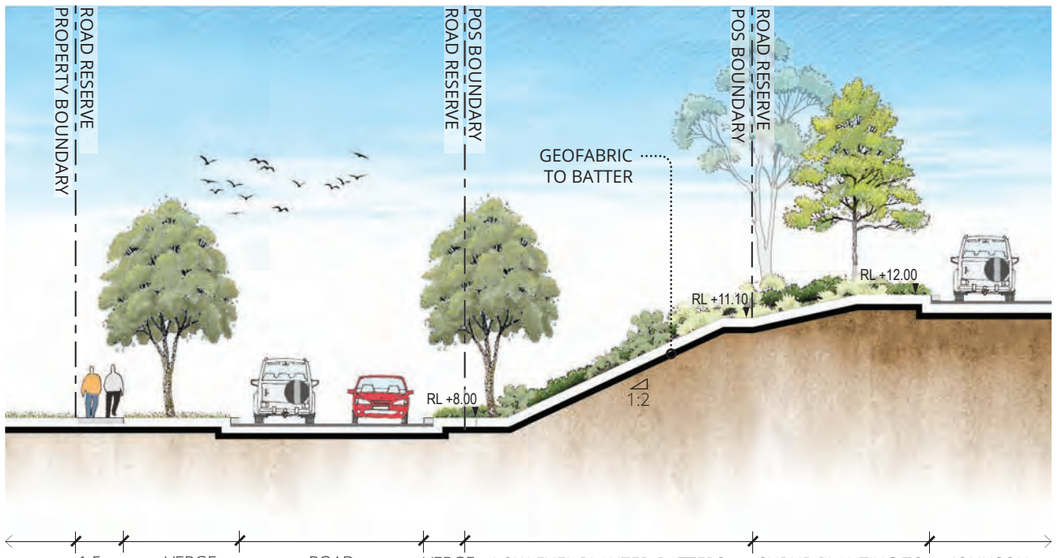
2.2 POS 1: Section B

Scale 1:100



2.3 POS 2: Section C

Scale 1:100



3.0 Street Tree Masterplan

Pyrus ussuriensis
Manchurian Pear

Cupaniopsis anacardioides
Tuckeroo

Melaleuca leucadendra
Weeping Paperbark

4.0 Planting Palette

4.1 Indicative Planting Palette

Trees (>3m)
Agonis flexuosa WA Peppermint
Banksia littoralis Swamp Banksia
Eucalyptus gomphocephala Tuart
Eucalyptus rudis Flooded Gum
Melaleuca preissiana Stout Paperbark
Melaleuca rhaphiophylla Swamp Paperbark
Pyrus calleryana Ornamental Pear

Large Shrubs (>1.5m) Golden Wreath Wattle
Acacia saligna Wooley Bush
Adenanthos sericeus One-Sided Bottlebrush
Calothamnus quadrifidus Yellow-spotted Emu Bush
Eremophila maculata 'Aurea' Olive Grevillea
Grevillea olivacea Chenille Honeymyrtle
Melaleuca huegelii Dwarf Melaleuca
Melaleuca 'Little Nessie' Coastal Daisy-Bush
Olearia axillaris

Medium Shrubs (1 - 1.5m) Grevillea
Grevillea crithmifolia upright Elegant beaufortia
Beaufortia elegans Club Rush
Ficinia nodosa Boobialla
Myoporum insulare Pom-Pom Myrtle
Melaleuca conothamnoides Heart Leaf Flame Pea
Chorizema cordatum Coastal Rosemary
Westringia fruticosa 'Grey Box'

Small Shrubs (0.5 - 1m) Red & Green Kangaroo Paw
Anigozanthos manglesii Grey Cottonhead
Conostylis candicans Stalked Guinea Flower
Hibbertita racemosa White myrtle
Hypocalymma angustifolium Cushion Bush
Leucophyta brownii Lomandra
Lomandra tanika Wingarra
Lomandra wingarra Native Iris
Patersonia occidentalis

Groundcovers (<0.5m) Prostrate Golden Wreath Wattle
Acacia saligna prostrate Honeypot Dryandra
Banksia Nivea Common Clematis
Clematis pubescens Creeping Boobialla
Myoporum parvifolium Eremophila
Eremophila glabra 'Roseworthy' Grevillea
Grevillea crithmifolia prostrate

Trees

Agonis flexuosa
WA Peppermint

Melaleuca rhaphiophylla
Swamp Paperbark

Eucalyptus gomphocephala
Tuart

Banksia littoralis
Swamp Banksia

Large Shrubs

Acacia saligna
Golden Wreath Wattle

Eremophila maculata 'Aurea'
Yellow-spotted Emu Bush

Melaleuca huegelii
Chenille Honeymyrtle

Calothamnus quadrifidus
One-Sided Bottlebrush

Medium Shrubs

Eremophila nivea
Spring Mist

Chroizema cordatum
Heart Leaf Flame Tree

Melaleuca conothamnoides
Pom-Pom Myrtle

Westringia fruticosa 'Grey Box'
Coastal Rosemary

Small Shrubs

Conostylis candicans
Grey Cottonhead

Leucophyta brownii
Cushion Bush

Lomandra wingarra
Wingarra

Patersonia occidentalis
Native Iris

Groundcovers

Acacia saligna prostrate
Prostrate Golden Wreath Wattle

Eremophila glabra 'Roseworthy'
Eremophila

Myoporum parvifolium
Creeping Boobialla

Banksia Nivea
Honeypot Dryandra

ATTACHMENT 7

Transport Impact Assessment [PJA]

Wellard Residential Pty Ltd

Lot 506 - Johnson Road, Wellard

Transport Impact Assessment – Structure Plan

November 2023

Project Code: 07576

PJA
Level 27
St Martins Tower
44 St Georges Terrace
Perth
WA 6000
Australia
pja.com.au

Version Control and Approval

Version	Date	Main Contributor	Issued by	Approved by
A – DRAFT	08 November 2023	Richard Spencer	Richard Spencer	-
B – FINAL	21 November 2023	Richard Spencer	Richard Spencer	Rodney Ding
C – UPDATED	22 November 2023	Richard Spencer	Richard Spencer	Rodney Ding

Prepared for:

Matthew Palmieri
Development Manager
Eastcourt
756 Canning Highway
Applecross
WA 6953
Australia

Contents

Section **Page**

1 Introduction 5
1.1 Background 5
1.2 Structure Plan Proposal 6
1.3 Summary of TIA 6
1.4 Regional and Local Policy Context 6

2 Existing Situation 8
2.1 Existing Site Context and Land Uses 8
2.2 Existing Road Network 8
2.3 Existing RAV Network 14
2.4 Existing Key Intersections on Surrounding Road Network 15
2.5 Existing Traffic Volumes 15
2.6 Johnson Road / Irasburg Parade / Breccia Parade Roundabout Intersection – 2023 Existing Traffic Volumes 16
2.7 Existing Pedestrian / Cycle Networks 17
2.8 Existing Public Transport 18
2.9 Crash Assessment 21

3 Proposed Structure Plan Development (Internal Transport Network) 23
3.1 Proposed Residential Development 23
3.2 Vehicular Access Arrangements 23
3.3 Proposed Internal Transport Networks 23
3.4 Assessment Years and Time Periods 23
3.5 Road Cross Sections and Intersection Controls 24
3.6 Pedestrian and Cyclist Access 24
3.7 Safe Walk/Cycle to School Assessment 24
3.8 Public Transport Routes 24

4 Changes to External Transport Network 25
4.1 Changes to Road Network 25
4.2 Oakabella Estate - Residential Development 25
4.3 Providence Estate - Residential Development 26
4.4 Changes to Pedestrian and Cycle Network 26
4.5 Changes to Public Transport Network 28

5 Integration with Surrounding Area 29
5.1 Surrounding Attractors / Generators 29
5.2 Proposed Changes to Surrounding Land Uses 29
5.3 Level of Overall Accessibility 29
5.4 Pedestrian and Cyclist Accessibility (Lot 506 Johnson Rd) 31

6 Analysis of Transport Network 32
6.1 Assessment Years and Time Period 32
6.2 Background Traffic 32
6.3 Traffic Growth 32
6.4 Traffic Generation – Lot 506 Johnson Road 32
6.5 Traffic Generation – Oakabella Estate 33
6.6 Traffic Generation – Providence Estate 33
6.7 Traffic Distribution and Assignment 33
6.8 Intersection Performance 37
6.9 Scenario – Ultimate 2029 Traffic Volumes 37
6.10 Proportional Impact of Development on Surrounding Road Network 38

7 Conclusions & Recommendations 39
7.1 Summary of TIA 39
7.2 Overall Integration with Surrounding Attractors / Generators 39
7.3 Road Network Accessibility 39
7.4 Pedestrian and Cycle Accessibility 39
7.5 Public Transport Accessibility 40
7.6 Road Safety Considerations 40
7.7 Speed Limit and School Zones 40
7.8 Analysis of the Transport Network 41

List of Tables

Table 2-1: Existing Traffic Volumes – Johnson Road, Wellard Road and Kwinana Freeway 15
Table 2-2: Existing Traffic Volumes – Breccia Parade, Bertram Road and Mortimer Road 15
Table 2-3: SIDRA Intersection Capacity Results – Johnson Road / Irasburg Parade Breccia Parade Intersection – 2023 AM and PM Peaks 17
Table 2-4: Crash Data for Johnson Road/Irasburg Parade/Cavendish Boulevard, between Wellard Road and Mortimer Road. 21
Table 2-5: Crash Data for the Roundabout Intersection of Bertram Road/Mortimer Road/Johnson Road 21
Table 3-1: Proposed Land Use Yield 23
Table 6-1: WAPC Trip Generation Rates 32
Table 6-2: Peak Hour Proposed Development Traffic Generation – Lot 506 Johnson Road 32
Table 6-3: Estimated All Day Proposed Development Traffic Generation – Lot 506 Johnson Road 32
Table 6-4: Remaining (Future) Development Traffic Generation – Oakabella Estate 33
Table 6-5: Remaining (Future) Development Traffic Generation – Providence Estate 33

List of Figures

Figure 1-1: Site Location 5
Figure 1-2: Proposed Concept Structure Plan 6
Figure 1-3: MRS Zone Map Sheet 27 and 28 – Map Name: Rockingham and Mundijong (respectively) 6
Figure 1-4: City of Kwinana's Local Planning Scheme No.2 7
Figure 2-1: Site Location in Context of Surrounding Road Network 8
Figure 2-2: Typical Layout of Johnson Road – Looking north (north of Breccia Parade) 9
Figure 2-3: Typical Layout of Irasburg Parade – Looking west (west of Cabot Lane) 9
Figure 2-4: Typical Layout of McWhirter Promenade – Looking south (south of Johnson Road) 10
Figure 2-5: Typical Layout of Millar Road – Looking west (west of McWhirter Promenade) 10
Figure 2-6: Typical Layout of Wellard Road – Looking north (north of Cavendish Boulevard) 11
Figure 2-7: Typical Layout of Bertram Road – Looking west (west of Johnson Road) 11
Figure 2-8: Typical Layout of Mortimer Road – Looking east (east of Johnson Road) 12
Figure 2-9: Kwinana Freeway – Looking north (north of Mortimer Road) 12
Figure 2-10: Main Roads WA Functional Road Hierarchy 13
Figure 2-11: Main Roads WA Speed Classifications 14
Figure 2-12: Existing RAV Network 14
Figure 2-13: Existing Key Intersections within 2.0km of the Site 15
Figure 2-14: Daily Average Traffic Volume – Monday to Friday (Two-Way) 16
Figure 2-15: 2023 AM Peak Traffic Volumes – Johnson Road / Breccia Parade Intersection 16
Figure 2-16: 2023 PM Peak Traffic Volumes – Johnson Road / Breccia Parade Intersection 17
Figure 2-17: Existing pedestrian / cycle networks 18
Figure 2-18: Bus Service 544 Timetable (Mon to Fri) 19
Figure 2-19: Bus Service 537 Route Map 19
Figure 2-20: Stopping Pattern on the Mandurah Rail Line to/from Perth. 20
Figure 2-21: Wellard Train Station Facilities 20
Figure 3-1: Proposed Vehicle Access Arrangements – Concept Plan 23
Figure 3-2: Walking Route to Wellard Primary School and Day Care Centre from Lot 506 24
Figure 4-1: Oakabella Estate - Wellard 25
Figure 4-2: Providence Estate - Wellard 26
Figure 4-3: Long-Term Cycling Network – Perth and Peel 27
Figure 4-4: Oakabella Estate Local Structure Plan 2016 – Movement Network 27
Figure 5-1: MRS Zone Map Sheet 27 and 28 – Map Name: Rockingham and Mundijong (respectively) 29
Figure 5-2: North-East Baldivis District Structure Plan Location 30
Figure 5-3: East of Kwinana Planning Investigation Area 30
Figure 6-1: Proposed Development Traffic Distribution – Lot 506 Johnson Road 33
Figure 6-2: Proposed Peak Hour Development Traffic Assignment – Lot 506 Johnson Road 34
Figure 6-3: Two–Way Proposed Development Traffic Assignment Within Lot 506 (All Day Volumes) 34
Figure 6-4: Oakabella Estate Peak Hour Traffic Assignment at Johnson Rd/Breccia Pde Roundabout 35
Figure 6-5: Providence Estate Peak Hour Traffic Assignment at Johnson Rd/Breccia Pde Roundabout 35
Figure 6-6: Estimated Ultimate 2029 Traffic Voumes at Johnson Rd/Breccia Pde Roundabout (Peak Hour) 36
Figure 6-7: Two – Way Estimated Ultimate 2029 Traffic Voumes Within Lot 506 (All Day Volumes) 36
Figure 6-8: Johnson Road/Irasburg Parade/Breccia Parade/Site Access: Proposed four-way single lane roundabout layout. 37
Figure 6-9: Johnson Road/Irasburg Parade/Breccia Parade/Site Access: Capacity Results (2029 Traffic Volumes) 38

Appendices

Appendix A TIA Checklist 42
Appendix B Proposed Concept Structure Plan 43
Appendix C SIDRA Intersection Assessment Results 44

1 Introduction

1.1 Background

Wellard Residential Pty Ltd (The Applicant) has commissioned PJA Australia Pty Ltd to prepare this Transport Impact Assessment (TIA) in relation to the proposed residential development of land to the west of Johnson Road in Wellard, (City of Kwinana), Western Australia. Specifically, this TIA has been prepared to accompany an amendment to the existing Providence Structure Plan.

This assessment has been prepared in accordance with the Western Australian Planning Commission's (WAPC) *Transport Impact Assessment Guidelines Volume 2 – Planning Schemes, Structure Plans & Activity Centre Plans (2016)*.

This report aims to assess the impacts of the proposed development upon the adjacent road network, with a focus on access requirements to/from Johnson Road and the surrounding local road network.

The potential yield of the development site (the Site) in terms of developable land use, which this TIA is based upon, is expected to be:

- Residential Lots = 128 dwellings.

The location of the site in relation to the immediate surrounding road network is shown on Figure 1-1.

Figure 1-1: Site Location

Source: Nearmap August 2023

1.2 Structure Plan Proposal

This proposal, which is being presented to accompany an amendment to the existing Providence Structure Plan, proposes a residential development with public open space. Based on the Concept Plan (**Figure 1-2** and **Appendix A**), the potential yield of the site comprises 128 residential lots.

Figure 1-2: Proposed Concept Structure Plan

1.3 Summary of TIA

In accordance with WAPC Guidelines for Transport Impact Assessments, this report sets out the details of the proposed Structure Plan, the key transport issues and impacts related to the development of the Site from a residential and traffic generation perspective including the current level of accessibility by road, public transport, cycle and on foot. This TIA identifies where the level of accessibility and infrastructure is acceptable and where it is found to be deficient, sets recommendations to improve these areas to a suitable level where required and appropriate for this development.

This TIA also considers the proposed modifications to the surrounding transport networks including local and state Government projects and initiatives, such as the planned widening of Wellard Road and Mortimer Road, and the minor road network yet to be completed at the Oakabella (north) and Providence Estates (west) which are currently under construction.

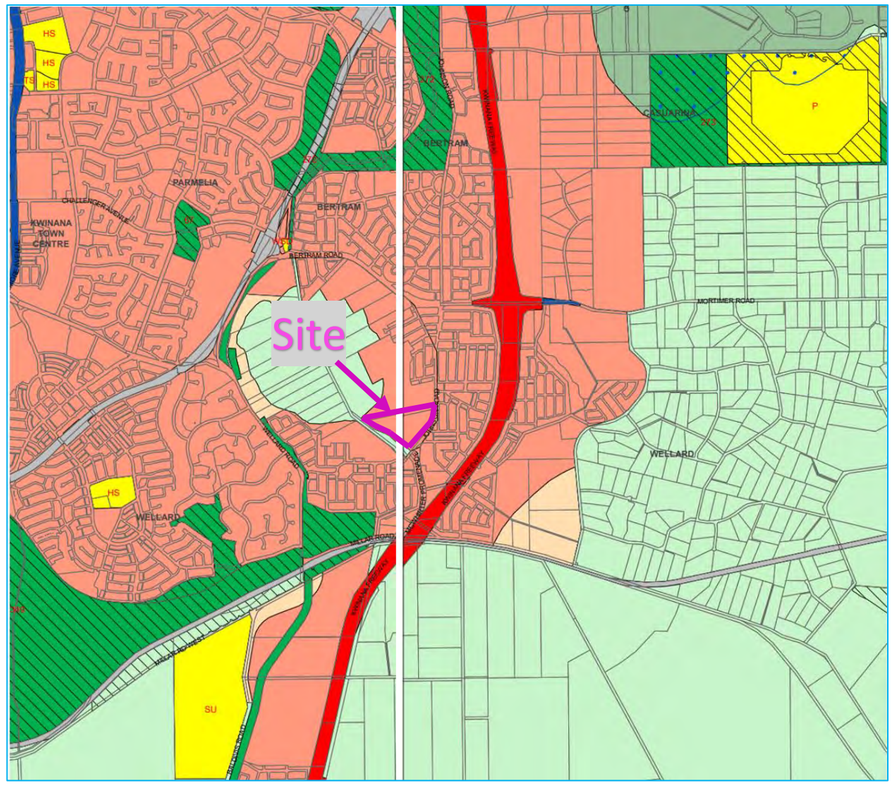
Extensive consultation has been undertaken with City of Kwinana throughout the scoping and production of this TIA. All information received from City of Kwinana has been used where appropriate.

1.4 Regional and Local Policy Context

Metropolitan Region Scheme (MRS)

The Site area is currently zoned 'Urban' under the MRS and is immediately surrounded to the north, east, south and south-west by land currently zoned as 'Urban'. Land immediately to the north-west is currently zoned as 'Rural'. **Figure 1-3** illustrates the site area's current MRS zoning, (Across Map Sheets 27 and 28).

Figure 1-3: MRS Zone Map Sheet 27 and 28 – Map Name: Rockingham and Mundijong (respectively)



Source: Metropolitan Region Scheme (MRS)

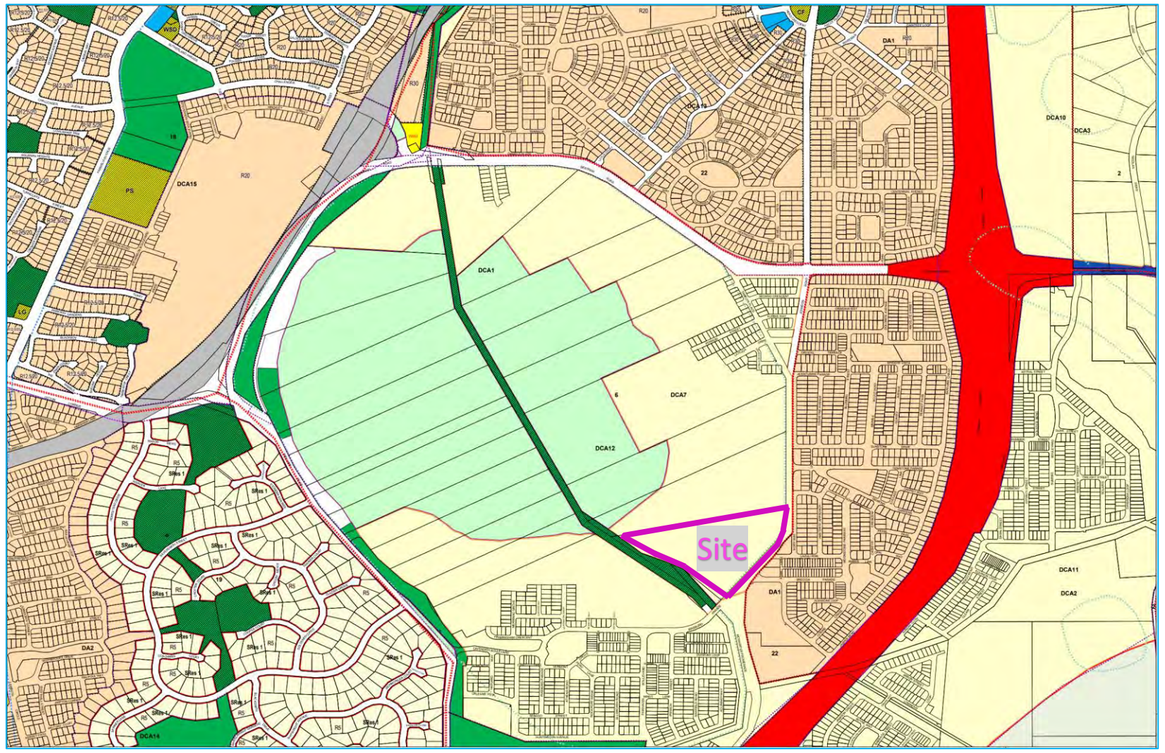
City of Kwinana Local Planning Scheme No.2

Under the provisions of *the City of Kwinana Local Planning Scheme No.2* (LPS No.2) the site area is currently zoned as 'Development'. Land situated immediately to the north, south and west is zoned as 'Development', to the east as 'Residential' and to the north-west as 'Rural A'.

The site is also situated within a Special Control Area being designated as an 'Area of Landscape Protection'. The LSP sets out:

> *Council's objective in setting aside Areas of Landscape Protection is to conserve areas of natural ecological value or landscape amenity whilst at the same time allowing development as provided in the Zoning Table No. 1 of the Scheme.*
>
> *No person shall, in any Area of Landscape Protection, without Council's Planning Approval in writing.*
>
> *(a) Carry out clearing of trees or other vegetation.*
>
> *(b) Carry out any filling, dredging or changes to the contour of the land.*
>
> *(c) Erect any advertising sign,*
>
> *(d) Erect or construct any building or outbuilding, Town of Kwinana L PS 2 Page No. 59*
>
> *(e) Degrade any natural wetland system,*
>
> *(f) Detract from the amenity of the locality.*
>
> *In considering an application for Planning Approval in respect of any land within an Area of Landscape Protection, Council shall have regard to the following:*
>
> *(a) The overall impact of the proposed development on the landscape amenity of the area and the desirability of limiting or modifying the siting, construction, design or materials of any building or associated services.*
>
> *(b) The need for an overall management plan prepared .by Council in consultation with the affected owners as a prerequisite to any Planning Approval being issued.*
>
> *(c) The extent to which any subdivision proposal should guarantee the protection of natural ecological features or areas of landscape amenity.*
>
> *(d) The desirability of minimising the effect of new road construction including earthworks and clearing of vegetation within road reserves.*

Figure 1-4: City of Kwinana's Local Planning Scheme No.2



LEGEND:

OTHER CATEGORIES

(see scheme text for additional information)

- Scheme Area Boundary
- Local Government Boundary
- Hope Valley - Wattleup Redevelopment Area
- R20 R Codes
- A1 Additional Uses
- **SRes1** Special Residential Area
- **SR1** Special Rural Area
- Area of Landscape Protection
- **DA1** Development Area
- **DA1** Development area
- **DCA1** Development Contribution Area
- Drainage Catchment Management
- **1** Policy Areas
- Preservation of Buildings, Objects and Places
- No Zone
- Waterbodies

LOCAL SCHEME ZONES

- Cluster/Communal Rural Settlement
- Commercial
- Development
- General Industry
- Kwinana Town Centre
- Light Industry
- Mixed Business 1
- Residential
- Rural A
- Rural B
- Rural Water Resource
- Service Commercial
- Special Residential
- Special Rural
- APH Special Use : Aged Persons Home
- CC Special Use : Cultural Centre
- SS Special Use : Service Station
- V Special Use : Various
- W Special Use : Welfare

2 Existing Situation

2.1 Existing Site Context and Land Uses

The Site is located on the western side of Johnson Road and Irasburg Parade, immediately opposite the existing three-arm roundabout intersection with Breccia Parade. Johnson Road runs in a north-south direction, connecting with Mortimer Road and Bertram Road to the north, some 430m west of the Mortimer Road intersection with the Kwinana Freeway.

Irasburg Parade, to the southern side of the site, predominantly runs in an east-west direction and connects with Cavendish Boulevard and Wellard Road to the west.

The Site is bounded to the north by existing vacant land, to the east and south by existing residential development, Wellard Primary school and a Child Care Centre. To the west of the site is the Peel Main Drain which separates the site from the existing 'Providence' residential development of which the balance of the estate area is currently under construction.

The land uses on the site currently consist of small agricultural holdings with small outbuildings within the vacant bushland. There are currently two informal vehicle access points to the site at the interface with Johnson Road, which are both designated with flush kerb crossover infrastructure and are assumed only for infrequent access to the land.

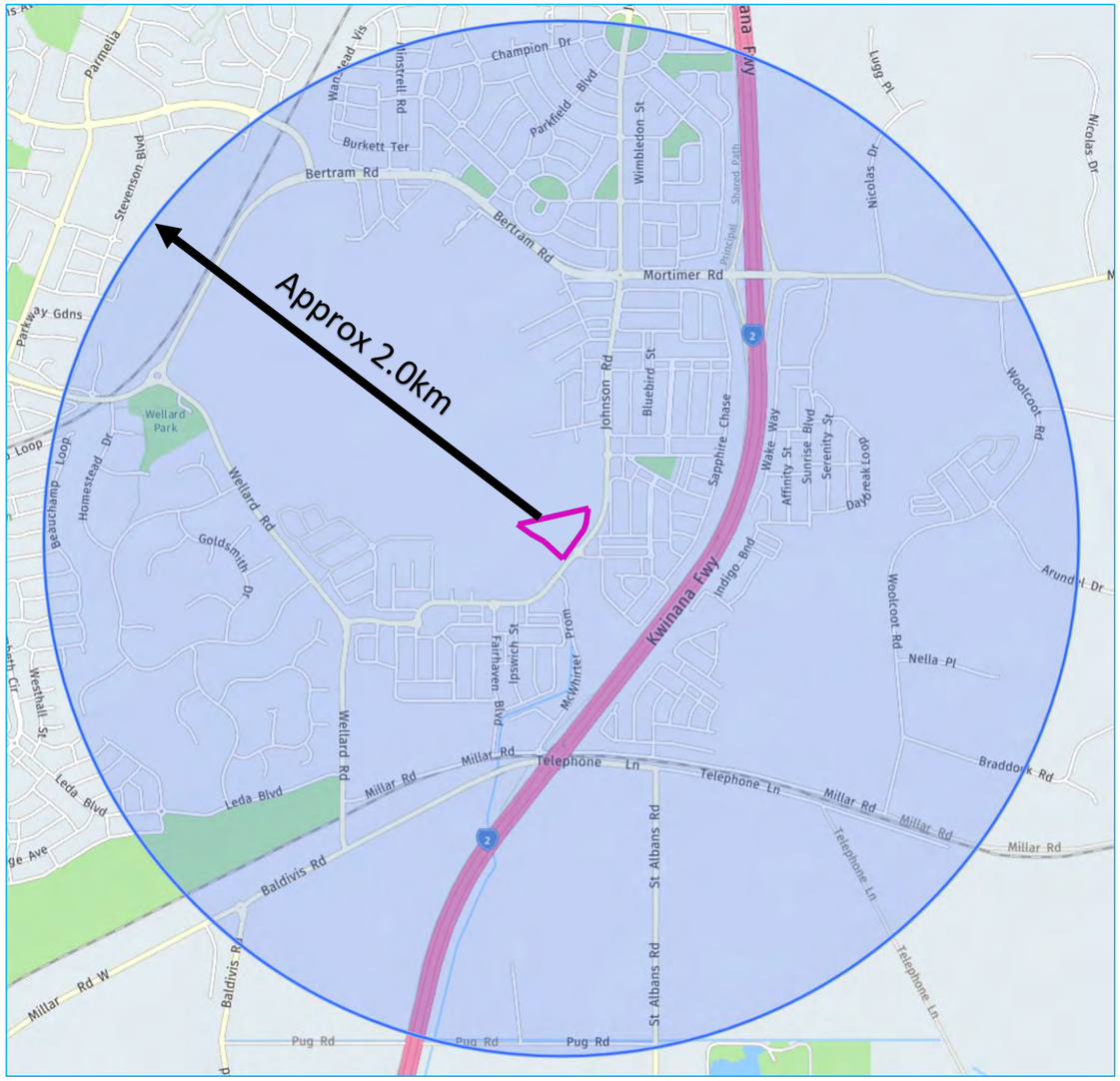
The location of the Site in relation to the surrounding road network is illustrated in **Figure 2-1 .**

2.2 Existing Road Network

Within an approximate area of 2.0 kilometres from the site boundaries, the existing road network comprises the main routes of:

- Johnson Road
- Irasburg Parade
- McWhirter Promenade and Millar Rd
- Wellard Road
- Betram Road
- Mortimer Road
- Kwinana Freeway.

Figure 2-1: Site Location in Context of Surrounding Road Network



Johnson Road:

Along the eastern boundary of the site Johnson Road runs in a north/south alignment, is a single carriageway undivided road, typically 7.5m pavement width, with no on-road cycle lane facilities and a single footpath on eastern side of the road with lighting. Johnson Road is classified as a *'Local Distributor'* road within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-2: Typical Layout of Johnson Road – Looking north (north of Breccia Parade)

Source: Google Street View

Irasburg Parade (south of the Site):

To the south of the Site (south of McWhirter Promenade) Irasburg Parade extends to provide access to Wellard Road via Cavendish Boulevard. In this area, Irasburg Parade runs in a predominantly east/east alignment, is a single carriageway divided road between McWhirter Promenade and Fairhaven Boulevard and undivided thereafter (except at intersections), Irasburg Parade pavement ranges in width between 7.3m to 10.3m, has no on-road cycle lane facilities and a single footpath on southern side of the road with lighting. Irasburg Parade in this location is classified as a *'Access Road'* within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-3: Typical Layout of Irasburg Parade – Looking west (west of Cabot Lane)

Source: Google Street View

Source: Google Street View

McWhirter Promenade and Millar Road (south of the Site):

To the south of the Site (south of McWhirter Promenade) Irasburg Parade extends to provide access to Millar Road and ultimately Wellard Road to the south-west. McWhirter Promenade runs in a north/south alignment, is a single carriageway road, typically between 5.8m to 6.0m pavement width, has no on-road cycle lane facilities and a single footpath on the eastern side of the road with lighting. McWhirter Promenade is classified as a *'Local Distributor'* road within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-4: Typical Layout of McWhirter Promenade – Looking south (south of Johnson Road)

Source: Google Street View

Millar Road:

Millar Road provides access to Wellard Road, to the west of McWhirter Promenade. Millar Road runs in an east/west alignment, is a single carriageway road, typically 7.3m pavement width (not including cycle lanes), has on-road cycle lane provision in both directions and only minimal footpath provision at intersections. Millar Road meets Wellard Road at a priority controlled T-intersection and is classified as a *'Local Distributor'* road within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-5: Typical Layout of Millar Road – Looking west (west of McWhirter Promenade)

Source: Google Street View

Wellard Road:

To the west of the site, Wellard Road runs in a north/south alignment, is a single carriageway undivided road, typically 7.5m pavement width, with on road cycle lanes in each direction (defined with red asphalt) converging into footpath cycle provision at roundabout intersections. Wellard Road meets Bertram Road at a roundabout intersection providing access to Wellard Centre, including Wellard Train Station. Wellard Road, is classified as a *'Distributor B'* road within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-6: Typical Layout of Wellard Road – Looking north (north of Cavendish Boulevard)

Source: Google Street View

Bertram Road:

To the north of the site, Bertram Road is a divided dual carriageway road, with no on-road cycle lane facilities and footpaths on both sides of the road at intermittent locations and has lighting. Bertram Road meets Johnson Road at a major roundabout intersection with two-lane approaches in the east and westbound directions. Bertram Road is classified as a *'Distributor A'* road within Main Roads WA's Functional Hierarchy and is under the care and control of City of Kwinana.

Figure 2-7: Typical Layout of Bertram Road – Looking west (west of Johnson Road)

Source: Google Street View

Mortimer Road:

Mortimer Road is a continuation of Bertram Road, which extends to provide northbound and southbound vehicle access to the Kwinana Freeway at traffic signal-controlled intersections with the on ramps/off ramps. In this location, Mortimer Road is a divided dual carriageway road, with no on-road cycle lane facilities and footpaths on both sides of the road and has lighting. In this location, Mortimer Road is classified as a *'Distributor A'* road within Main Roads WA's Functional Hierarchy and to the east of the Freeway is classified as a 'Regional Distributor'. Mortimer Road is under the care and control of City of Kwinana.

Figure 2-8: Typical Layout of Mortimer Road – Looking east (east of Johnson Road)

Source: Google Street View

Kwinana Freeway:

Approximately 1.5 kilometres distance to the north-east of the site, Mortimer Road provides northbound and southbound vehicle access to the Primary Road network of the Kwinana Freeway, which in this location is dual carriageway in both north and southbound directions. The Kwinana Freeway is classified as a '*Primary Distributor'* within Main Roads WA's Functional Hierarchy and is under the care and control of Main Roads Western Australia.

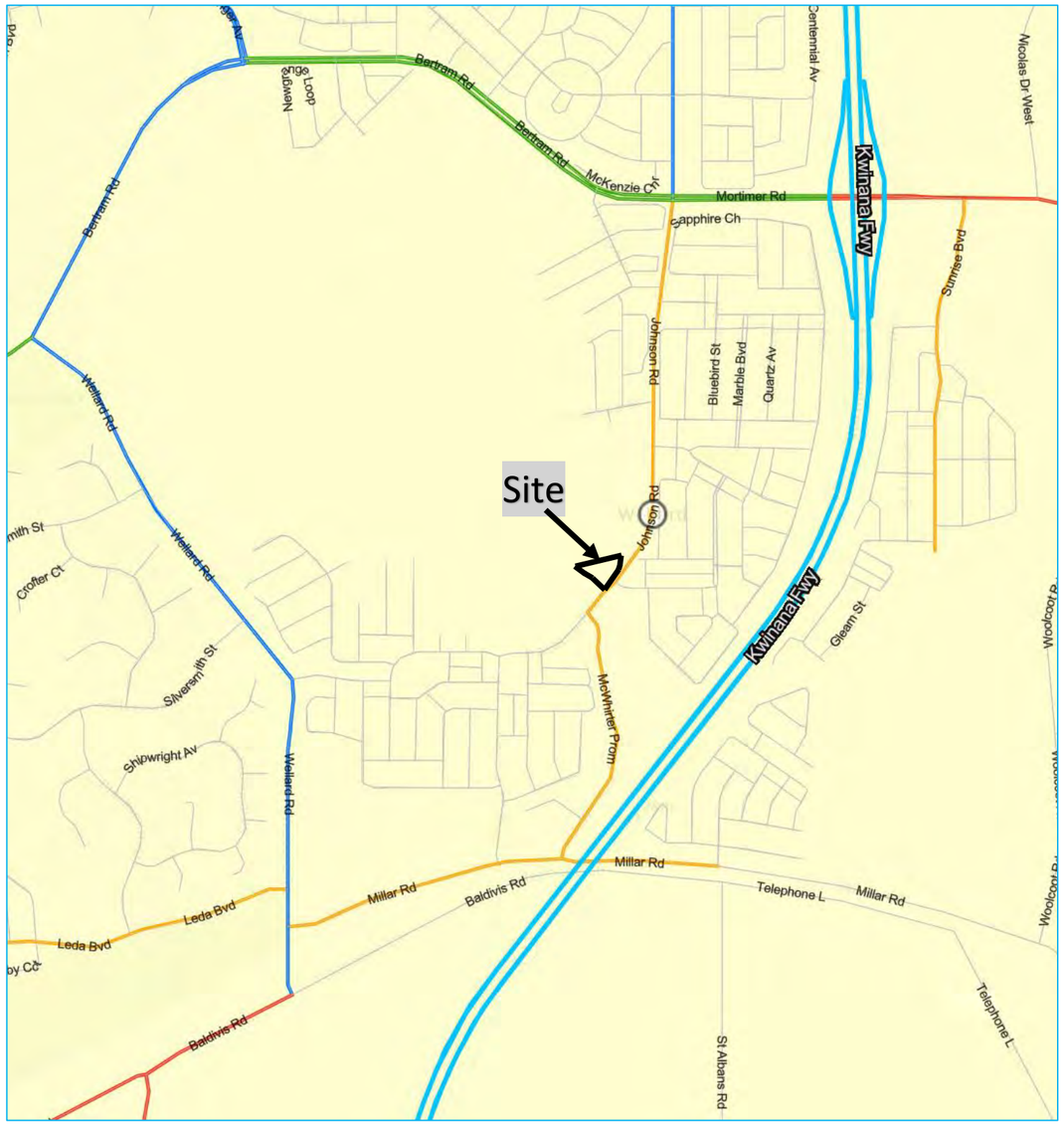
Figure 2-9: Kwinana Freeway – Looking north (north of Mortimer Road)

Source: Google Street View

Road Hierarchy:

Figure 2-10 shows the layout and classification of the roads surrounding the site, including the primary road network.

Figure 2-10: Main Roads WA Functional Road Hierarchy



Road classifications are defined in the Main Roads Functional Hierarchy as follows:

Primary Distributors (light blue): Form the regional and inter-regional grid of MRWA traffic routes and carry large volumes of fast-moving traffic. Some are strategic freight routes, and all are National or State roads. They are managed by Main Roads.

Regional Distributors (red): Roads that are not Primary Distributors, but which link significant destinations and are designed for efficient movement of people and goods within and beyond regional areas. They are managed by Local Government.

District Distributor A (green): These carry traffic between industrial, commercial, and residential areas and connect to Primary Distributors. These are likely to be truck routes and provide only limited access to adjoining property. They are managed by Local Government.

District Distributor B (dark blue): Perform a similar function to "District Distributor A" but with reduced capacity due to flow restrictions from access to and roadside parking alongside adjoining property. These are often older roads with traffic demand in excess of that originally intended. District Distributor A and B roads run between land-use cells and not through them, forming a grid that would ideally be around 1.5 kilometres apart. They are managed by Local Government.

Local Distributors (orange)**:** Carry traffic within a cell and link District Distributors at the boundary to access roads. The route of the Local Distributor discourages through traffic so that the cell formed by the grid of District Distributors only carries traffic belonging to or serving the area. These roads should accommodate buses but discourage trucks. They are managed by Local Government.

Access Roads (grey): Provide access to abutting properties with amenity, safety and aesthetic aspects having priority over the vehicle movement function. These roads are bicycle and pedestrian friendly. They are managed by Local Government.

Speed Zoning:

Figure 2-11 shows the zoning of speeds on the roads surrounding the site including School Zones on Breccia Parade and Jasper Bend to the east of the site, shown coloured orange, with Johnson Road being subject to a 60km/h speed limit north of McWhirter Promenade.

Figure 2-11: Main Roads WA Speed Classifications

2.3 Existing RAV Network

In terms of the roads surrounding the site, Johnson Road and McWhirter Promenade form part of Main Roads WA's Restricted Access Vehicle (RAV) Network up to level 4.

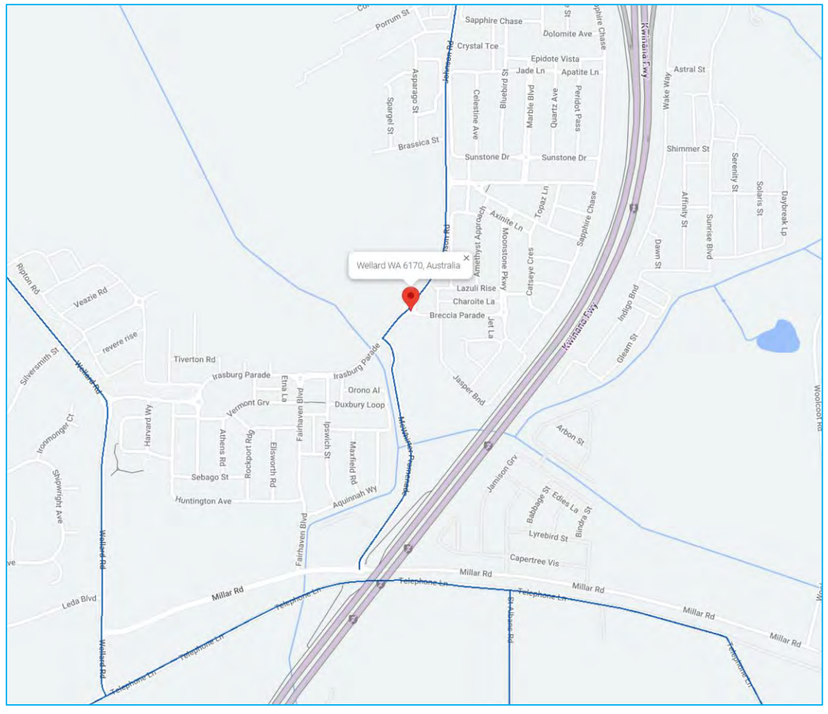
The RAV 4 network generally permits heavy vehicles with the following specifications:

- Gross Vehicle Mass (GVM) up to 88.5 tonnes
- Overall vehicle length including any trailers is limited to 27.5 metres and maximum width of 2.5 metres (without an oversize / over mass permit).

It is noted that this RAV route ceases at the intersection with Millar Road to the south of the site and does not connect thereafter. When reviewing this RAV route, and in relation to the past Johnson Road and Irasburg Parade road upgrades (circa September 2016) including the construction of the Johnson Road/Breccia Parade roundabout intersection, the realignment of Johnson Road, and the creation of McWhirter Promenade, this RAV route is expected to no longer serve its original purpose. These significant road modifications were undertaken as part of the Providence Estate development and other nearby residential developments.

PJA has contacted Main Roads WA to understand the current status of this RAV route, who have in turn spoken to the City of Kwinana regarding this. City of Kwinana will be investigating the matter and undertaking surveys on Johnson Road and McWhirter Promenade to determine if any RAVs are operating on these roads. They have advised that an outcome will be available at the end of November 2023.

Figure 2-12: Existing RAV Network

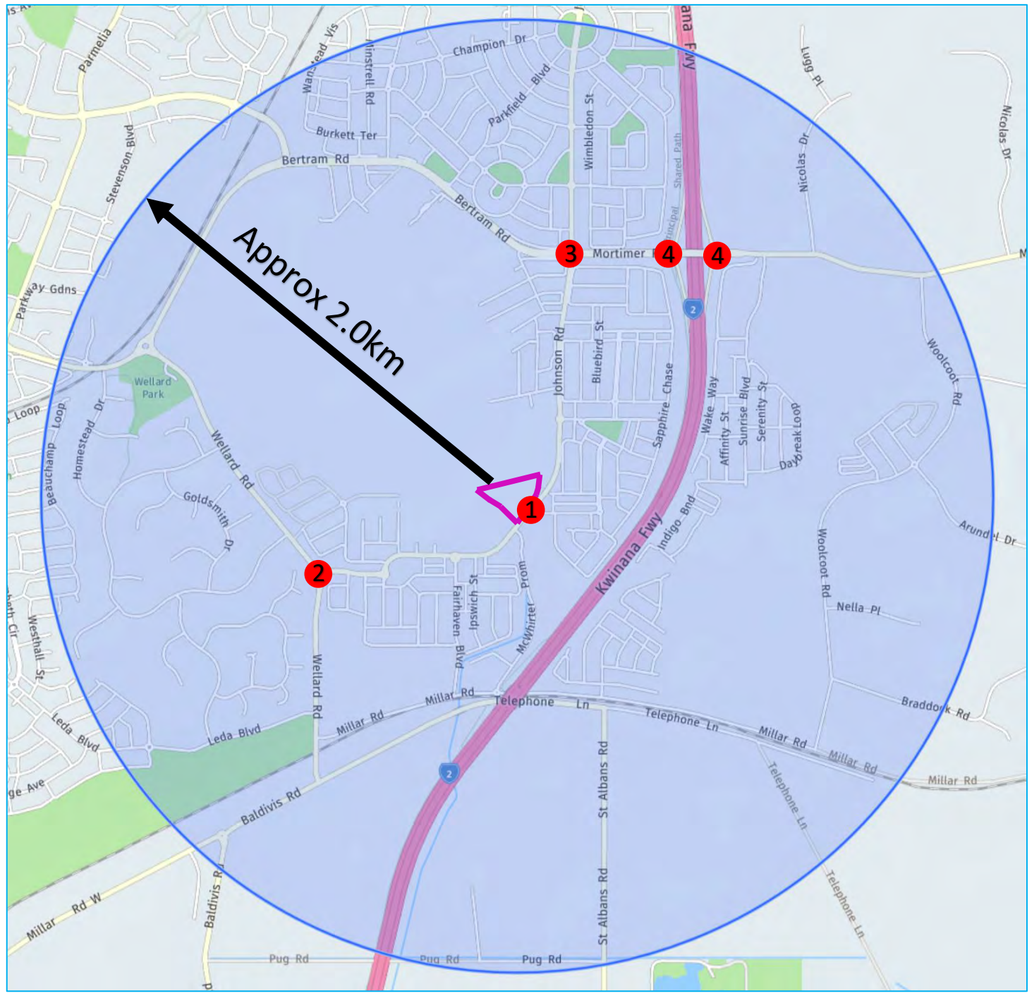


2.4 Existing Key Intersections on Surrounding Road Network

The following key intersections, providing access to the wider road network, are located within a 2.0km radius of the site:

1. Johnson Road / Breccia Parade – Roundabout Intersection.
2. Wellard Road / Cavendish Boulevard – Roundabout Intersection.
3. Bertram Road / Mortimer Road / Johnson Road – Roundabout Intersection.
4. Mortimer Road / Kwinana Freeway Northbound & Southbound On/Off Ramps – Signal Controlled Intersections.

Figure 2-13: Existing Key Intersections within 2.0km of the Site



Existing Key Intersections Surrounding Site

2.5 Existing Traffic Volumes

Existing traffic count data has been obtained from Main Roads WA's online Traffic Map, where available, and City of Kwinana kindly provided traffic volume data from their records for Irasburg Parade, McWhirter Promenade and Johnson Road.

Table 2-1 and Table 2-2 show the average Monday to Friday two-way daily and peak hour traffic volumes on the key roads identified within 2.0km of the Site.

Table 2-1: Existing Traffic Volumes – Johnson Road, Wellard Road and Kwinana Freeway

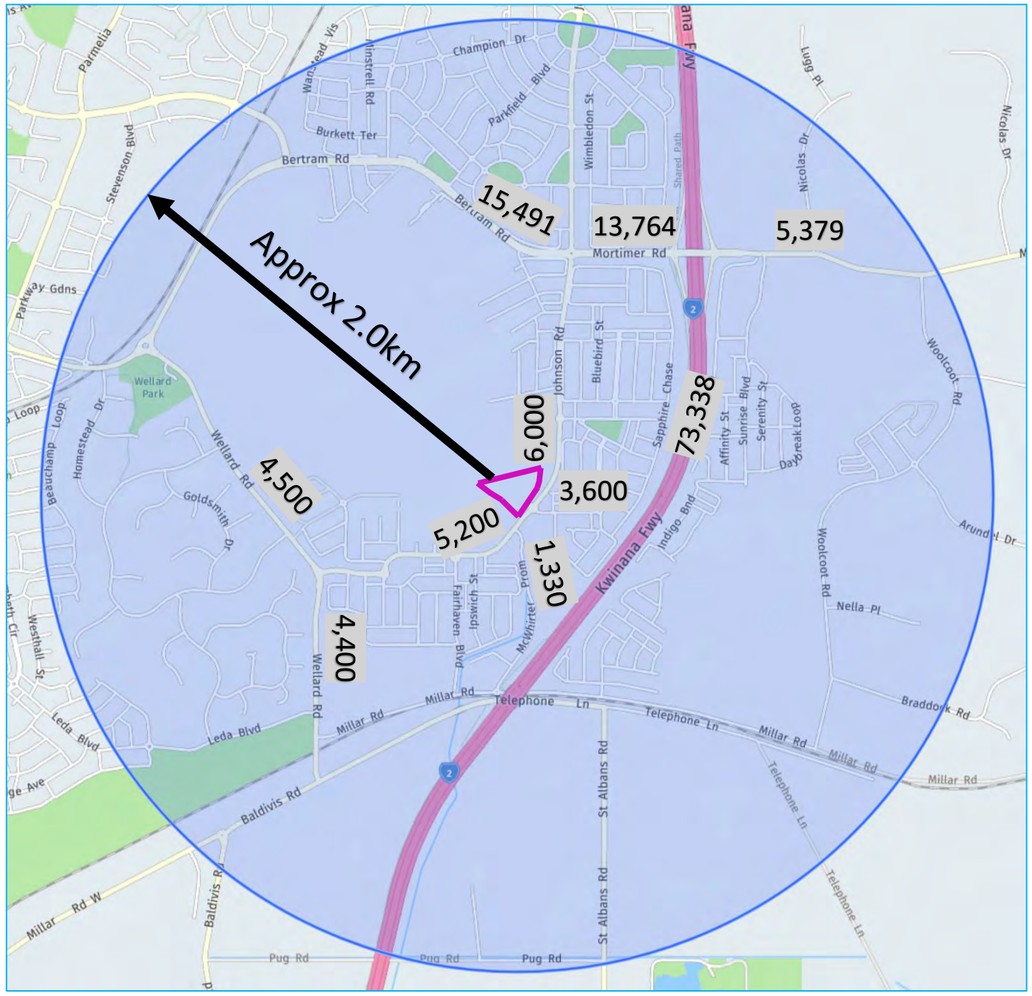
Road Name	Daily Average Mon to Fri (Two-Way)	% Heavy Vehs	AM Peak Hour		PM Peak Hour	
			Northbound	Southbound	Northbound	Southbound
Johnson Road (north of Breccia Parade)	6,000	2%	334	269	267	251
Johnson Road (south of Breccia Parade)	5,200	3%	285	238	224	261
Kwinana Freeway (south of Mortimer Road)	73,338	14%	3,156	2,220	2,373	3,313
			Two-Way		Two-Way	
Wellard Road (north of Cavendish Blvd)	4,500	10%	445		380	
Wellard Road (south of Cavendish Blvd)	4,400	10%	370		370	

Table 2-2: Existing Traffic Volumes – Breccia Parade, Bertram Road and Mortimer Road

Road Name	Daily Average Mon to Fri (Two-Way)	% Heavy Vehs	AM Peak Hour		PM Peak Hour	
			Eastbound	Westbound	Eastbound	Westbound
Breccia Parade (east of Site)	3,600	1%	175	193	131	184
Bertram Road	15,491	5%	711	498	617	629
Mortimer Road	13,764	6%	595	464	530	629

For ease of reference the daily average traffic volumes have been transposed onto **Figure 2-14** over the page.

Figure 2-14: Daily Average Traffic Volume – Monday to Friday (Two-Way)



2.6 Johnson Road / Irasburg Parade / Breccia Parade Roundabout Intersection – 2023 Existing Traffic Volumes

The No.1 key existing intersection in relation the Site is the Johnson Road/Breccia Parade single lane roundabout. This intersection carries traffic volumes to/from Wellard Primary School and is planned to be modified by this subdivision proposal to create access to the Lot 506 site via a new fourth arm into the Site. PJA commissioned a fully classified turning traffic count (Tuesday 24 October 2023) at this intersection to cover both commuter and school peaks for the purpose of the TIA.

The 2023 AM and PM peak hour traffic volumes at this intersection are provided at **Figure 2-15 and Figure 2-16** and the intersection has been tested for operational capacity and performance within the computer modelling software, SIDRA. The results of this capacity assessment are given in **Table 2-3.**

Figure 2-15: 2023 AM Peak Traffic Volumes – Johnson Road / Breccia Parade Intersection

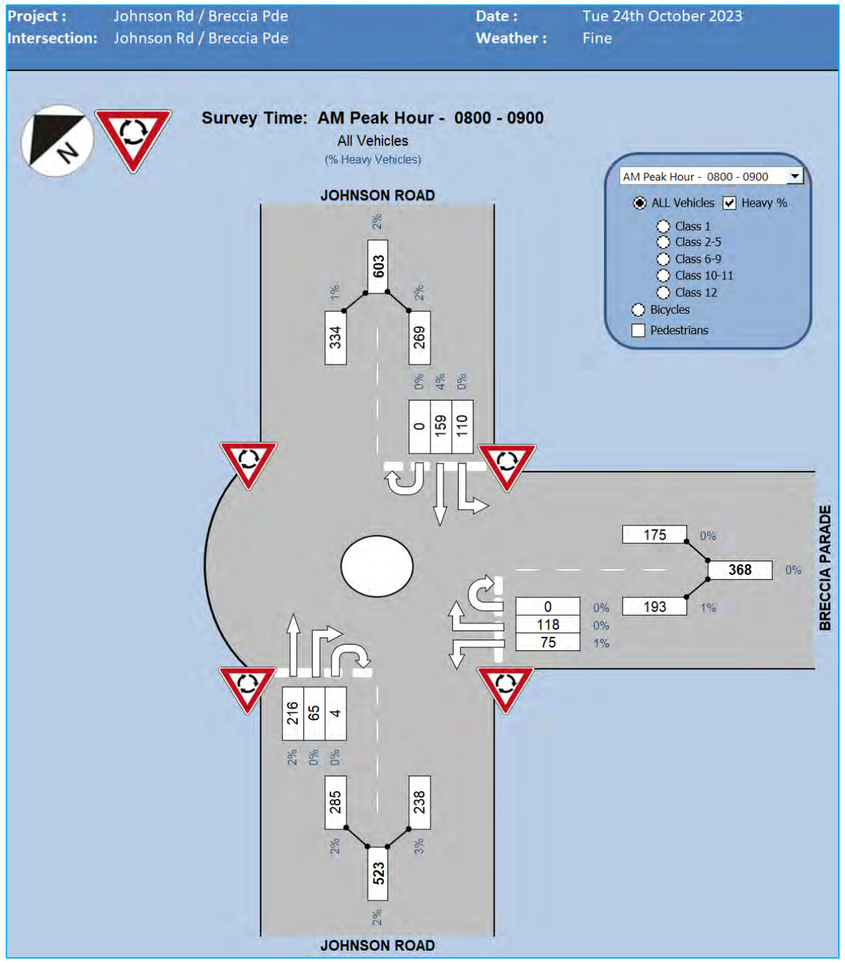
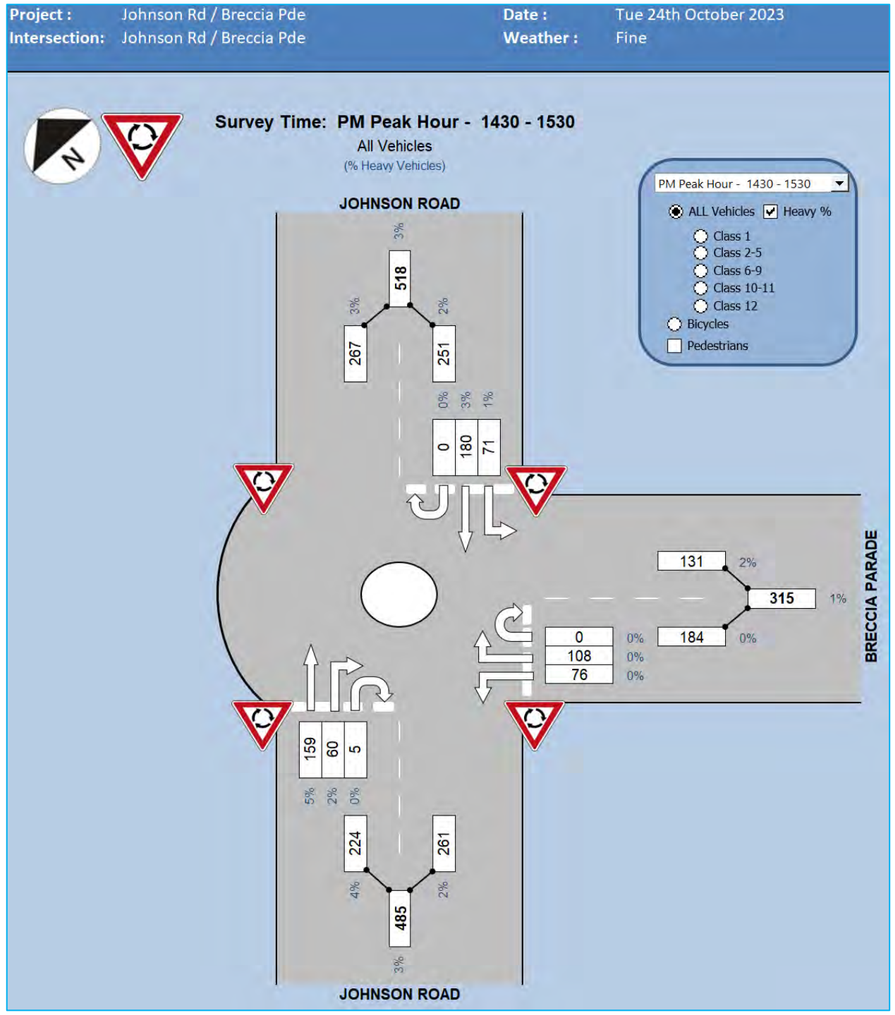


Figure 2-16: 2023 PM Peak Traffic Volumes – Johnson Road / Breccia Parade Intersection



The traffic survey indicates that heavy vehicle volumes comprise approximately 2% to 3% of all vehicles recorded. Interestingly, there were no Restricted Access Vehicle (RAV) movements (Austroads class 10 or above) recorded on this section of Johnson Road/Irasburg Parade which may alleviate some of the uncertainty surrounding the status of this RAV 4 route.

The survey event log showed that in the morning school peak period, there were only two instances (at 08:25 and 08:30) of vehicles stopping on Breccia Road for the Children's crossing combined with the vehicle queue extending back into the roundabout. In the afternoon school peak period there was only one instance of this occurring. In relation to the benefit that stoppages to traffic for crossing children contributes to overall road safety, this situation is considered acceptable because it prioritises vulnerable road users in this location.

Table 2-3: SIDRA Intersection Capacity Results – Johnson Road / Irasburg Parade Breccia Parade Intersection – 2023 AM and PM Peaks

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Int. Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Int. Level of Service	95th %ile Q (m)
Johnson Road / Irasburg Parade / Breccia Parade - Existing Roundabout Layout 2023 Existing Traffic Volumes								
Breccia Parade – South-East Approach								
Through/Left/Right	0.189	5.3	A	8.1	0.183	5.3	A	7.8
Johnson Road – North-East Approach								
Through/Left/Right	0.207	4.6	A	9.8	0.193	4.6	A	8.9
Irasburg Parade – South-West Approach								
Through/Left/Right	0.232	6.0	A	10.9	0.185	6.2	A	8.6
Intersection	**0.232**	**6.0**	**A**	**10.9**	**0.193**	**6.2**	**A**	**8.9**

The SIDRA intersection assessment results shown above indicate that the existing Johnson Road / Irasburg Parade / Breccia Parade single lane roundabout currently operates within recognised thresholds of acceptable performance with degree of saturation less than 0.8, average delays less than 35 seconds for any approach and less than 45 seconds for any individual movement and levels of service 'A' within both AM and PM peak periods. The existing roundabout has spare capacity to accommodate future traffic growth on the road network.

2.7 Existing Pedestrian / Cycle Networks

In the vicinity of the Site, Johnson Road has a single footpath on the eastern side which may be legally shared by pedestrians and cyclists, however Johnson Road itself does not feature any on road cycle facilities. At posted 60km/h near a primary school, this is a safer outcome unless the on-road cycle lanes are physically separated from through vehicles. At the roundabout intersection of Johnson Road/Breccia Road, there are pedestrian crossing points across Johnson Road on the northern arm of the roundabout, including pedestrian ramps and tactile ground surface indicators. However, this crossing point does not currently lead to anywhere on the western side of Johnson Road and it is assumed this has been provided for the future development of land on the western side given is zoning as 'Urban' in the MRS and LPS No.2.

To the south of the intersection with McWhirter Promenade, footpaths exist on both sides of Johnson Road, however the northern side is intermittent and is expected to be completed as part of the adjacent 'Providence Estate' residential development which is currently under construction.

Existing cycle networks are illustrated in

Figure 2-17**.**

To the south and west of the site, Wellard Road and Millar Road include on road cycle lanes in each direction converging into footpath cycle provision at intersections along their length. To the west of the site and en-route to Wellard Train Station, Silversmith Street and Homestead Drive provide an alternative 'Good Road Riding Environment' and Shared Path access to Wellard Road (west of Bertram Road). Wellard Train Station provides bike lockers and shelters.

Further, the posted speed limit on Millar Road and Wellard Road of 80km/h are well above Safe System principles for vulnerable road users sharing the carriageway without any physical separation, noting 10% heavy vehicles along this road.

The closest access the Kwinana Freeway Principal Shared Path (PSP) from the site is approximately 800 metres south via McWhirter Promenade upon which cyclists are able to use the wide footpath. The access to the PSP is located adjacent to the intersection of McWhirter Promenade/Millar Road.

Figure 2-17: Existing pedestrian / cycle networks

2.8 Existing Public Transport

Bus Service 544

The existing bus route within close vicinity of the Site includes the 544, which operates on Johnson Road, stopping in both directions some 30m to 60m south of the intersection with Breccia Parade a distance which is within a five-minute walk of the entre site. Bus service 544 provides a link between the site and Wellard Train Station and Town Centre to the west.

The frequency of service 544 during the week (Mon to Fri) is at an excellent 15 to 20 minute interval in the morning peak period between 06:05am and 08:42am, increasing to an hourly frequency between 09:00am and 2:30pm and then between 20 to 30 minutes frequency between 3:15pm and 7:00pm. The frequency of service on Saturdays and Sundays is hourly during the main part of the day time (08:00am to 8:00pm).

Figure 2-18: Bus Service 544 Timetable (Mon to Fri)

Route 544 - To Wellard

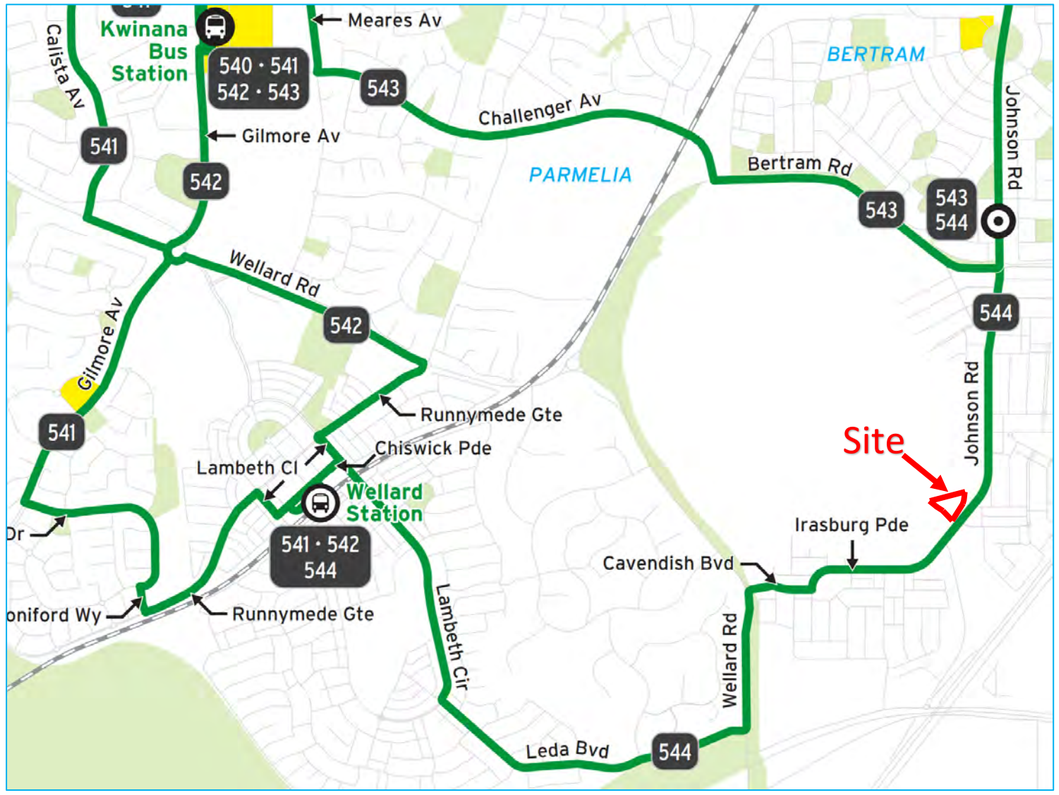
Timed Stops			
Stop No.	23801 / Stand 4	23102	23781 / Stand 4
Route No.	Kwinana Stn	Johnson Rd / Bertram Rd	Wellard Stn
Monday to Friday			
am 544	6:05	6:07	6:20
544	6:25	6:27	6:40
544	6:40	6:42	6:55
544	7:00	7:02	7:15
544	7:24	7:27	7:40
544	7:44	7:47	8:00
544	8:07	8:10	8:23
544	8:27	8:30	8:43
544	8:42	8:45	8:58
544	9:27	9:30	9:43
544	10:24	10:27	10:40
544	11:24	11:27	11:40
pm 544	12:24	12:27	12:40
544	1:24	1:27	1:40
544	2:24	2:27	2:40
544	3:14	3:17	3:30
544 A	3:24	3:30	3:53
544	3:54	3:57	4:10
544	4:24	4:27	4:40
544	4:45	4:48	5:01
544	5:05	5:08	5:21
544	5:25	5:28	5:41
544	5:46	5:49	6:02
544	6:06	6:09	6:22
544	6:26	6:29	6:42
544	6:45	6:48	7:01
544	7:04	7:07	7:20
544	7:39	7:42	7:55
544	8:39	8:42	8:55

Legend

A Operates on school days only and deviates via The King's College.

Source: Public Transport Authority

Figure 2-19: Bus Service 537 Route Map



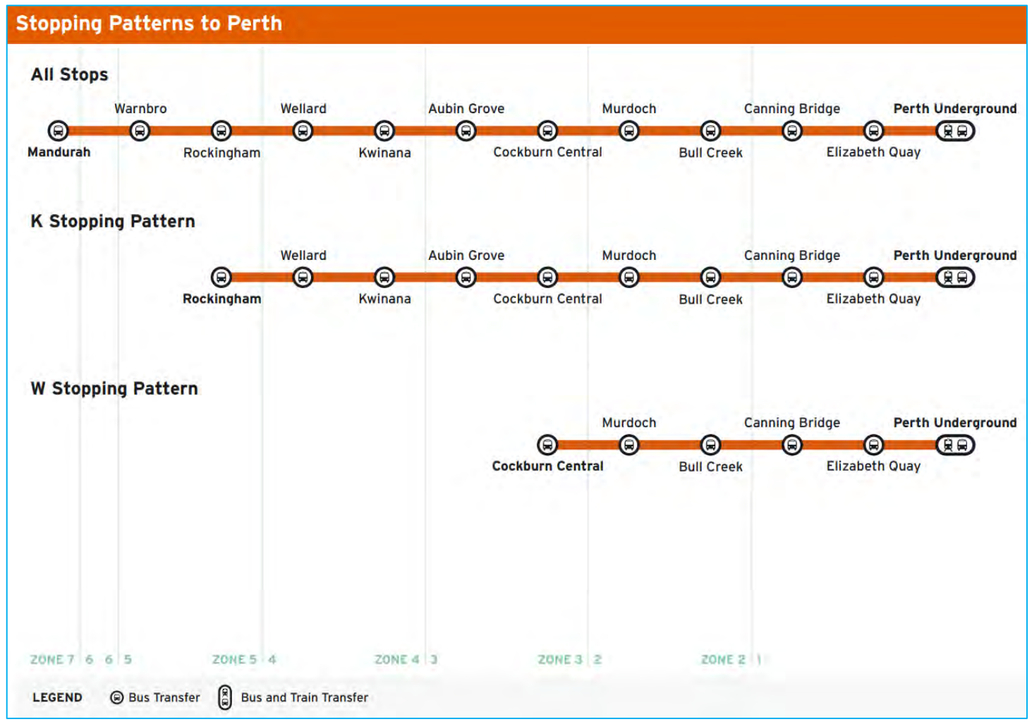
Source: Public Transport Authority

Rail Services

Wellard Train Station is accessible via bus service 544 and provides access to the Mandurah Railway Line and alternate bus services 541 and 542.

During the week, the Mandurah railway line carries passenger rail services between Perth city and stations in between, stopping at Wellard Train Station at intervals of approximately 5 to 10 minutes during the morning peak period and every 10 to 15 minutes during the remainder of the day. The frequency of services from Perth Station to Wellard Train Station are very similar during the evening peak period. The frequency reduces past 10:00pm to every 30 minutes until 12:30am.

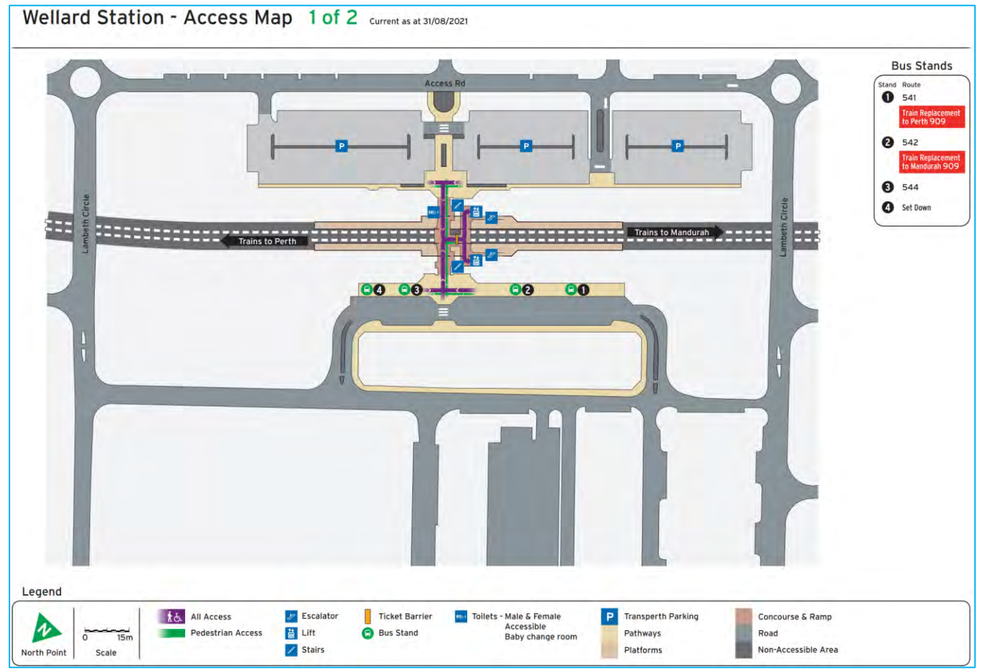
Figure 2-20: Stopping Pattern on the Mandurah Rail Line to/from Perth.

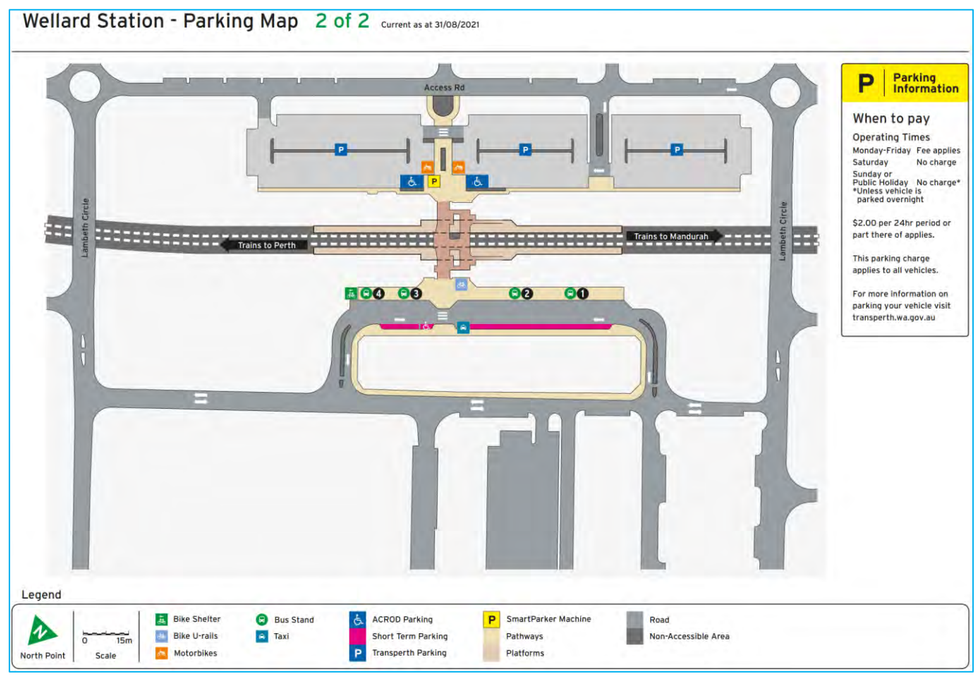


Source: Public Transport Authority

The facilities at Wellard Train Station include a total of 263 long-term parking bays and 13 short-term parking bays with provision for motorcycle parking. The station is listed as 'Independent Access', meaning it meets higher accessibility standards for universal access and access to the station is not via a pedestrian crossing.

Figure 2-21: Wellard Train Station Facilities





2.9 Crash Assessment

A search of the Main Roads WA Reporting Centre for crash data surrounding the site was undertaken for the 2.0 kilometre section of Johnson Road/Irasburg Parade/Cavendish Boulevard between and including the intersections with Wellard Road and Mortimer Road.

This search covered all recorded traffic accidents for the most recently available five-year reporting period between 1 January 2018 and 31 December 2022: The recorded crash statistics are summarised in **Table 2-4 and Table 2-5.**

No crashes are recorded as occurring at the existing roundabout intersection of Johnson Road/Breccia Parade. In addition, no crashes are recorded as occurring at the existing roundabout intersection of Wellard Road/Cavendish Boulevard.

A total of 10 crashes have been recorded on Johnson Road/Irasburg Parade/Cavendish Boulevard between Wellard Road and Mortimer Road, 8 of which involved property damage only type crashes and 2 which involved hospitalisation of those involved as follows:

A summary of the crash types recorded on this section of road are included in **Table 2-4** below.

Table 2-4: Crash Data for Johnson Road/Irasburg Parade/Cavendish Boulevard, between Wellard Road and Mortimer Road.

Type of Crash	Fatal	Hospital	Medical	Major PDO*	Minor PDO*	Total
Rear End	-	-	-	1	1	-
Sideswipe	-	-	-	-	-	-
Hit Object	-	-	-	1	-	-
Head On	-	1	-	-	-	-
Right Angle	-	1	-	3	2	-
Right Turn Thru	-	-	-	-	-	-
Other	-	-	-	-	-	-
Total	-	-	-	-	-	-

**Property Damage Only*

The crash which involved a 'head-on' impact with hospitalisation required, occurred on Irasburg Parade 43 metres east of Fairhaven Boulevard. The crash involved a police pursuit of a stolen vehicle which crashed in this location and struck a private car which had stopped to give way to the police. This crash may be considered a 'one-off' incident in this location and is not attributable to the road environment or geometry of this location.

The crash which involved a 'right-angle' impact with hospitalisation required, occurred on Cavendish Boulevard at the intersection with Huntington Avenue. The right turning vehicle into Huntington Drive failed to give way to a vehicle on Cavendish Boulevard which flipped the vehicle onto its side. Forward sight lines at this intersection are good with the alignment of Cavendish Boulevard relatively straight in this location, so the road environment does not to have been a contributing factor.

In relation to the above crashes and the remaining eight crashes, there appears to be no specific pattern or trend of crash types occurring in one identified location, with most crashes spread across the study area.

A total of 16 crashes have been recorded at the roundabout intersection of Bertram Road/Mortimer Road/Johnson Road. A summary of the crash types recorded at these intersections are included in **Table 2-5 .**

Table 2-5: Crash Data for the Roundabout Intersection of Bertram Road/Mortimer Road/Johnson Road

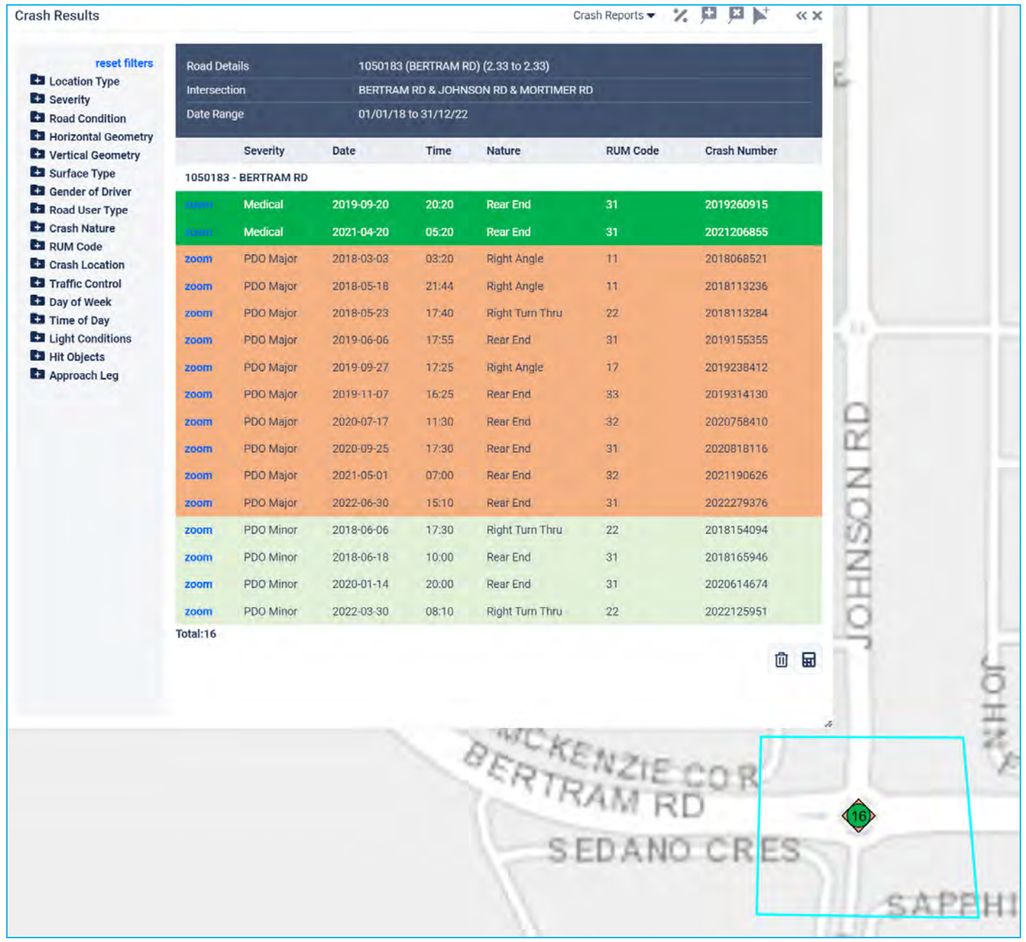
Type of Crash	Fatal	Hospital	Medical	Major PDO*	Minor PDO*	Total
Rear End	-	-	2	6	2	-
Sideswipe	-	-	-	-	-	-
Hit Object	-	-	-	-	-	-
Head On	-	-	-	-	-	-
Right Angle	-	-	-	3	-	-
Right Turn Thru	-	-	-	1	2	-
Other	-	-	-	-	-	-
Total	-	-	-	-	-	-

**Property Damage Only*

Severity	No.	%
Fatal	0	0
Hospital	0	0
Medical	2	12.50
PDO Major	10	62.50
PDO Minor	4	25.00

Year	No.	%
2018	5	31.25
2019	4	25.00
2020	3	18.75
2021	2	12.50
2022	2	12.50

Nature	No.	%
Head On	0	0
Hit Animal	0	0
Hit Object	0	0
Hit Pedestrian	0	0
Non Collision	0	0
Not Known	0	0
Rear End	10	62.50
Right Angle	3	18.75
Right Turn Thru	3	18.75
Sideswipe Opposite Dirn	0	0
Sideswipe Same Dirn	0	0



The majority of the crashes (63%) which have occurred at this intersection are of a ‘rear-end’ type, which appears to be a significant trend, with 2 of the 10 rear-end crashes resulting in medical attention being required. Right turning crashes account for the remaining 37% of crashes in this location.

3 Proposed Structure Plan Development (Internal Transport Network)

3.1 Proposed Residential Development

The Site area is currently zoned 'Urban' under the MRS. Under the provisions of *the City of Kwinana Local Scheme No.2* (LPS No.2) the site area is currently zoned as 'Development'.

The concept structure plan (Appendix A) proposes a residential development only. The potential yield of the development site in terms of its developable land use is expected to be:

Table 3-1: Proposed Land Use Yield

Land Use	Yield
Residential	128 lots

Table 3-1: Proposed Development Summary

3.2 Vehicular Access Arrangements

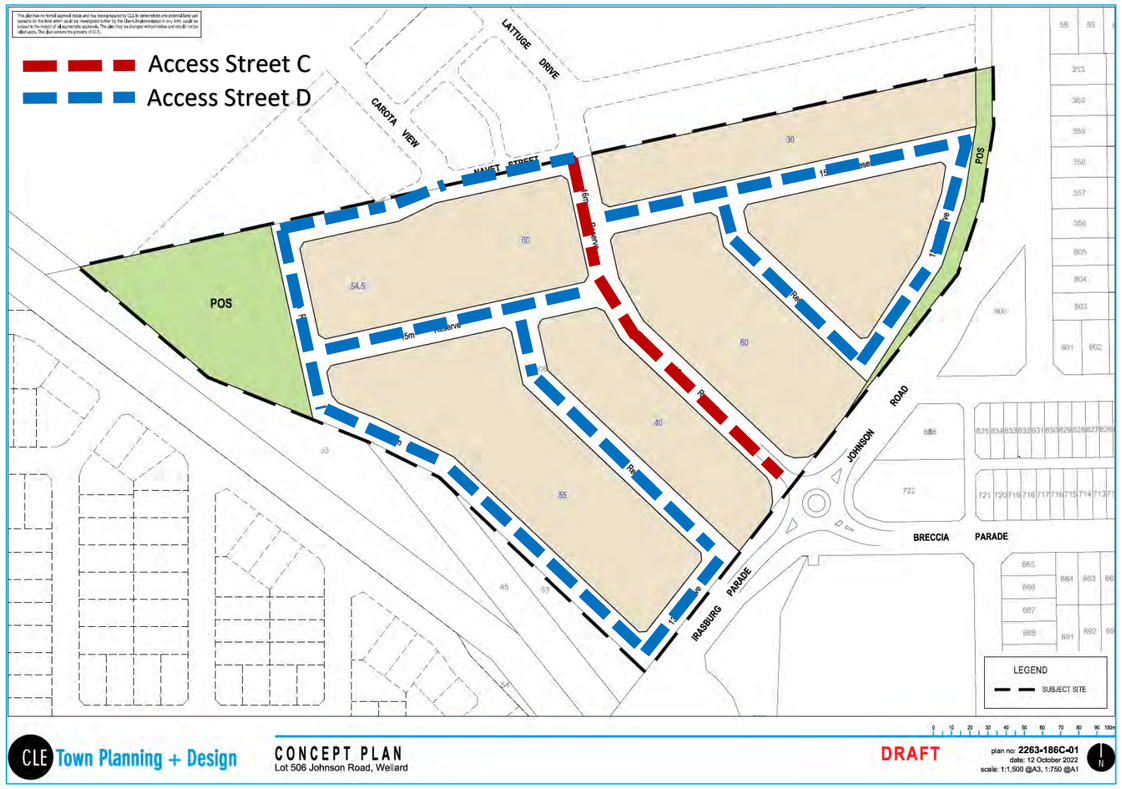
There are currently two informal vehicle access points to the site at the interface with Johnson Road, which are both designated with flush kerb crossover infrastructure and are assumed only for infrequent access to the land. The land uses on the site currently consist of small agricultural holdings with outbuildings within the vacant bushland.

The proposed site Concept Plan (**Figure 3-1**) sets out the indicative future access strategy from Johnson Road. It is intended to construct a fourth road arm at the existing Johnson Road/Breccia Parade roundabout intersection to access the site. The site is also intended to include through vehicular movement from the adjacent Oakabella development to the north via Latitude Drive

A desktop assessment indicates that the proposed access point at the existing roundabout intersection of Johnson Road/Breccia Parade/Irasburg Parade would comply with the Austroads requirements of Safe Intersection Stopping Sight Distance.

3.3 Proposed Internal Transport Networks

Figure 3-1: Proposed Vehicle Access Arrangements – Concept Plan



3.4 Assessment Years and Time Periods

The WAPC Guidelines for TIAs states that because Structure Planning is usually a longer-term process, the development of a structure plan area may occur over a number of years, often 15 to 20 years into the future. The WAPC guidelines also suggest that the analysis of the analysis of the transport network should therefore be undertaken for the assumed year of full development.

The developer, Wellard Residential Pty Ltd, has confirmed that it is their expectation that Lot 506 will be fully built out and occupied within the next five-year timeframe, based on the progression of their adjacent development site, Providence Estate. In addition, the Oakabella Estate is also already established and has a proposed future vehicle linkage through Lot 506, which is likely required to be completed within this same timeframe. Section 6.1 of this assessment has further details on this situation.

Assessment time periods will be in line with the existing recognised AM and PM peak periods 08:00 – 09:00 and 14:30 – 15:30 respectively. Section 6 of this report discusses the assessment years, times and development traffic generation in more detail.

3.5 Road Cross Sections and Intersection Controls

As shown in **Figure 3-1 ,** there is one proposed Access Street C. This will feature a 16m wide road reserve and at least footpaths on both sides as per the requirement of *Liveable Neighbourhoods*. The remaining Local Access Roads (Access Street D) will include a 13m to 15m wide road reserve with at least one footpath on one side of the roads as per current guidelines. Laneway access to properties will have a 6m wide road reserve.

The intersections within the site where two roads meet will take the form of T-Intersections spaced at or more than the appropriate distance criteria of 20m as per Liveable Neighbourhoods guidance for an Access Street.

3.6 Pedestrian and Cyclist Access

Pedestrian and cyclist access has not yet been fully defined for this site, however it should be provided generally in accordance with the requirements of the guidance for *Liveable Neighbourhoods*. The approved Oakabella site immediately to the north of Lot 506 will feature pedestrian and cyclist infrastructure which is expected to seamlessly integrate and extend through Lot 506.

As part of the Oakabella Estate Local Structure Plan, prepared by TBB in July 2016, the Movement Network Diagram (refer to **Figure 4-4** – page 27) shows the introduction of a Shared Path network through the Oakabella Estate and extending through the Lot 506 site (by others). It is understood that the developer of Lot 506 could deliver the extension of this planned cycle and footpath infrastructure through the site to connect with Johnson Road at the Breccia Parade roundabout.

Following the guidance of the WAPC *Liveable Neighbourhoods* Policy, the proposed pedestrian and cyclist facilities aim to provide a permeable road network within the subject site and create excellent opportunities for the provision of good pedestrian and cyclist facilities that maximise the use of non-motorised transport modes. Section 5 of this report discuss access to public transport and recommended improvements.

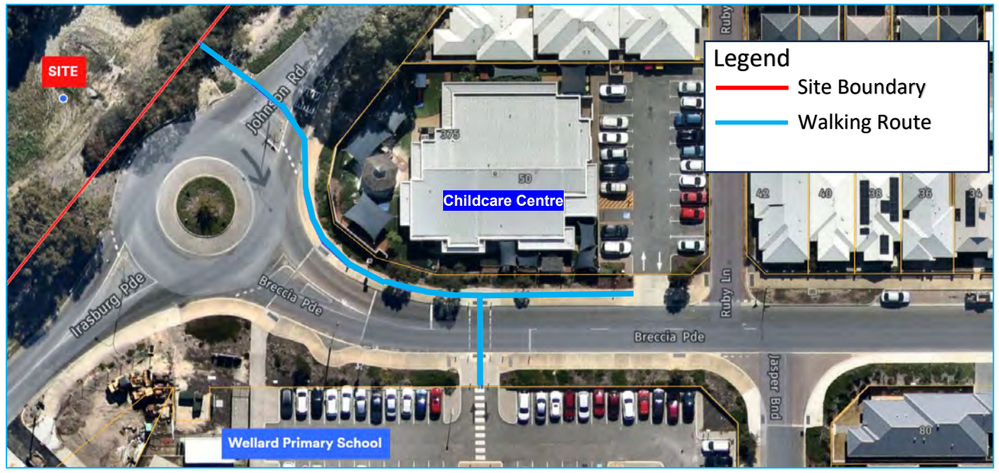
3.7 Safe Walk/Cycle to School Assessment

As discussed previously, the Site is bounded to the east and south by existing residential development, Wellard Primary School and a child care centre.

The likely routes that residents may take from the site to access the school and the child care centre will likely be via the internal street network and across Johnson Road using the Breccia Parade roundabout intersection. There is an existing Children's Crossing on Breccia Parade approximately 30 metres east of Johnson Road.

However, the current posted speed limit on Johnson Road and Irasburg Parade (north of McWhirter Promenade) is 60km/h and this section of road is not covered by a peak period Schol Zone Speed Limit, which currently is limited to Breccia Parade. This current situation may present a barrier to movement for school trips by foot and cycle between the Lots 506, Oakabella Estate and Wellard Primary School as well as road safety concerns during the school peak periods following the build out of these sites and the completion of the road and footpath connections to Johnson Road. Section 5.4 of this assessment discusses recommendations to improve this situation.

Figure 3-2: Walking Route to Wellard Primary School and Day Care Centre from Lot 506



Further afield to the south-west of the site is Wellard Village Primary School which is accessible using bus service 544 and Bertram Primary School and St Vincent's School to the north and north-west respectively of which both are unlikely to be accessed on foot or by cycle.

It is concluded that the likely routes that will be taken by residents of the proposed development area to access the nearby Wellard Primary School should be suitable, as continuous footpaths will likely be provided along all of the sections with crossing facilities already provided on Breccia Parade.

However, it is a recommendation of this report that prior to the full build out of the Oakabella and Lot 506 sites, City of Kwinana in conjunction with Main Roads WA (custodian of speed zoning in Western Australia) should investigate the extension of the Breccia Parade School Speed Zone to include a length of Johnson Road specifically surrounding the likely crossing point at the Breccia Parade roundabout intersection. It is expected that this will improve road safety for school children and parents crossing Johnson Road in the future.

3.8 Public Transport Routes

There are no proposed public transport routes intended through the development site. Section 2.8 of this report details the existing public transport bus route 544 on Johnson Road which is within easy walking distance of the site and integrates well with the proposed residential development.

4 Changes to External Transport Network

4.1 Changes to Road Network

A thorough review of proposed changes to the surrounding local and primary road network has been undertaken by exploring current and future projects with City of Kwinana and Main Roads WA. Extensive consultation has been undertaken with City of Kwinana regarding road upgrade projects which will directly affect Johnson Road or any of the roads immediately surrounding the site with a 2.0km radius. An appraisal of State Government road projects in the area has been undertaken using the Main Roads WA website, which contains an extensive library of current and future road projects. At the present time there are no significant Main Roads WA projects within the area.

Other projects, these being City of Kwinana projects are noted below.

4.1.1 Wellard Road Upgrade – Bertram Road to Cavendish

City of Kwinana has confirmed that the Wellard Road Upgrade is scheduled to take place with the next five-year time period. The carriageway will be widened to include two lanes on each side (dual carriageway) with a central median island along its length.

4.1.2 Mortimer Road MRS Widening Works

City of Kwinana has also confirmed that the Mortimer Road MRS widening works are in progress under the Department of Planning, Lands and Heritage. The upgrades to Mortimer Road will be limited to realignment and reconstruction of the current road to a 7.4m pavement width, as well as the installation of a 2.5m wide dual use path. Additional items include:

- Construction of two roundabouts at the junctions of Woolcoot Road and the Neighbourhood Connector.
- Drainage to both sides of Mortimer Road.
- Street lighting
- The undergrounding of power.

4.1.3 Recent Significant Works

Prior to September 2016, Johnson Road was under a different alignment more suited to heavy vehicles movements than is currently the case today. Around September 2016, the Johnson Road/Breccia Parade roundabout intersection was constructed together with the realignment of Johnson Road, the creation of McWhirter Promenade and the connection of Irasburg Parade. These significant road modifications were undertaken as part of the Providence Estate development access from Irasburg Parade and other nearby residential developments off Breccia Parade.

These changes to the local road network over the past 7 to 8 years represent the most significant recent changes surrounding this site in terms of public works. This TIA is based upon these changes which are now fully operational, with the exception of the completion of the Providence and Oakabella sites which are discussed further below.

4.2 Oakabella Estate - Residential Development

The Oakabella Estate in Wellard is located immediately to the north of Lot 506 Johnson Road. The Oakabella Estate is an approved residential development comprising a total of 400 new homes. The site is currently under construction and an appraisal of current aerial imagery (August 2023), the site appears to be approximately 50% constructed with approximately 223 houses constructed or under-construction, with an estimated 182 homes currently occupied. Therefore, an estimated **218** homes in the Oakabella Estate are yet to be occupied and generate traffic movements.

The Oakabella Estate is intended to extend through and integrate with the Lot 506 site via an extension of Lattuge Drive which will ultimately connect with Johnson Road at the existing Breccia Parade roundabout. Consideration of the Oakabella Estate as a committed development and its vehicular connections through the Lot 506 site are included in this Transport Impact Assessment. The Oakabella Estate and its intended connections with Lot 506 are shown on **Figure 4-1 .**

Figure 4-1: Oakabella Estate - Wellard

4.3 Providence Estate - Residential Development

The Providence Estate in Wellard is located immediately to the west of Lot 506 Johnson Road and is accessed off Irasburg Parade and Cavendish Boulevard. The Providence Estate is an approved residential development comprising a total of 787 new homes. The site is currently under construction and an appraisal of current aerial imagery (August 2023), the site appears to be approximately 70% constructed, with approximately 572 houses constructed or under-construction, with an estimated 534 homes currently occupied. Therefore, an estimated **253** homes in the Providence Estate are yet to be occupied and generate traffic movements.

Consideration of the Providence Estate as a committed development and its vehicular connections to Irasburg Parade and Cavendish Boulevard are included in this TIA. The Providence Estate is shown on **Figure 4-2.**

Figure 4-2: Providence Estate - Wellard

4.4 Changes to Pedestrian and Cycle Network

Pedestrian Footpath Network:

There are currently no City of Kwinana planned pedestrian footpath improvement works in the area other than the minor footpath projects completed in recent years. However, as part of the future Oakabella Estate and Providence Estate residential developments, the footpath network on the future Lattuge Drive (internal to Oakabella) and footpaths along the eastern section of Irasburg Parade will be constructed to improve footpath connectivity to surrounding services and areas.

Long-Term Cycling Network – Perth and Peel:

The Department of Transport's (DoT) Long-Term Cycling Network (LTCN) was endorsed by the City of Kwinana in 2020. In terms of the Long-Term Cycle Network (past the proposed site access), Johnson Road is classified as a 'Local Route' meaning:

> *"Lower level of demand providing critical access to higher order routes, local amenities, and recreational spaces. Predominantly located in local residential areas, local routes often support the start or end of each trip, and as such need to cater for the needs of users of all ages and abilities."*

Local Routes are often characterised by integrated cycle facilities i.e., sharing the same space as vehicles, with lower order speed limits typically 50km/h of less. Johnson Road in the location of Lot 506 is currently subject to a 60km/h speed limit.

Most significantly, Wellard Road and Millar Road are classified as a 'Secondary Route' meaning:

> *"moderate level of demand, providing connectivity between primary routes and major activity centres such as shopping precincts, industrial areas or major health, education, sporting and civic facilities."*

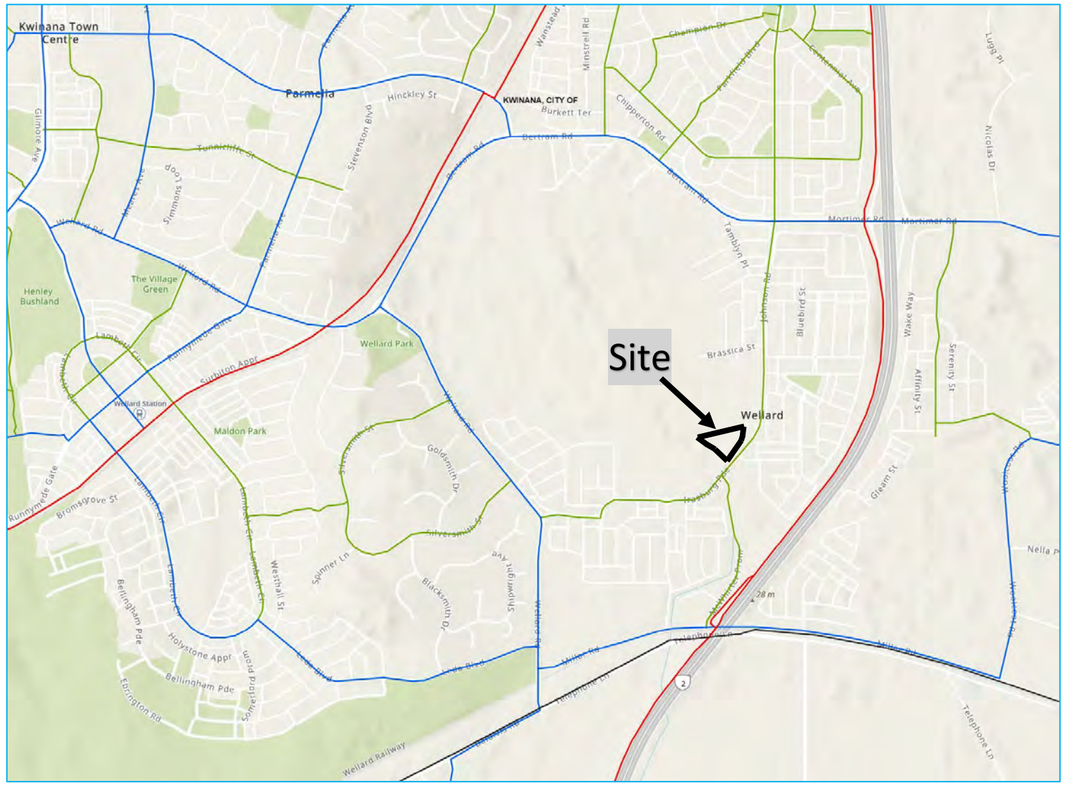
Wellard Road and Millar Road currently include on-road cycle lanes in both directions, which are not separated from vehicular traffic with a prevailing speed limits of 80km/h on both roads.

When comparing existing and proposed future cycle infrastructure in the area of Lot 506, two key additions are included in the Long-Tern Cycling Network Plan.

- A new Secondary Route via Leda Boulevard and Lambeth Circle to the west of Lot 506 providing linkages to/from Wellard Town Centre and Wellard Train Station.
- A new Primary Route is proposed along the Mandurah Train Line, south of Wellard Road and passing through Wellard Train Station and beyond.

The development site Lot 506 is well placed to take advantage of the DoT's Long-Term future strategy for the cycling network which would encourage trips by cycle for commuting and recreational purposes.

Figure 4-3: Long-Term Cycling Network – Perth and Peel



Primary Routes
High demand corridors that connect major destinations of regional importance. They form the spine of the cycle network and are often located adjacent to major roads, rail corridors, rivers and ocean foreshores. Primary routes are vital to all sorts of bike riding, including medium or long-distance commuting / utility, recreational training and tourism trips.
Secondary Routes
Moderate level of demand, providing connectivity between primary routes and major activity centres such as shopping precincts, industrial areas or major health, education, sporting and civic facilities.
Local Routes
Lower level of demand providing critical access to higher order routes, local amenities, and recreational spaces. Predominantly located in local residential areas, local routes often support the start or end of each trip, and as such need to cater for the needs of users of all ages and abilities.

Oakabella Estate and Johnson Road Shared Path Network:

As part of the Oakabella Estate Local Structure Plan, prepared by TBB in July 2016, the Movement Network shows the introduction of a Shared Path network through the Oakabella Estate and extending through the Lot 506 site (by others). It is understood that the developer of Lot 506 has the potential to deliver the extension of this planned cycle and footpath infrastructure through the site to connect with Johnson Road at the Breccia Parade roundabout.

In addition, the existing footpath network on the eastern side of Johnson Road, is shown as allocated for upgrade to a Shared Path standard, connecting to Mortimer Road in the north and along the Lot 506 frontage (eastern side) in the south. The Lot 506 site is ideally located to take advantage of this planned infrastructure improvement.

Figure 4-4: Oakabella Estate Local Structure Plan 2016 – Movement Network

4.5 Changes to Public Transport Network

PJA contacted the Public Transport Authority and was advised that there are no changes likely in the area to bus services.

Section 2.8 noted there is an existing bus route 544 within close vicinity of the site, which operates on Johnson Road, stopping in both directions some 30m to 60m south of the intersection with Breccia Parade a distance which is within a five-minute walk of the entre site. Bus service 544 provides a link between the site and Wellard Train Station and Town Centre to the west.

The existing frequency of service 544 during the week (Mon to Fri) is at an excellent 15-to-20-minute interval in the morning peak period between 06:05am and 08:42am, increasing to an hourly frequency between 09:00am and 2:30pm and then between 20 to 30 minutes frequency between 3:15pm and 7:00pm. The frequency of service on Saturdays and Sundays is hourly during the main part of the day time (08:00am to 08:00pm). It is considered that these excellent frequencies will continue to encourage trips by public transport as the development site continues to build out.

5 Integration with Surrounding Area

5.1 Surrounding Attractors / Generators

The surrounding area primarily consists of residential land use and Wellard Primary School immediately to the east of Johnson Road opposite the site.

The Bertram Shopping Centre is located approximately 2.0km north via Johnson Road. The Kwinana Town Centre is approximately 5.0km north-west of the site. The Wellard Village Centre is located surrounding the Wellard Train Station, which his approximately 4.0km west of the site.

The primary traffic generator in the surrounding area is the expanding residential development and Wellard Primary School.

The Kwinana Freeway, accessible some 1.5km north-east from the Site, providing access to the major employment areas to the north and south of Wellard, with strategic road links to the remaining metropolitan area.

5.2 Proposed Changes to Surrounding Land Uses

The key proposed change to the surrounding land uses within an approximate 2.0km of the site is shown on the MRS, being the allocation of land to the east of the Kwinana Freeway and bounded by Millar Road and Woolcoot Road. The MRS designates this land for further development 'Urban' and 'Urban Deferred'. City of Kwinana's Town Planning Scheme designates this area of land as 'Development' and 'Cluster/Communal Rural Settlement', the development of which are unlikely to significantly impact on Johnson Road and the immediate local network of Lot 506.

Figure 5-1 illustrates the site area's current MRS zoning, (Map Sheet 24).

Baldivis (North) District Structure Plan:

To the south of Telephone Lane and immediately west of the Kwinana Freeway, a change to the current land use is the MRS designated 'Urban' zone along the corridor between the Freeway and Baldivis Road. The Millars Landing Estate is already in development in this area. In addition, the west of Baldivis Road, the MRS designates a large area of land as 'Special Use' (SU). The increased traffic flow resulting from this area will need to be monitored and addressed in the planning and development of the area.

North-East Baldivis District Structure Plan:

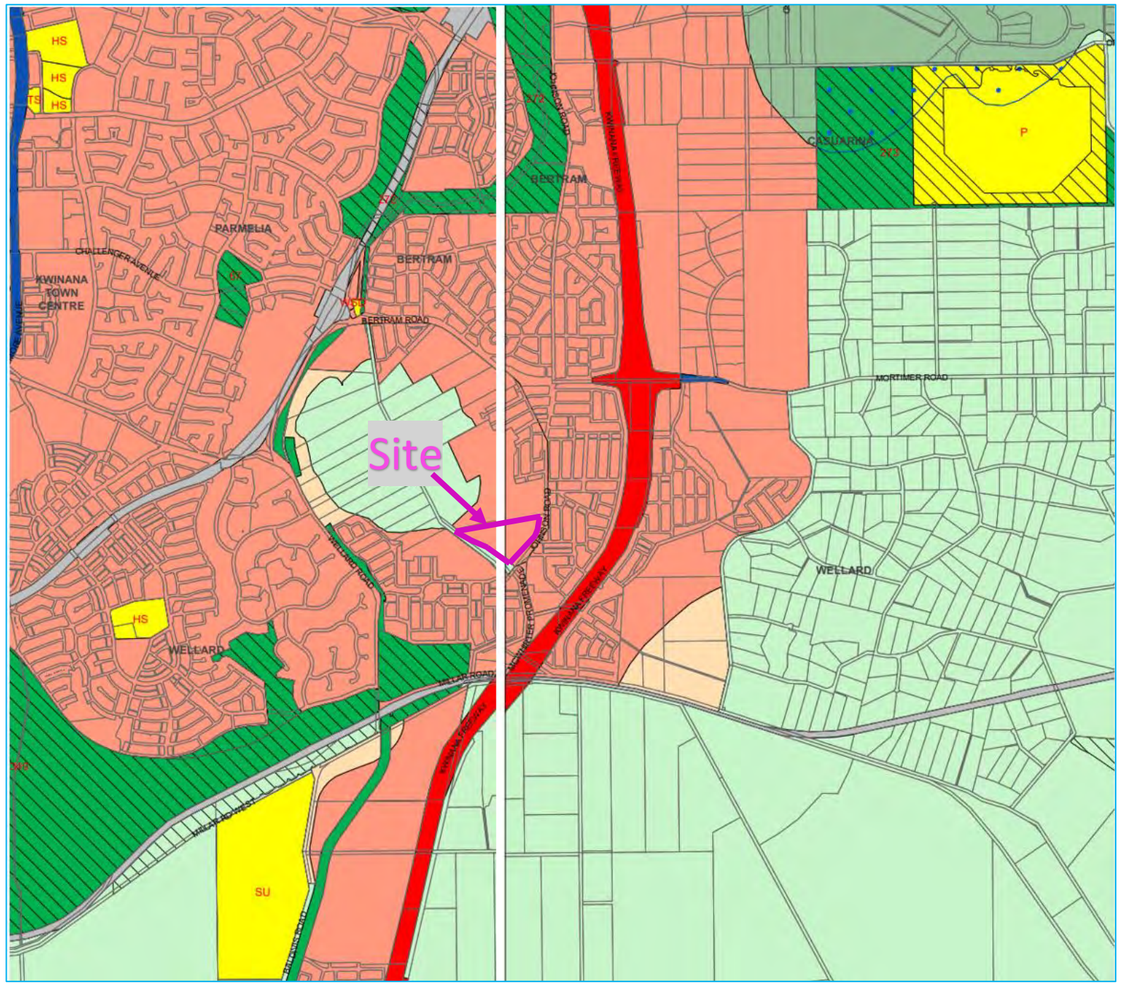
Whilst not currently shown on the MRS (currently allocated as 'Rural' land use), the 'North-East Baldivis District Structure Plan' is located immediately to south of Telephone Lane and to the east of the Kwinana Freeway. This Planning Investigation Area (PIA) was approved by the Transport Minster in September 2022 as 'Urban Investigation' and includes proposed land uses such a primary school, high school, local centre, residential and employment. A DSP is currently underway for this area led by the proponent and has not been advertised at the time of writing this report. The increased traffic flow resulting from this DSP will need to be carefully managed and addressed in the planning and development of the area.

Figure 5-2 illustrates the North-East Baldivis District Structure Plan location. Figure 5-3 illustrates the overall Planning Investigation Area.

5.3 Level of Overall Accessibility

When the land is fully developed, the Site will form part of a wholly integrated residential suburban area with appropriate and ideal vehicular connections to the primary and road network, including the Kwinana Freeway, Thomas Road, Mundijong Road and Safety Bay Road providing an excellent level of vehicular access to and from the Site.

Figure 5-1: MRS Zone Map Sheet 27 and 28 – Map Name: Rockingham and Mundijong (respectively)



Source: Metropolitan Region Scheme

Figure 5-2: North-East Baldivis District Structure Plan Location

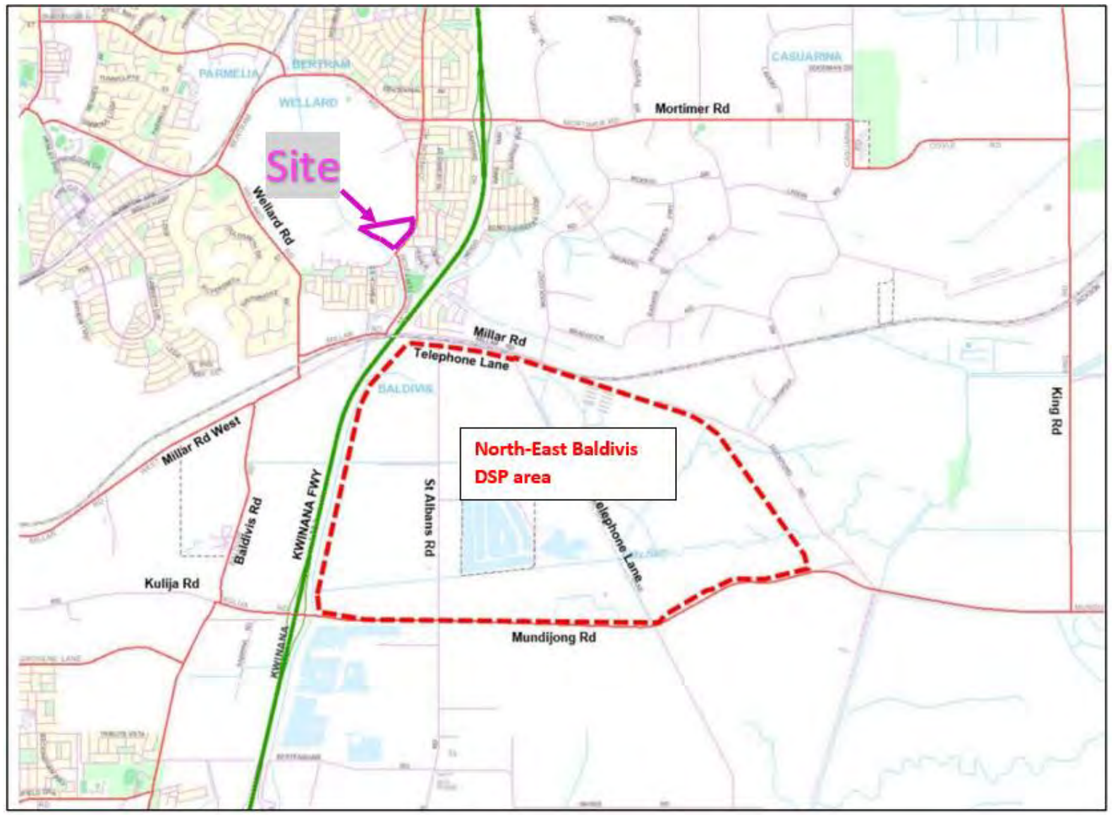


Figure 5-3: East of Kwinana Planning Investigation Area

Source: wa.gov.au

5.4 Pedestrian and Cyclist Accessibility (Lot 506 Johnson Rd)

The existing footpath network on the eastern side of Johnson Road provides good links to the surrounding residential area and local centres. To the south of the intersection with McWhirter Promenade, footpaths exist on both sides of Johnson Road, however the northern side is intermittent and is expected to be completed as part of the adjacent 'Providence' residential development which is currently under construction.

However, there is no existing footpath on the western side of Johnson Road (fronting the Site), which will create a barrier to pedestrian and cycle trips to/from the development Site. It is a recommendation of this report that investigations be undertaken to extend the existing footpath network on the western side of Johnson Road to link in with the crossing location at the Breccia Parade roundabout and also to continue south and link in with the proposed footpath to be constructed adjacent to the Providence Estate. A footpath in this location will also connect with the existing bus stop on Johnson Road, just south of Breccia Parade. If feasible, this would encourage trips on foot and micro-mobility to local centres, Wellard Primary School and access to bus stops to help increase public transport usage and reduce the reliance on private vehicle modes. The funding mechanisms for which these improvements could be budgeted, would be with the City of Kwinana.

Furthermore, it is a recommendation of this Transport Impact Assessment that City of Kwinana in consultation with Main Road WA (custodians of speed zoning in WA), investigate the potential to reduce the prevailing speed limit of Johnson Road and Irasburg Parade on both approaches to the Breccia Parade roundabout from 60km/h to 50km/h and introduce a School Zone Speed Limit (40km/h) on Johnson Road and Irasburg Parade, to include the roundabout at Breccia Parade, with the intention of improving road safety for vulnerable road users crossing Johnson Road between Lot 506 site, Oakabella Estate and Wellard Primary School once these developments are significantly occupied.

This recommended speed limit change would effectively comprise an extension of the existing 50km/h speed zone on Irasburg Parade, south of McWhirter Promenade, which was implemented following the Providence Estate development and would therefore be a natural extension of the 50km/h limit as the land along Irasburg Parade and Johnson Road develops into the future.

In terms of cyclist accessibility, it is also a recommendation of this report that in light of the DoT's Long-Term future strategy for the cycling network (LTCN), specifically the allocation of Wellard Road and Millar Road as 'Secondary Cycling Routes', City of Kwinana should be encouraged to investigate improving the safety of cycling facilities along these roads both in terms of potentially reducing the speed limit of each road down from 80km/h and/or segregate the cycling infrastructure from the carriageway and speed of passing traffic.

Such measures would work towards 'Safe System Principles' with the aim of improving safety for vulnerable road users and improve road user collision outcomes. It is recommended that City of Kwinana investigate the integration of the need for cycle segregation along Wellard Road as part of their proposed widening works within the next five-year timeframe.

The development site is well placed to take advantage of the DoT's Long-Term future strategy for the cycling network (LTCN) and the future Shared Path network upgrades in the Oakabella Estate and on the eastern side of Johnson Road, which would all combine to encourage trips by cycle for commuting and recreational purposes.

6 Analysis of Transport Network

6.1 Assessment Years and Time Period

The WAPC Guidelines for Transport Impact Assessment states that because structure planning is usually a longer-term process, the development of a structure plan area may occur over a number of years, often 15 to 20 years into the future. The WAPC guidelines suggest that the analysis of the analysis of the transport network should therefore be undertaken for the assumed year of full development.

Whilst the above is acknowledged, given the Lot 506 site is a relatively small development area and is an extension of the existing Providence Estate west and is located in close proximity to the Oakabella Estate to the north, both of which are currently under construction, an appropriate and realistic sense of the likely timeframe for full build out and occupancy of Lot 506 has been investigated.

The developer, Wellard Residential Pty Ltd, has confirmed that it is their expectation that Lot 506 will be fully built out and occupied within the next five-year timeframe, based on the existing progression of the Providence Estate. In addition, the Oakabella Estate is also already established and has a proposed future vehicle linkage through Lot 506, which is likely required to be completed within this same timeframe.

As such, it is reasonable to assume the future year assessment of full build out and occupancy of the Lot 506 site will be within the next five-year timeframe and therefore the likely main traffic growth along the Johnson Road/Irasburg Parade corridor into the future will be as a result of the neighbouring Providence and Oakabella residential developments in addition to the Lot 506 site. This is particularly applicable given the location of Johnson Road, between Wellard Road and Mortimer Road and the nearby alternative major transport routes of the Kwinana Freeway and Bertram Road.

Therefore, given the establishment of the above and the acknowledgement that the WAPC guidance is perhaps more suited to larger structure plan areas, to test the adequacy of the road network at this 'Structure Plan' stage of the planning process, based on the assumed year of full development, the future site access intersection at Johnson Road/Breccia Parade roundabout has been assessed for capacity under the following scenario:

- Assessment Scenario - Ultimate 2029 Traffic Volumes with full build out of Lot 506 residential development.

Assessment time periods will be in line with the existing recognised AM and PM peak periods 08:00 – 09:00 and 14:30 – 15:30 respectively.

6.2 Background Traffic

The background traffic for this assessment has been derived from existing traffic data provided by City of Kwinana for surrounding roads and also PJA has commissioned a fully classified traffic count of the Johnson Road/Breccia Parade roundabout intersection, undertaken on Tuesday 24 October 2023, to establish up to date traffic volume data for Johnson Road and Breccia Parade.

The capture of traffic data within this survey accounts for the traffic generation of the previously identified 182 occupied homes in the Oakabella Estate and 534 occupied homes in the Providence Estate. The traffic generation associated with the remaining 218 and 253 homes respectively (417 total) will be added to the road network for assessment purposes as detailed further in Section 6.5, 6.6 and 6.7 of this report.

6.3 Traffic Growth

Furthe to the information contained in Section 6.1, an assessment of the expected traffic growth on Johnson Road and Irasburg Parade over the next five year timeframe (development full build out horizon), and in consideration of the surrounding land use allocations and the level of residential development currently under construction at sites off Johnson Road and Irasburg Parade such as Providence Estate and Oakabella Estate, it is considered that together with the development of Lot 506, the main element of traffic growth over this time period will be the afore mentioned residential developments.

As such, the future traffic growth assessment assumed on Johnson Road will include 100% build out and occupancy Providence Estate and Oakabella Estate, a total of 1,200 new homes. The expected traffic generation of the Lot 506 site will be added to the background traffic and this traffic growth for assessment purposes within this TIA.

6.4 Traffic Generation – Lot 506 Johnson Road

The traffic generation rates in **Table 6-1** , sourced from the WAPC Guidelines, have been used to calculate an estimate of the traffic generated in the AM and PM peak periods by the proposed Lot 506 residential development. Given the location of the site, the above is considered a robust trip rate, with no reductions applied to account for linked or internal trips.

Table 6-1: WAPC Trip Generation Rates

Land Use	AM Peak Hour		PM Peak Hour	
	IN	OUT	IN	OUT
Residential	0.2 trips per dwelling	0.6 trips per dwelling	0.5 trips per dwelling	0.3 trips per dwelling

Table 6-2 and Table 6-3 summarises the trip volumes derived from the adopted generation rates.

Table 6-2: Peak Hour Proposed Development Traffic Generation – Lot 506 Johnson Road

No of Dwellings	AM Peak Hour		PM Peak Hour	
	IN	OUT	IN	OUT
128	26	77	64	39

Table 6-3: Estimated All Day Proposed Development Traffic Generation – Lot 506 Johnson Road

No of Dwellings	All Day Traffic Volume
	Two-Way
128	1,000 – 1,100 vpd*

*Based on 8 trips per dwelling per day.

6.5 Traffic Generation – Oakabella Estate

The traffic generation associated with the remaining 218 homes yet to be occupied at the Oakabella Estate has been calculated for assessment purposes based on the rates in Table 6-1. These rates have been used to calculate an estimate of the future committed traffic yet to be generated in the AM and PM peak periods by the Oakabella Estate. The traffic generation has been distributed onto the road network as shown in Section 6.7 of this report.

Table 6-4: Remaining (Future) Development Traffic Generation – Oakabella Estate

No of Dwellings	AM Peak Hour		PM Peak Hour	
	IN	OUT	IN	OUT
218	44	131	109	65

6.6 Traffic Generation – Providence Estate

The traffic generation associated with the remaining 253 homes yet to be occupied at the Providence Estate has also been calculated for assessment purposes based on the rates in Table 6-1. These rates have been used to calculate an estimate of the future committed traffic yet to be generated in the AM and PM peak periods by the Providence Estate. The traffic generation has been distributed onto the road network as shown in Section 6.7 of this report.

Table 6-5: Remaining (Future) Development Traffic Generation – Providence Estate

No of Dwellings	AM Peak Hour		PM Peak Hour	
	IN	OUT	IN	OUT
253	51	152	127	76

6.7 Traffic Distribution and Assignment

Lot 506, Johnson Road

The distribution of trips to and from the site via the future fourth arm (site access) of the Johnson Road/Breccia Parade roundabout intersection has been estimated based on the recorded existing traffic flow percentage split travelling northbound and southbound on Johnson Road in the AM and PM peak periods passing the site on Johnson Road (not including traffic turning to/from Wellard Primary School).

The percentage split of traffic is in keeping with the expectation that a greater proportion of trips generated by the site will travel north in the morning to the Kwinana Freeway and the employment areas it gives access to with others travelling south given the attractiveness and proximity of Wellard Train Station. The estimated distribution is presented in **Figure 6-1.**

Figure 6-1: Proposed Development Traffic Distribution – Lot 506 Johnson Road

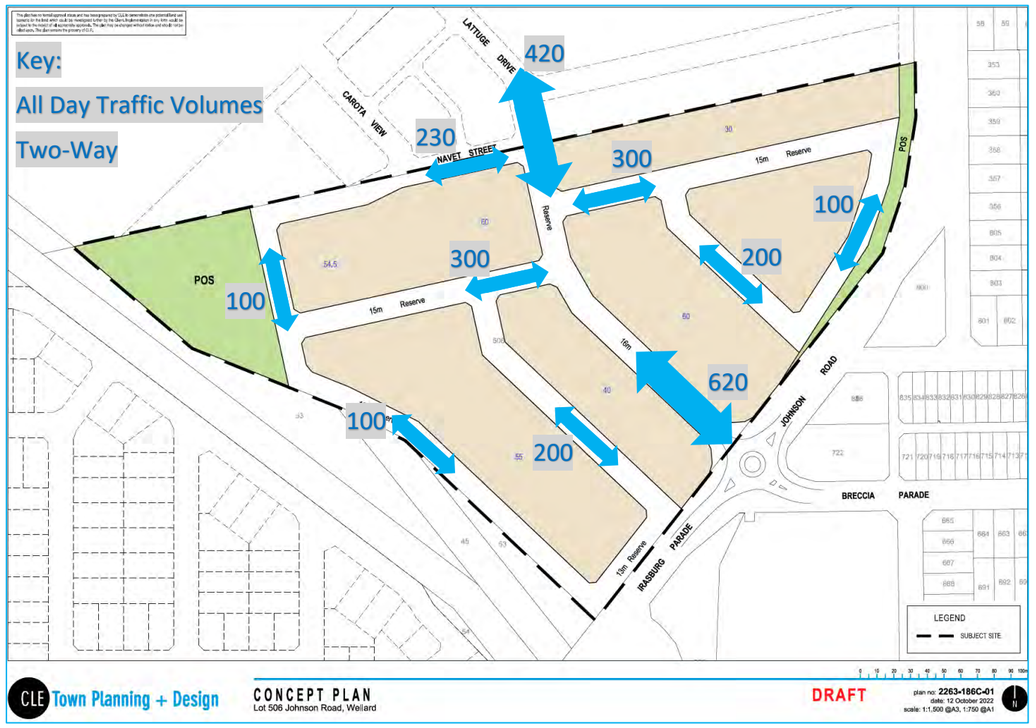
Given the future road linkage (Lattuge Drive) between Lot 506 and the Oakabella Estate (refer Section 4.2) and in the absence of a Transport Impact Assessment for the Oakabella Estate (confirmed by City of Kwinana), the assumed proportional impact along Lattuge Drive is considered to be a 60/40 split of traffic generation from Lot 506 in favour of Johnson Road. i.e., 60% of Lot 506 traffic generation will utilise the Johnson Road access and the remaining 40% will travel to/from the site via Lattuge Drive to the north through the Oakabella Estate.

This assumption is based on the proximity of the Lot 506 site to Johnson Road, the recorded proportional split of north/south traffic on Johnson Road and the relative attractiveness of Lattuge Drive, through Oakabella Estate, for access to/from the north including the options for traffic to access Mortimer Road or Bertram Road from either Johnson Road or Tamblyn Place. The assignment of 60% of the Lot 506 site peak hour traffic generation is presented in **Figure 6-2.**

Figure 6-2: Proposed Peak Hour Development Traffic Assignment – Lot 506 Johnson Road

In reference to the 'all-day' traffic generating potential of the Lot 506 site only, the estimated assignment of all proposed development traffic generation within the Lot 506 site is presented in **Figure 6-3** in terms of 'all-day' two-way traffic flow.

Figure 6-3: Two–Way Proposed Development Traffic Assignment Within Lot 506 (All Day Volumes)



Oakabella Estate

In regard to the attractiveness of the future road linkage (Lattuge Drive) through the Lot 506 site for traffic associated with the Oakabella Estate, the proportional split is expected to be in the region of 70/30 in favour of the vehicle linkages to Johnson Road intersections to the north.

This assumption is based upon the relative distance of the Oakabella Estate from the Johnson Road/Breccia Parade roundabout intersection and the alternate ease of access of the Oakabella Estate to Johnson Road via the purpose built intersections at Brassica Street and Lattuge Drive, plus the relative attractiveness of Lattuge Drive for access to/from the north including the options for traffic to access Mortimer Road or Bertram Road from either Johnson Road or Tamblyn Place.

Therefore 30% of the remaining traffic generated by the Oakabella Estate, given in **Table 6-4**, will be assigned to the Johnson Road/Breccia Parade/Site Access intersection for assessment purposes. The assignment of 30% of the remaining Oakabella Estate site traffic generation is presented in **Figure 6-4.**

Figure 6-4: Oakabella Estate Peak Hour Traffic Assignment at Johnson Rd/Breccia Pde Roundabout

Providence Estate

In regard to the remaining traffic generation from the remaining 253 houses yet to be constructed and occupied at the Providence Estate, this will be distributed onto Johnson Road and pass through the existing roundabout intersection with Breccia Parade in the same proportions as the existing north/south directional split of traffic on Johnson Road, i.e. 58% north / 42% south in the AM peak and 47% north / 53% south in the PM peak for assessment purposes. The assignment of the remaining Providence Estate site traffic generation is presented in **Figure 6-5 .**

Figure 6-5: Providence Estate Peak Hour Traffic Assignment at Johnson Rd/Breccia Pde Roundabout

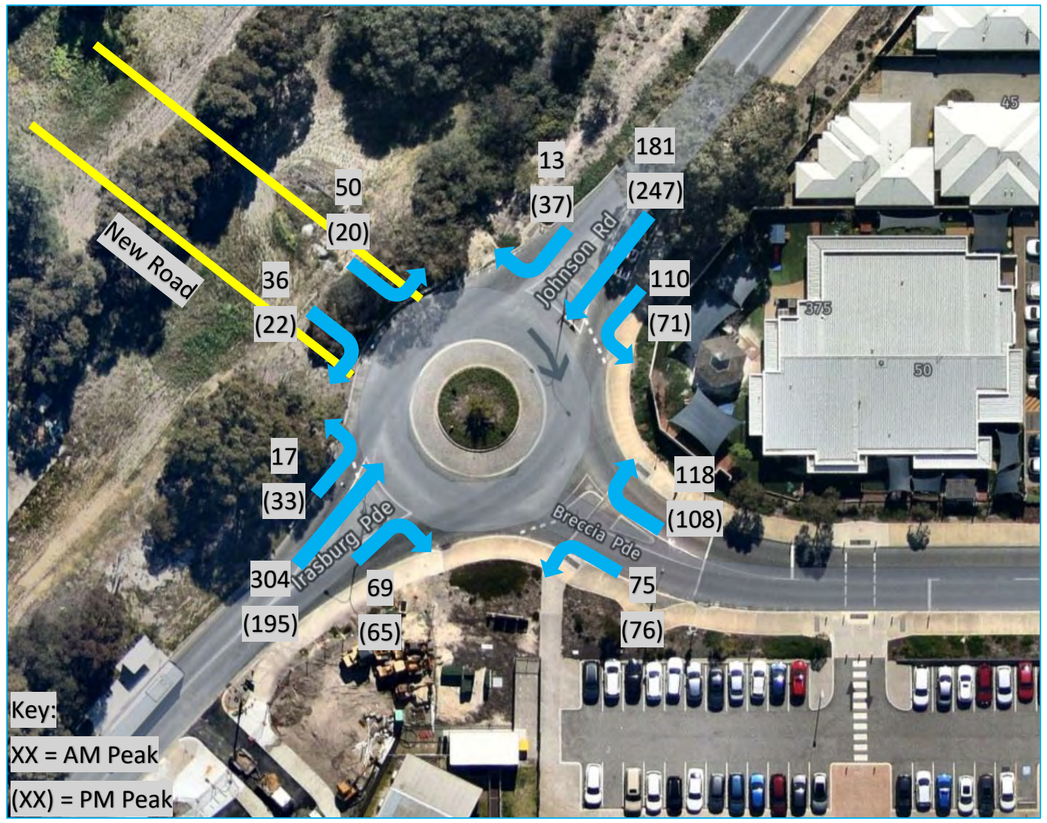
Combined Peak Hour Traffic Demand

The 2023 background traffic volumes have been combined with full build out of the Lot 506 residential development and the remaining traffic generation from the developing Oakabella and Providence Estates at the intersection of Johnson Road/Breccia Road/Lot 506 Site Access.

It should be noted that the network PM peak period of 14:30 – 15:30 on this section of Johnson Road is such because of Wellard Primary School, which does not necessarily coincide with the traditional PM peak traffic generating period for residential development, which is traditionally around 17:00 to 18:00. However, for the purposes of this robust assessment, both the AM and PM peak traffic generation from the residential developments have been combined with the road network peaks, which demonstrates a worst-case assessment in terms of traffic volume and impact.

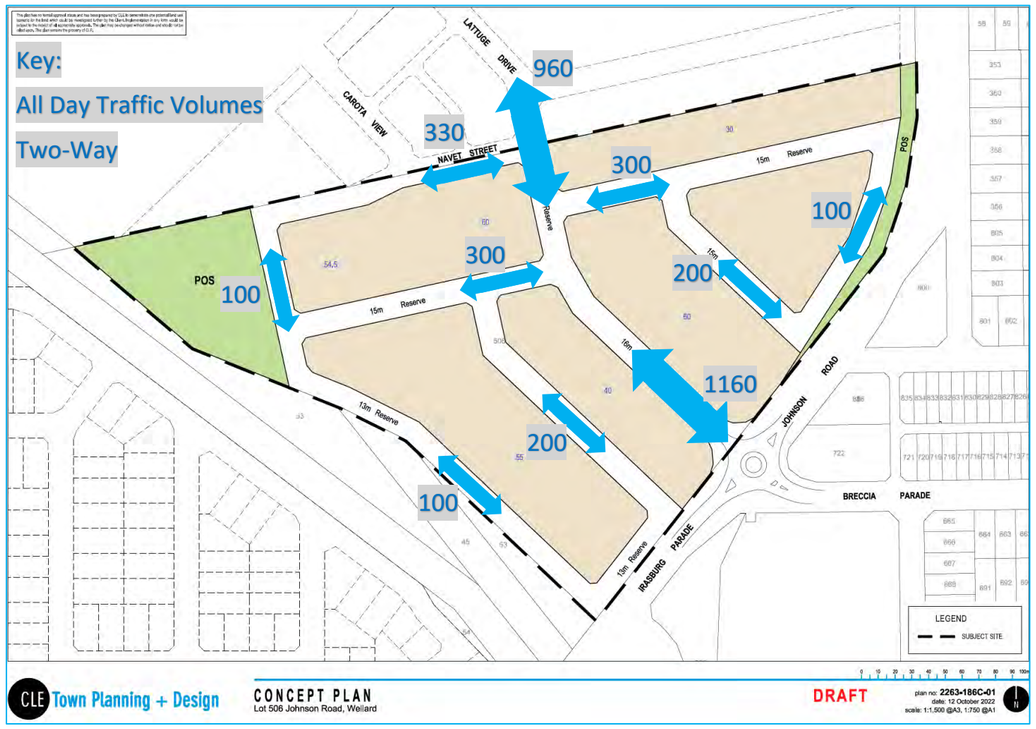
The following traffic volumes **(Figure 6-6)** have been analysed within a SIDRA intersection model to test the operational capacity and performance of the intersection in the 2029 design year, the results of which are provided in Section 6.8.

Figure 6-6: Estimated Ultimate 2029 Traffic Voumes at Johnson Rd/Breccia Pde Roundabout (Peak Hour)



In reference to the combined Lot 506 and Oakabella 'all-day' traffic movements within the Lot 506 site, the estimated assignment in the future 2029 design year is presented in **Figure 6-7** in terms of 'all-day' two-way traffic flow.

Figure 6-7: Two – Way Estimated Ultimate 2029 Traffic Voumes Within Lot 506 (All Day Volumes)



6.8 Intersection Performance

SIDRA analysis has been undertaken to estimate the impact of the Lot 506 development generated traffic and the committed development traffic (Oakabella and Providence Estates) at the proposed Johnson Road/Breccia Parade/Lot 506 Site Access roundabout intersection.

SIDRA results for each approach are presented below in the form of Degree of Saturation (DOS), Average Delay, Level of Service (LOS) and 95th Percentile Queue. These characteristics are defined as follows:

- **Degree of Saturation (DOS)**: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The theoretical intersection capacity is exceeded for an un-signalised intersection where DOS > 0.80.
- **95% Queue:** is the statistical estimate of the queue length up to or below which 95% of all observed queues would be expected.
- **Average Delay:** is the average of all travel time delays for vehicles through the intersection. An unsignalised intersection is considered to be operated at capacity where the average delay exceeds 35 seconds for an approach and 45 seconds for any individual movement; and
- **Level of Service (LOS)**: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers.

6.9 Scenario – Ultimate 2029 Traffic Volumes

The following presents the analysis of the proposed Johnson Road/Irasburg Parade/Breccia Parade/Site Access roundabout intersection, including the future fourth-arm for access to Lot 506. The results assume a future year horizon to 2029 with full built out of the Lot 506 site and the remaining traffic generation associated with the Oakabella and Providence Estate developments for a comprehensive assessment.

Figure 6-8 is a SIDRA layout representation of the proposed intersection and **Figure 6-9** shows the modelled traffic volumes analysed.

Figure 6-8: Johnson Road/Irasburg Parade/Breccia Parade/Site Access: Proposed four-way single lane roundabout layout.

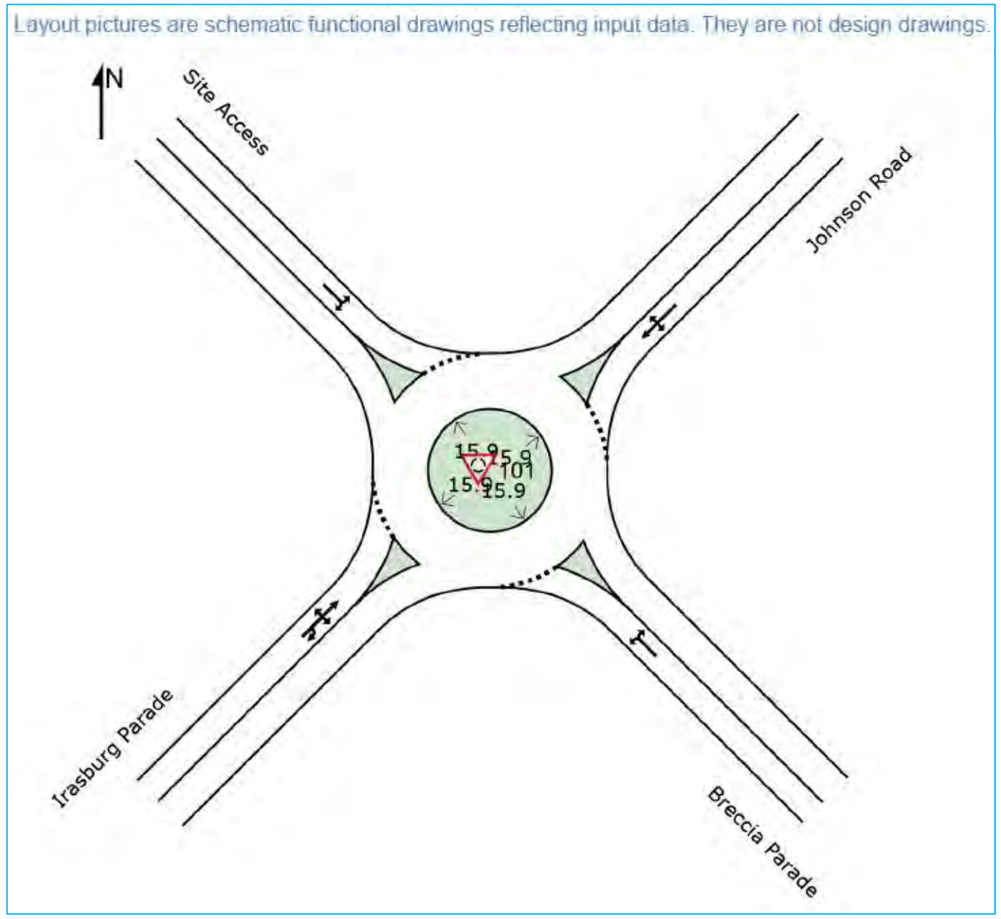


Figure 6-9: Johnson Road/Irasburg Parade/Breccia Parade/Site Access: Capacity Results (2029 Traffic Volumes)

Lane	AM Peak				PM Peak			
	Degree of Saturation	Average Delay (s)	Int. Level of Service	95th %ile Q (m)	Degree of Saturation	Average Delay (s)	Int. Level of Service	95th %ile Q (m)
Johnson Road / Irasburg Parade / Breccia Parade / Site Access – Proposed Roundabout Layout 2029 Ultimate Traffic Volumes (With Development)								
Breccia Parade – South-East Approach								
Through/Left/Right	0.204	5.8	A	8.8	0.208	6.3	A	9.0
Johnson Road – North-East Approach								
Through/Left/Right	0.247	5.1	A	11.8	0.278	5.3	A	13.9
Site Access – Nort- West Approach								
Through/Left/Right	0.115	6.9	A	4.8	0.050	6.1	A	2.0
Irasburg Parade – South-West Approach								
Through/Left/Right	0.320	5.9	A	16.5	0.251	6.2	A	12.2
Intersection	**0.320**	**6.9**	**A**	**16.5**	**0.278**	**6.2**	**A**	**13.9**

Analysis of the proposed Johnson Road/Irasburg Parade/Breccia Parade/Site Access roundabout intersection at the 2029 design horizon shows that there are predicted to be no issues with respect to traffic queuing and delays for any movement in both the AM and PM peak periods. All parameters of this capacity assessment are within recognised thresholds for acceptable intersection operation with the intersection predicted to operate around 30% of its theoretical maximum in both peak periods and a 95%ile vehicle queue of approximately 2 to 3 vehicles in the AM peak on the busiest approach road (Irasburg Parade).

6.10 Proportional Impact of Development on Surrounding Road Network

In accordance with advice given in the WAPC Guidelines, all parts of the transport network that are likely to be materially affected by the proposed land use should be considered. As a general guide, an increase in traffic of less than 10 per cent of capacity would not normally be likely to have a material impact on any particular section of road, but increases of over 10 per cent may.

An intersection would generally be considered to be materially affected if flows on any leg increase by more than 10 per cent or any individual movement would increase by more than 20 per cent. For already congested intersections, lower thresholds may again trigger the need for assessment.

Other factors that should be taken into consideration when determining the study area include:

- Change of intersection control type (for example, from priority to traffic signals).
- New or modified intersections or crossovers.
- New or widened roads, shared paths, etc.; and
- New or modified bus routes or bus stop locations

Therefore, from an assessment the impact of the Lot 506 traffic generation on the local road network and surrounding intersections with in a 2.0km radius of the site, it has been determined that only the Johnson Road/Irasburg Parade/Breccia Parade roundabout intersection would experience an increase of approximately 10% of the existing traffic volumes and 2029 traffic volumes. Other intersections would have traffic volumes increases less than this and thus not require analysis on this basis.

7 Conclusions & Recommendations

7.1 Summary of TIA

This assessment has been prepared in accordance with the Western Australian Planning Commission's (WAPC) *Transport Impact Assessment Guidelines Volume 2 – Planning Schemes, Structure Plans & Activity Centre Plans (2016)*. In accordance with WAPC Guidelines for Transport Impact Assessments, this report sets out the details of the proposed structure plan, the key transport issues and impacts related to the development of the Site from a residential and traffic generation perspective including the current level of accessibility by road, public transport, cycle and on foot. This TIA identifies where the level of accessibility and infrastructure is acceptable and where it is found to be deficient, sets recommendations to improve these areas to a suitable level where required and appropriate for this development.

Extensive consultation has been undertaken with City of Kwinana throughout the scoping and production of this Transport Impact Assessment. All information received from City of Kwinana has been used where appropriate.

The site, which is the subject of this assessment, is currently zoned 'Urban' under the MRS and is immediately surrounded to the north, east, south and south-west by land currently zoned as 'Urban'. Land immediately to the north-west is currently zoned as 'Rural'.

This report assesses the impacts of the proposed development upon the adjacent road network, with a focus on access requirements to/from Johnson Road and the surrounding local road network. The potential yield of the development site (the Site) in terms of developable land use, which this TIA is based upon, is expected to be 128 residential lots.

The following conclusions and recommendations have been made regarding the proposed development with respect to this TIA:

7.2 Overall Integration with Surrounding Attractors / Generators

The proposed Site integrates well with the existing and proposed land uses immediately surrounding the site which consists primarily of residential land use and Wellard Primary School immediately to the east of Johnson Road opposite the site.

The Bertram Shopping Centre is located approximately 2.0km north via Johnson Road. The Kwinana Town Centre is approximately 5.0km north-west of the site. The Wellard Village Centre is located surrounding the Wellard Train Station, which his approximately 4.0km west of the site.

The primary traffic generator in the surrounding area is the expanding residential development and Wellard Primary School.

The Kwinana Freeway, accessible some 1.5km north-east from the Site, providing access to the major employment areas to the north and south of Wellard, with strategic road links to the remaining metropolitan area.

The key proposed change to the surrounding land uses within an approximate 2.0km of the site is shown on the MRS, being the allocation of land to the east of the Kwinana Freeway and bounded by Millar Road and Woolcoot Road. The MRS designates this land for further development 'Urban' and 'Urban Deferred'. City of Kwinana's Town Planning Scheme designates this area of land as 'Development' and 'Cluster/Communal Rural Settlement', the development of which are unlikely to impact on Johnson Road and the immediate local network.

To the south of Telephone Lane and immediately west of the Kwinana Freeway, a change to the current land uses is the designated 'Urban' zone along the corridor between the Freeway and Baldivis Road. In addition, the west of Baldivis Road, the MRS designates a large area of land as 'Special Use' (SU), the development of which are unlikely to impact on Johnson Road and the immediate local network.

When the land is fully developed, the Site will form part of a wholly integrated residential suburban area with appropriate and ideal vehicular connections to the primary and road network, including the Kwinana Freeway, Thomas Road, Mundijong Road and Safety Bay Road providing an excellent level of vehicular access to and from the Site.

7.3 Road Network Accessibility

The site at 506 Johnson Road is well located in relation to the existing local and primary state road network and the future road modifications and amenities associated with the Oakabella Estate. This site is well located to take advantage of close access to the local and primary state road network and access to employment areas and the wider strategic road network.

In relation to the internal site road network accessibility, due to the relatively low volume and low speed residential nature of the proposed development area, all intersections within the site are intended to be constructed as priority-controlled T-intersections, where three road arms meet.

7.4 Pedestrian and Cycle Accessibility

The Site currently has poor accessibility in relation to the existing intermittent footpath network on the western side of Johnson Road, which is required to be improved. The existing footpath network on the eastern side of Johnson Road provides good links to the surrounding residential area and local centres. To the south of the intersection with McWhirter Promenade, footpaths exist on both sides of Johnson Road, however the northern side is intermittent and is expected to be completed as part of the adjacent 'Providence' residential development which is currently under construction.

Planned upgrades, are due including a new shared path network through the Oakabella Estate with the potential to extend through the Lot 506 site. It is understood that the developer of Lot 506 could deliver the extension of this planned cycle and footpath infrastructure through the site to connect with Johnson Road at the Breccia Parade roundabout. In addition, the existing footpath network on the eastern side of Johnson Road, is allocated for upgrade to a shared path standard, connecting to Mortimer Road in the north and along the Lot 506 frontage (eastern side) in the south.

However, there is no existing footpath on the western side of Johnson Road (flanking the Site), which will create a barrier to pedestrian and cycle trips to/from the development Site. It is a recommendation of this report that investigations be undertaken to extend the existing footpath network on the western side of Johnson Road to link in with the crossing location at the Breccia Parade roundabout and also to continue south and link in with the proposed footpath to be constructed adjacent to the Providence Estate. A footpath in this location will also connect with the existing bus stop on Johnson Road, just south of Breccia Parade. If feasible, this would encourage trips on foot and micro-mobility to local centres, Wellard Primary School and access to bus stops to help increase public transport usage and reduce the reliance on private vehicle modes. The funding mechanisms for which these improvements could be budgeted, would be with the City of Kwinana.

In terms of cyclist accessibility, it is also a recommendation of this report that in light of the DoT's Long-Term future strategy for the cycling network (LTCN), specifically the allocation of Wellard Road and Millar Road as 'Secondary Cycling Routes',

City of Kwinana should be encouraged to investigate improving the safety of cycling facilities along these roads both in terms of potentially reducing the speed limit of each road down from 80km/h and/or segregate the cycling infrastructure from the carriageway and speed of passing traffic. This is considered to be very important for the safety of cyclists.

Such measures would work towards 'Safe System Principles' with the aim of improving safety for vulnerable road users and improve road user collision outcomes. It is recommended that City of Kwinana investigate the integration of the need for cycle segregation along Wellard Road as part of their proposed widening works within the next five-year timeframe.

However, the development site is well placed to take advantage of the DoT's Long-Term future strategy for the cycling network (LTCN) and the future Shared Path network upgrades in the Oakabella Estate and on the eastern side of Johnson Road, which would all combine to encourage trips by cycle for commuting and recreational purposes.

7.5 Public Transport Accessibility

The site benefits from nearby public transport facilities with an existing bus route within close vicinity of the Site includes the 544, which operates on Johnson Road, stopping in both directions some 30m to 60m south of the intersection with Breccia Parade a distance which is within a five-minute walk of the entre site. Bus service 544 provides a link between the site and Wellard Train Station and Town Centre to the west.

The frequency of service 544 during the week (Mon to Fri) is at an excellent 15-to-20-minute interval in the morning peak period between 06:05am and 08:42am, increasing to an hourly frequency between 09:00am and 2:30pm and then between 20 to 30 minutes frequency between 3:15pm and 7:00pm. The frequency of service on Saturdays and Sundays is hourly during the main part of the day time (8:00am to 8:00pm). It is considered that these excellent frequencies during peak period times will continue to encourage trips by public transport as the development Site continues to build out.

Wellard Train Station is accessible via bus service 544 and provides access to the Mandurah Railway Line and alternate bus services 541 and 542.

During the week, the Mandurah railway line carries passenger rail services between Perth city and stations in between, stopping at Wellard Train Station at intervals of approximately 5 to 10 minutes during the morning peak period and every 10 to 15 minutes during the remainder of the day. The frequency of services from Perth Station to Wellard Train Station are very similar during the evening peak period. The frequency reduces past 10:00pm to every 30 minutes until 12:30am.

The facilities at Wellard Train Station include a total of 263 long-term parking bays and 13 short-term parking bays with provision for motorcycle parking. The station is listed as 'Independent Access', meaning it meets higher accessibility standards for universal access and access to the station is not via a pedestrian crossing.

7.6 Road Safety Considerations

A search of the Main Roads WA Reporting Centre for crash data surrounding the site was undertaken for the 2.0 kilometre section of Johnson Road/Irasburg Parade/Cavendish Boulevard between and including the intersections with Wellard Road and Mortimer Road for the period between 1 January 2018 and 31 December 2022

No crashes are recorded as occurring at the existing roundabout intersection of Johnson Road/Irasburg Parade/Breccia Parade. In addition, no crashes are recorded as occurring at the existing roundabout intersection of Wellard Road/Cavendish Boulevard.

A total of 10 crashes have been recorded on Johnson Road/Irasburg Parade/Cavendish Boulevard between Wellard Road and Mortimer Road, 8 of which involved property damage only type crashes and 2 which involved hospitalisation of those involved as follows:

The crash which involved a 'head-on' impact with hospitalisation required, occurred on Irasburg Parade 43 metres east of Fairhaven Boulevard. The crash involved the police pursuit of a stolen vehicle which crashed in this location and struck a private car which had stopped to give way to the police. This crash may be considered a 'one-off' incident in this location and is not attributable to the road environment or geometry of this location.

The crash which involved a 'right-angle' impact with hospitalisation required, occurred on Cavendish Boulevard at the intersection with Huntington Avenue. The right turning vehicle into Huntington Drive failed to give way to a vehicle on Cavendish Boulevard which flipped the vehicle onto its side. Forward sight lines at this intersection are good with the alignment of Cavendish Boulevard relatively straight in this location and as such the road environment is not considered to be a contributing factor.

In relation to the above crashes and the remaining eight crashes resulting in property damage only, there appears to be no specific pattern or trend of crash types occurring in one identified location, with most crashes spread across the study area.

A total of 16 crashes have been recorded at the roundabout intersection of Bertram Road/Mortimer Road/Johnson Road. The majority of these crashes (63%) which have occurred at this intersection are of a 'rear-end' type, which appears to be a significant trend, with 2 of the 10 rear-end crashes resulting in medical attention being required. Right turning crashes account for the remaining 37% of crashes in this location.

It is unlikely that the proposed development site has the potential to significantly exacerbate the recorded crash types, due to the associated traffic generation of the site being less than 10% increase of traffic volumes at all locations other than the roundabout intersection of Johnson Road/Irasburg Parade/Breccia Parade.

7.7 Speed Limit and School Zones

Furthermore, it is a recommendation of this Transport Impact Assessment that City of Kwinana in consultation with Main Road WA (custodians of speed zoning in WA), investigate the potential to reduce the prevailing speed limit of Johnson Road and Irasburg Parade on both approaches to the Breccia Parade roundabout from 60km/h to 50km/h and introduce a School Zone Speed Limit on Johnson Road and Irasburg Parade, to include the roundabout at Breccia Parade, with the intention of improving road safety for vulnerable road users crossing Johnson Road between Lot 506 site, Oakabella Estate and Wellard Primary School once these developments are significantly occupied.

This recommended speed limit change would effectively comprise an extension of the existing 50km/h speed zone on Irasburg Parade, south of McWhirter Promenade, which was implemented as part of the Providence Estate development and would therefore be a natural extension of the 50km/h limit as land along Irasburg Parade and Johnson Road develops into the future.

7.8 Analysis of the Transport Network

The existing Johnson Road / Irasburg Parade / Breccia Parade single lane roundabout currently operates within recognised thresholds of acceptable performance with degree of saturation less than 0.8, average delays less than 35 seconds for an approach and less than 45 seconds for any individual movement and levels of service 'A' within both AM and PM peak periods under the 2023 existing traffic demands. The existing roundabout has significant spare capacity to accommodate future traffic growth on the road network.

Following full development of the Lot 506 Johnson Road site and including the remaining traffic to be generated by the Oakabella and Providence Estate development, analysis of the proposed Johnson Road/Irasburg Parade/Breccia Parade/Site Access roundabout intersection at the 2029 design horizon shows that there are predicted to be no issues with respect to traffic queuing and delays for any movement in both the AM and PM peak periods. All parameters of this capacity assessment are within recognised thresholds for acceptable intersection operation with the intersection predicted to operate around 30% of its theoretical maximum in both peak periods and a 95%ile vehicle queue of approximately 2 to 3 vehicles in the AM peak on the busiest approach road (Irasburg Parade).

From an assessment the impact of the Lot 506 traffic generation on the local road network and surrounding intersections with in a 2.0km radius of the site, it has been determined that only the Johnson Road/Irasburg Parade/Breccia Parade roundabout intersection would experience an increase of approximately 10% of the existing traffic volumes and 2029 traffic volumes, i.e. the only intersection to be materially affected by the proposed development generated traffic. Traffic impacts at other intersections would not have a material impact and typically not be discernible to the average motorist driving through these other intersections.

Appendix A TIA Checklist

Item	Provided	Comments/Proposals
Summary	Y	
Introduction / Background	Y	
Structure Plan Proposal	Y	
Regional context	Y	
Proposed land uses	Y	
Table of land uses and quantities	Y	
Major attractors / generators	Y	
Specific issues	Y	
Existing Situation	Y	
Existing land uses within structure plan	Y	
Existing land uses within 800m of structure plan area	Y	
Existing road network within structure plan area	Y	
Existing pedestrian / cycle network within structure plan area	Y	
Existing public transport services within structure plan area	Y	
Existing road network within 2 (or 5) km of structure plan area	Y	
Traffic flows on roads within structure plan area (PM and/or AM peak hours)	Y	
Existing pedestrian / cycle networks within 800m of structure plan area.	Y	
Existing public transport services within 800m of structure plan area.	Y	
Proposed Internal Transport Networks	Y	
Changes / additions to existing road network or proposed new road network	Y	
Road reservation widths	Y	
Road cross-sections & speed limits	Y	
Intersection controls	Y	
Pedestrian / cycle networks and crossing facilities	Y	
Changes to External Transport Networks	Y	
Road network	Y	
Intersection controls	Y	
Pedestrian/cycle networks and crossing facilities	Y	
Public transport services	Y	
Integration with surrounding area	Y	
Trip attractors / generators within 800 metres	Y	
proposed changes to land uses within 800 metres	Y	
travel desire lines from development to these attractors/ generators	Y	
adequacy of external transport networks	Y	
deficiencies in external transport networks	Y	
remedial measures to address deficiencies	Y	
Analysis of internal transport networks	Y	
assessment years	Y	
time periods	Y	
Structure plan generated traffic	Y	
Extraneous (through) traffic	Y	
Design traffic flows (that is, total traffic)	Y	
Road cross-sections	Y	
Intersection controls	Y	
Access strategy	Y	
Pedestrian / cycle networks	Y	
Safe routes to schools	Y	
Pedestrian permeability & efficiency	Y	
Access to public transport	Y	
Analysis of external transport networks	Y	
Extent of analysis	Y	
Base flows for assessment year(s)	Y	
Total traffic flows	Y	
Road cross-sections	Y	
Intersection layouts and controls	Y	
Pedestrian / cycle networks	Y	
Conclusions	Y	

Appendix B Proposed Concept Structure Plan

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

LATTUGE DRIVE
CAROTA VIEW
NAVET STREET
POS
30
60
54.5
16m Reserve
13m Reserve
15m Reserve
506
40
55
53
45
54
ROAD
JOHNSON
BRECCIA
PARADE
IRASBURG
PARADE
886
722
800
58
59
353
360
359
358
357
356
805
804
803
801
802
835 834 833 832 831 830 829 828 827 826
721 720 719 718 717 716 715 714 713 71
665
666
667
668
664
663
691
692

LEGEND
SUBJECT SITE

0 10 20 30 40 50 60 70 80 90 100m

CLE Town Planning + Design

CONCEPT PLAN
Lot 506 Johnson Road, Wellard

DRAFT

plan no: **2263-186C-01**
date: 12 October 2022
scale: 1:1,500 @A3, 1:750 @A1

N

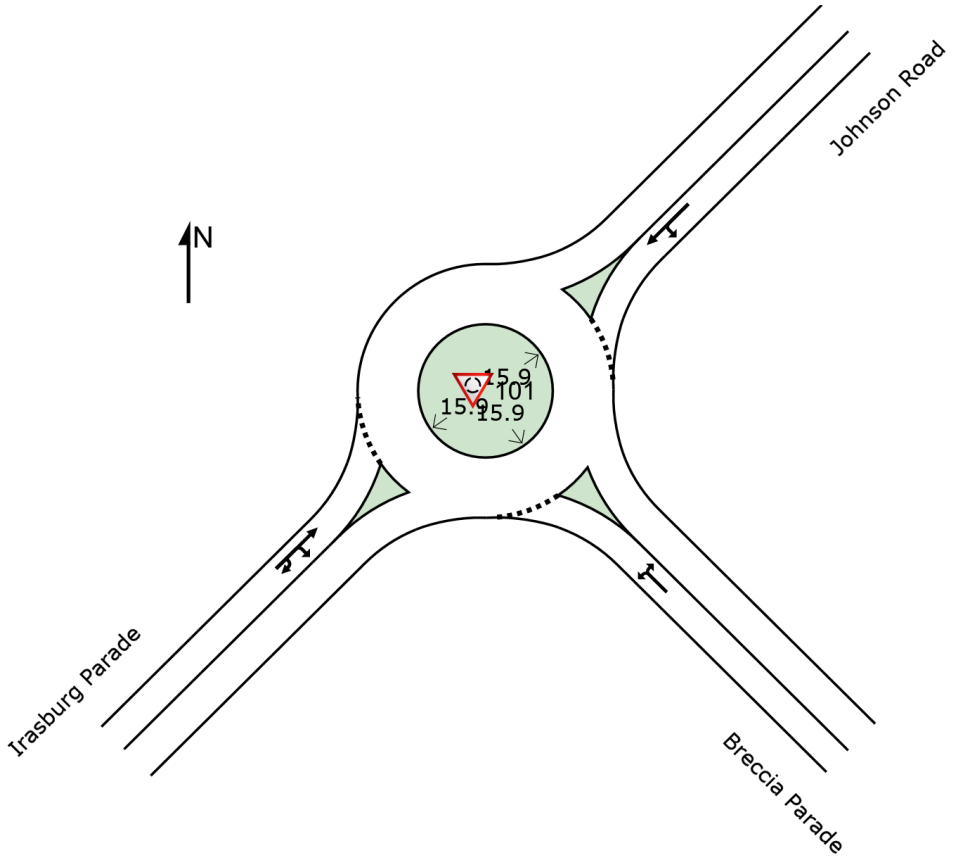
Appendix C SIDRA Intersection Assessment Results

SITE LAYOUT

Site: 101 [JohnsonRoad_BrecciaParade 2023 AM Peak (Site Folder: General)]

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2023 AM Peak (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Breccia Parade															
Lane 1[d]	203	0.5	203	0.5	1077	0.189	100	5.3	LOS A	1.1	8.1	Full	280	0.0	0.0
Approach	203	0.5	203	0.5		0.189		5.3	LOS A	1.1	8.1				
NorthEast: Johnson Road															
Lane 1[d]	283	2.2	283	2.2	1369	0.207	100	4.6	LOS A	1.3	9.8	Full	380	0.0	0.0
Approach	283	2.2	283	2.2		0.207		4.6	LOS A	1.3	9.8				
SouthWest: Irasburg Parade															
Lane 1[d]	300	1.8	300	1.8	1294	0.232	100	6.0	LOS A	1.5	10.9	Full	380	0.0	0.0
Approach	300	1.8	300	1.8		0.232		6.0	LOS A	1.5	10.9				
All Vehicles	786	1.6	786	1.6		0.232		5.3	LOS A	1.5	10.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

d Dominant lane on roundabout approach

Approach Lane Flows (veh/h)

SouthEast: Breccia Parade

Mov. From SE To Exit:	L2 SW	R2 NE	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	79	124	203	0.5	1077	0.189	100	NA	NA
Approach	79	124	203	0.5		0.189			

NorthEast: Johnson Road

Mov. From NE To Exit:	L2 SE	T1 SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	116	167	283	2.2	1369	0.207	100	NA	NA
Approach	116	167	283	2.2		0.207			

SouthWest: Irasburg Parade

Mov. From SW To Exit:	T1 NE	R2 SE	U SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	227	68	4	300	1.8	1294	0.232	100	NA	NA

Approach	227	68	4	300	1.8		0.232
	Total	%HV	Deg.Satn (v/c)				
All Vehicles	786	1.6	0.232				

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
SouthEast: Breccia Parade				
Lane 1	0.0	0.0	0.0	0.0
NorthEast: Johnson Road				
Lane 1	0.0	0.0	0.0	0.0
SouthWest: Irasburg Parade				
Lane 1	0.0	0.0	0.0	0.0

MOVEMENT SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2023 AM Peak (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
SouthEast: Breccia Parade															
21	L2	All MCs	79	1.3	79	1.3	0.189	3.1	LOS A	1.1	8.1	0.41	0.52	0.41	36.4
23	R2	All MCs	124	0.0	124	0.0	0.189	6.7	LOS A	1.1	8.1	0.41	0.52	0.41	36.1
Approach			203	0.5	203	0.5	0.189	5.3	LOS A	1.1	8.1	0.41	0.52	0.41	36.2
NorthEast: Johnson Road															
24	L2	All MCs	116	0.0	116	0.0	0.207	4.4	LOS A	1.3	9.8	0.26	0.45	0.26	50.8
25	T1	All MCs	167	3.8	167	3.8	0.207	4.8	LOS A	1.3	9.8	0.26	0.45	0.26	51.3
Approach			283	2.2	283	2.2	0.207	4.6	LOS A	1.3	9.8	0.26	0.45	0.26	51.1
SouthWest: Irasburg Parade															
31	T1	All MCs	227	2.3	227	2.3	0.232	5.0	LOS A	1.5	10.9	0.34	0.50	0.34	50.3
32	R2	All MCs	68	0.0	68	0.0	0.232	9.1	LOS A	1.5	10.9	0.34	0.50	0.34	48.7
32u	U	All MCs	4	0.0	4	0.0	0.232	11.0	LOS B	1.5	10.9	0.34	0.50	0.34	49.9
Approach			300	1.8	300	1.8	0.232	6.0	LOS A	1.5	10.9	0.34	0.50	0.34	50.0
All Vehicles			786	1.6	786	1.6	0.232	5.3	LOS A	1.5	10.9	0.33	0.48	0.33	46.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

LANE SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2023 PM Peak (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Breccia Parade															
Lane 1[d]	194	0.0	194	0.0	1056	0.183	100	5.3	LOS A	1.1	7.8	Full	280	0.0	0.0
Approach	194	0.0	194	0.0		0.183		5.3	LOS A	1.1	7.8				
NorthEast: Johnson Road															
Lane 1[d]	264	2.4	264	2.4	1371	0.193	100	4.6	LOS A	1.2	8.9	Full	380	0.0	0.0
Approach	264	2.4	264	2.4		0.193		4.6	LOS A	1.2	8.9				
SouthWest: Irasburg Parade															
Lane 1[d]	236	4.0	236	4.0	1274	0.185	100	6.2	LOS A	1.1	8.6	Full	380	0.0	0.0
Approach	236	4.0	236	4.0		0.185		6.2	LOS A	1.1	8.6				
All Vehicles	694	2.3	694	2.3		0.193		5.4	LOS A	1.2	8.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

d Dominant lane on roundabout approach

Approach Lane Flows (veh/h)

SouthEast: Breccia Parade

Mov. From SE To Exit:	L2 SW	R2 NE	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	80	114	194	0.0	1056	0.183	100	NA	NA
Approach	80	114	194	0.0		0.183			

NorthEast: Johnson Road

Mov. From NE To Exit:	L2 SE	T1 SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	75	189	264	2.4	1371	0.193	100	NA	NA
Approach	75	189	264	2.4		0.193			

SouthWest: Irasburg Parade

Mov. From SW To Exit:	T1 NE	R2 SE	U SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	167	63	5	236	4.0	1274	0.185	100	NA	NA

Approach	167	63	5	236	4.0		0.185
	Total	%HV	Deg.Satn (v/c)				
All Vehicles	694	2.3		0.193			

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
SouthEast: Breccia Parade				
Lane 1	0.0	0.0	0.0	0.0
NorthEast: Johnson Road				
Lane 1	0.0	0.0	0.0	0.0
SouthWest: Irasburg Parade				
Lane 1	0.0	0.0	0.0	0.0

MOVEMENT SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2023 PM Peak (Site Folder: Existing)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
SouthEast: Breccia Parade															
21	L2	All MCs	80	0.0	80	0.0	0.183	3.3	LOS A	1.1	7.8	0.43	0.52	0.43	36.4
23	R2	All MCs	114	0.0	114	0.0	0.183	6.8	LOS A	1.1	7.8	0.43	0.52	0.43	36.1
Approach			194	0.0	194	0.0	0.183	5.3	LOS A	1.1	7.8	0.43	0.52	0.43	36.2
NorthEast: Johnson Road															
24	L2	All MCs	75	1.4	75	1.4	0.193	4.4	LOS A	1.2	8.9	0.24	0.44	0.24	50.5
25	T1	All MCs	189	2.8	189	2.8	0.193	4.7	LOS A	1.2	8.9	0.24	0.44	0.24	51.5
Approach			264	2.4	264	2.4	0.193	4.6	LOS A	1.2	8.9	0.24	0.44	0.24	51.3
SouthWest: Irasburg Parade															
31	T1	All MCs	167	5.0	167	5.0	0.185	5.0	LOS A	1.1	8.6	0.32	0.51	0.32	49.6
32	R2	All MCs	63	1.7	63	1.7	0.185	9.0	LOS A	1.1	8.6	0.32	0.51	0.32	48.3
32u	U	All MCs	5	0.0	5	0.0	0.185	10.9	LOS B	1.1	8.6	0.32	0.51	0.32	49.9
Approach			236	4.0	236	4.0	0.185	6.2	LOS A	1.1	8.6	0.32	0.51	0.32	49.3
All Vehicles			694	2.3	694	2.3	0.193	5.4	LOS A	1.2	8.9	0.32	0.48	0.32	45.7

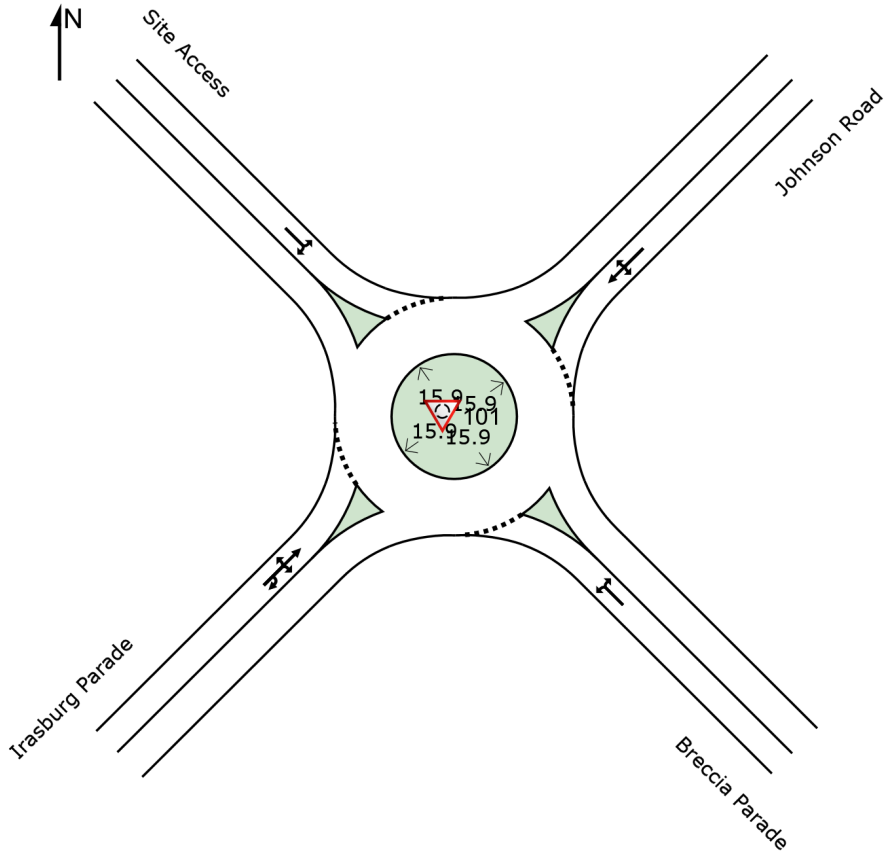
Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SITE LAYOUT

Site: 101 [JohnsonRoad_BrecciaParade 2029 w dev AM (Site Folder: Proposed)]

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2029 w dev AM (Site Folder: Proposed)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Breccia Parade															
Lane 1[d]	203	0.5	203	0.5	995	0.204	100	5.8	LOS A	1.2	8.8	Full	280	0.0	0.0
Approach	203	0.5	203	0.5		0.204		5.8	LOS A	1.2	8.8				
NorthEast: Johnson Road															
Lane 1[d]	320	2.3	320	2.3	1297	0.247	100	5.1	LOS A	1.6	11.8	Full	380	0.0	0.0
Approach	320	2.3	320	2.3		0.247		5.1	LOS A	1.6	11.8				
NorthWest: Site Access															
Lane 1[d]	91	0.0	91	0.0	786	0.115	100	6.9	LOS A	0.7	4.8	Full	280	0.0	0.0
Approach	91	0.0	91	0.0		0.115		6.9	LOS A	0.7	4.8				
SouthWest: Irasburg Parade															
Lane 1[d]	411	1.8	411	1.8	1283	0.320	100	5.9	LOS A	2.2	16.5	Full	380	0.0	0.0
Approach	411	1.8	411	1.8		0.320		5.9	LOS A	2.2	16.5				
All Vehicles	1024	1.5	1024	1.5		0.320		5.7	LOS A	2.2	16.5				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

d Dominant lane on roundabout approach

Approach Lane Flows (veh/h)

SouthEast: Breccia Parade

Mov. From SE To Exit:	L2 SW	R2 NE	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	79	124	203	0.5	995	0.204	100	NA	NA
Approach	79	124	203	0.5		0.204			

NorthEast: Johnson Road

Mov. From NE To Exit:	L2 SE	T1 SW	R2 NW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	116	191	14	320	2.3	1297	0.247	100	NA	NA
Approach	116	191	14	320	2.3		0.247			

NorthWest: Site Access

Mov. From NW To Exit:	L2 NE	R2 SW	Total	%HV			Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	53	38	91	0.0			786	0.115	100	NA	NA
Approach	53	38	91	0.0				0.115			
SouthWest: Irasburg Parade											
Mov. From SW To Exit:	L2 NW	T1 NE	R2 SE	U SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	18	320	68	4	411	1.8	1283	0.320	100	NA	NA
Approach	18	320	68	4	411	1.8		0.320			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	1024	1.5	0.320

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.												

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
SouthEast: Breccia Parade				
Lane 1	0.0	0.0	0.0	0.0
NorthEast: Johnson Road				
Lane 1	0.0	0.0	0.0	0.0
NorthWest: Site Access				
Lane 1	0.0	0.0	0.0	0.0
SouthWest: Irasburg Parade				
Lane 1	0.0	0.0	0.0	0.0

MOVEMENT SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2029 w dev AM (Site Folder: Proposed)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
SouthEast: Breccia Parade															
21	L2	All MCs	79	1.3	79	1.3	0.204	3.7	LOS A	1.2	8.8	0.49	0.55	0.49	36.2
23	R2	All MCs	124	0.0	124	0.0	0.204	7.2	LOS A	1.2	8.8	0.49	0.55	0.49	36.0
Approach			203	0.5	203	0.5	0.204	5.8	LOS A	1.2	8.8	0.49	0.55	0.49	36.1
NorthEast: Johnson Road															
24	L2	All MCs	116	0.0	116	0.0	0.247	4.7	LOS A	1.6	11.8	0.33	0.47	0.33	50.3
25	T1	All MCs	191	3.9	191	3.9	0.247	5.0	LOS A	1.6	11.8	0.33	0.47	0.33	50.8
26	R2	All MCs	14	0.0	14	0.0	0.247	9.1	LOS A	1.6	11.8	0.33	0.47	0.33	49.6
Approach			320	2.3	320	2.3	0.247	5.1	LOS A	1.6	11.8	0.33	0.47	0.33	50.6
NorthWest: Site Access															
27	L2	All MCs	53	0.0	53	0.0	0.115	5.4	LOS A	0.7	4.8	0.63	0.63	0.63	35.7
29	R2	All MCs	38	0.0	38	0.0	0.115	8.9	LOS A	0.7	4.8	0.63	0.63	0.63	35.5
Approach			91	0.0	91	0.0	0.115	6.9	LOS A	0.7	4.8	0.63	0.63	0.63	35.6
SouthWest: Irasburg Parade															
30	L2	All MCs	18	0.0	18	0.0	0.320	4.9	LOS A	2.2	16.5	0.40	0.50	0.40	49.3
31	T1	All MCs	320	2.3	320	2.3	0.320	5.2	LOS A	2.2	16.5	0.40	0.50	0.40	50.3
32	R2	All MCs	68	0.0	68	0.0	0.320	9.2	LOS A	2.2	16.5	0.40	0.50	0.40	48.7
32u	U	All MCs	4	0.0	4	0.0	0.320	11.1	LOS B	2.2	16.5	0.40	0.50	0.40	49.9
Approach			411	1.8	411	1.8	0.320	5.9	LOS A	2.2	16.5	0.40	0.50	0.40	50.0
All Vehicles			1024	1.5	1024	1.5	0.320	5.7	LOS A	2.2	16.5	0.41	0.51	0.41	45.4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

LANE SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2029 w dev PM (Site Folder: Proposed)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Lane Use and Performance

	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
SouthEast: Breccia Parade															
Lane 1[d]	194	0.0	194	0.0	932	0.208	100	6.3	LOS A	1.2	9.0	Full	280	0.0	0.0
Approach	194	0.0	194	0.0		0.208		6.3	LOS A	1.2	9.0				
NorthEast: Johnson Road															
Lane 1[d]	374	2.3	374	2.3	1344	0.278	100	5.3	LOS A	1.9	13.9	Full	380	0.0	0.0
Approach	374	2.3	374	2.3		0.278		5.3	LOS A	1.9	13.9				
NorthWest: Site Access															
Lane 1[d]	44	0.0	44	0.0	883	0.050	100	6.1	LOS A	0.3	2.0	Full	280	0.0	0.0
Approach	44	0.0	44	0.0		0.050		6.1	LOS A	0.3	2.0				
SouthWest: Irasburg Parade															
Lane 1[d]	308	3.4	308	3.4	1229	0.251	100	6.2	LOS A	1.6	12.2	Full	380	0.0	0.0
Approach	308	3.4	308	3.4		0.251		6.2	LOS A	1.6	12.2				
All Vehicles	920	2.1	920	2.1		0.278		5.8	LOS A	1.9	13.9				

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Lane LOS values are based on average delay per lane.
Intersection and Approach LOS values are based on average delay for all lanes.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

d Dominant lane on roundabout approach

Approach Lane Flows (veh/h)

SouthEast: Breccia Parade

Mov. From SE To Exit:	L2 SW	R2 NE	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	80	114	194	0.0	932	0.208	100	NA	NA
Approach	80	114	194	0.0		0.208			

NorthEast: Johnson Road

Mov. From NE To Exit:	L2 SE	T1 SW	R2 NW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	75	260	39	374	2.3	1344	0.278	100	NA	NA
Approach	75	260	39	374	2.3		0.278			

NorthWest: Site Access

Mov. From NW To Exit:	L2 NE	R2 SW	Total	%HV			Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	21	23	44	0.0			883	0.050	100	NA	NA
Approach	21	23	44	0.0				0.050			
SouthWest: Irasburg Parade											
Mov. From SW To Exit:	L2 NW	T1 NE	R2 SE	U SW	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	35	205	63	5	308	3.4	1229	0.251	100	NA	NA
Approach	35	205	63	5	308	3.4		0.251			

	Total	%HV	Deg.Satn (v/c)
All Vehicles	920	2.1	0.278

Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Critical Gap pcu/h	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
There are no Exit Short Lanes for Merge Analysis at this Site.											

Variable Demand Analysis

	Initial Queued Demand veh	Residual Queued Demand veh	Time for Residual Demand to Clear sec	Duration of Oversatn sec
SouthEast: Breccia Parade				
Lane 1	0.0	0.0	0.0	0.0
NorthEast: Johnson Road				
Lane 1	0.0	0.0	0.0	0.0
NorthWest: Site Access				
Lane 1	0.0	0.0	0.0	0.0
SouthWest: Irasburg Parade				
Lane 1	0.0	0.0	0.0	0.0

MOVEMENT SUMMARY

Site: 101 [JohnsonRoad_BrecciaParade 2029 w dev PM (Site Folder: Proposed)]

Output produced by SIDRA INTERSECTION Version: 9.1.2.202

128 houses off Johnson Road in Wellard
Site Category: Existing Design
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
SouthEast: Breccia Parade															
21	L2	All MCs	80	0.0	80	0.0	0.208	4.2	LOS A	1.2	9.0	0.55	0.59	0.55	36.0
23	R2	All MCs	114	0.0	114	0.0	0.208	7.8	LOS A	1.2	9.0	0.55	0.59	0.55	35.8
Approach			194	0.0	194	0.0	0.208	6.3	LOS A	1.2	9.0	0.55	0.59	0.55	35.9
NorthEast: Johnson Road															
24	L2	All MCs	75	1.4	75	1.4	0.278	4.6	LOS A	1.9	13.9	0.31	0.47	0.31	49.8
25	T1	All MCs	260	2.8	260	2.8	0.278	4.9	LOS A	1.9	13.9	0.31	0.47	0.31	50.9
26	R2	All MCs	39	0.0	39	0.0	0.278	9.0	LOS A	1.9	13.9	0.31	0.47	0.31	49.4
Approach			374	2.3	374	2.3	0.278	5.3	LOS A	1.9	13.9	0.31	0.47	0.31	50.5
NorthWest: Site Access															
27	L2	All MCs	21	0.0	21	0.0	0.050	4.3	LOS A	0.3	2.0	0.54	0.58	0.54	36.1
29	R2	All MCs	23	0.0	23	0.0	0.050	7.8	LOS A	0.3	2.0	0.54	0.58	0.54	35.8
Approach			44	0.0	44	0.0	0.050	6.1	LOS A	0.3	2.0	0.54	0.58	0.54	36.0
SouthWest: Irasburg Parade															
30	L2	All MCs	35	0.0	35	0.0	0.251	4.9	LOS A	1.6	12.2	0.39	0.51	0.39	49.2
31	T1	All MCs	205	4.6	205	4.6	0.251	5.3	LOS A	1.6	12.2	0.39	0.51	0.39	49.7
32	R2	All MCs	63	1.7	63	1.7	0.251	9.3	LOS A	1.6	12.2	0.39	0.51	0.39	48.3
32u	U	All MCs	5	0.0	5	0.0	0.251	11.2	LOS B	1.6	12.2	0.39	0.51	0.39	49.8
Approach			308	3.4	308	3.4	0.251	6.2	LOS A	1.6	12.2	0.39	0.51	0.39	49.4
All Vehicles			920	2.1	920	2.1	0.278	5.8	LOS A	1.9	13.9	0.40	0.51	0.40	45.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2022 Akcelik and Associates Pty Ltd | sidrasolutions.com