

22 November 2023

Paul King
Frenchmans Bay Albany Pty Ltd
PO Box 518
SUBIACO WA 6904

Dear Paul

CONDITION 13 LDP: INFILTRATION TESTING – PROPOSED DEVELOPMENT OF LOTS 1 AND 2 FRENCHMAN BAY ROAD, FRENCHMAN BAY

BACKGROUND

Frenchmans Bay Albany Pty Ltd is planning to construct a tourism development on Lots 1 and 2 Frenchman Bay Road, Frenchman Bay (the Site). The Site comprises Lot 1 (1.8987 ha) and Lot 2 (1.3607 ha). The landowner has developed a Local Development Plan (LDP) which is included in Attachment A.

A previously approved LDP (Attachment B) included several conditions, including:

13. Prior to submitting any development application for the tourist development, in-situ soil infiltration testing shall be undertaken to the satisfaction of the Department of Water and Environmental Regulation. If required, the Site and Soil Evaluation Report shall be updated to reflect amended land application areas and shall be submitted to the City of Albany for approval.

In 2022, Biodiverse Solutions undertook a Site and Soil Evaluation (SSE) (Attachment C) which included infiltration (permeability) testing at two locations as follows:

In-field permeability testing was conducted on the 25th October 2022 at 2 locations within the proposed land application areas (Figure 9). Permeability testing was conducted using the Talsma-Hallam method. Hydraulic conductivity at IT1 (Figure 9) was found to be 4.03m/day (4.7×10^{-5} m/sec) and hydraulic conductivity at IT2 was found to be 1.21m/day (1.4×10^{-5} m/s), the hydraulic conductivity raw data and calculations is shown in Appendix C. Both hydraulic conductivities are considered to be rapid as shown in Figure 7. The hydraulic conductivity found at IT1 was found to be consistent with that of Soil Category 1 - Sand/gravel and the hydraulic conductivity at IT2 was found to be consistent with that of Soil Category 3 – Loams as per Table L1 of AS/NZS 1547:2012. The lower hydraulic conductivity encountered at IT2 was likely due to the compaction of the soil at this location due to vehicle movement given its close proximity to the site entrance. The soil at this location was also impacted by the presence of the surrounding established Norfolk pines, with soil mounding evident here due to the pine tree's root system. The soil hydraulic conductivity at IT1 within natural bushland was more indicative of that likely encountered across the majority of the site.



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Overview Map Scale 1:100,000

Legend

- Subject Site
- + CoA Production Bore
- Vancouver and Small Springs
- 100m setback to springs
- production bore setback
- 100m setback to coast line
- Indicative Land Application Area

Local Development Plan

- Camp Area
- Stormwater Storage
- Car bays
- Carrage
- Buildings
- Pool
- Significant Trees
- Trees



Scale
1:1,500 @ A3
GDA MGA 94 Zone 50

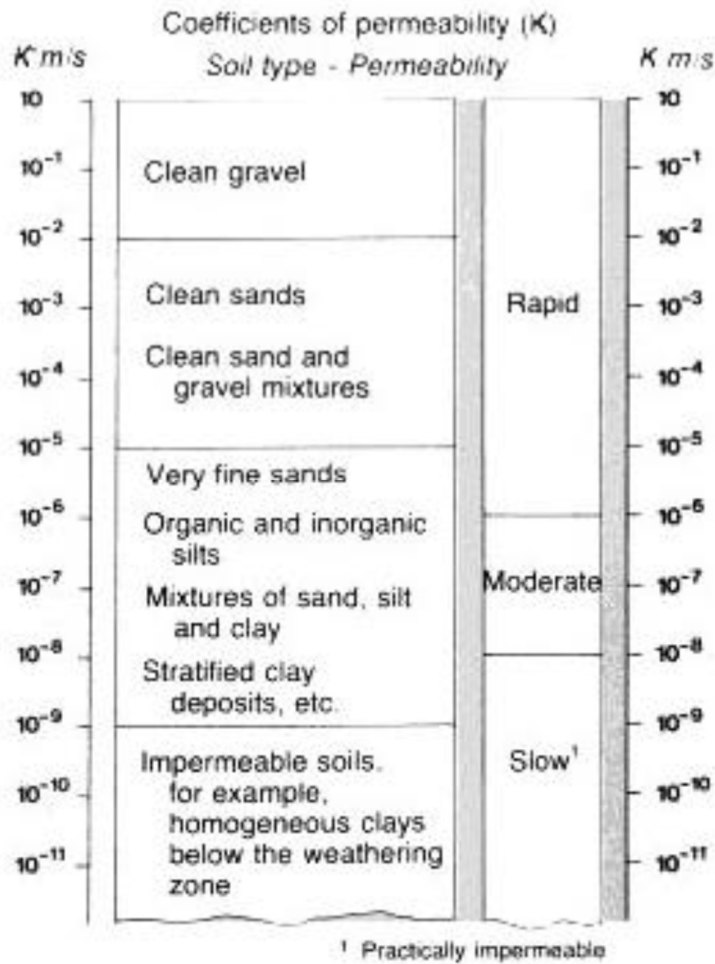
Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

CLIENT
Frenchman Bay Albany Pty Ltd
Lot 1 and 2 Frenchman Bay
Frenchman Bay, WA 6330

Figure 9: Indicative land application areas

	QA Check KK	Drawn by CC
STATUS FINAL	FILE MSC403	DATE 7/11/2022

FIGURE 7: HYDRAULIC CONDUCTIVITY OF SOIL TYPES



Source: Artiola *et al*, 2004¹

Soil testing by Landform Research for six drill holes (2008) identified relatively homogeneous soils comprising Quaternary coastal, aeolian sands (from 0m BGL to between 6.5 and >16 m BGL).

Therefore, infiltration and/or permeability rates for the current LDP are likely to be similar to those measured by Biodiverse Solutions. The range is considered to be acceptable for infiltration of treated waste water, especially if irrigation areas have plantings or landscaping to intercept the water.

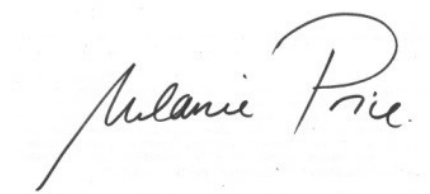
CONCLUSION

The infiltration rates previously identified are considered to be representative of soils found in the LDP area and are suitable for infiltration of treated waste water. It is considered that the information satisfies Condition 13.

¹ Environmental Monitoring and Characterization (2004) edited by Janick F. Artiola, Ian L. Pepper, Mark L. Brusseau. Elsevier Press.

If you have any queries regarding this assessment, please contact the undersigned on 0447 446 343 or melanie.price@auroraenvironmental.com.au.

For and on behalf of Aurora Environmental

A handwritten signature in black ink that reads "Melanie Price". The signature is written in a cursive style with a large, looping initial 'M'.

Melanie Price

Principal Environmental Scientist (Director)

Attachments

- A. Lots 1 and 2 Frenchman Bay Road, Frenchman Bay – Proposed Local Development Plan
- B. Currently Approved LDP
- C. Biodiverse Solutions (2022) Site Soil Evaluation

ATTACHMENT A

**LOTS 1 AND 2 FRENCHMAN BAY ROAD, FRENCHMAN BAY –
PROPOSED LOCAL DEVELOPMENT PLAN**

BUILDING TYPES	FOOT PRINT	NO. OF UNITS
1. LODGE	300m ²	1
2. GARAGE	80m ²	1
3. ALFRESCO	80m ²	1
4. GREAT ROOM	200m ²	1
5. 2 STORY PODS	30m ²	6
6. BBR	200m ²	2
7. SHED	200m ²	1
8. GLAMPING TENTS	30m ²	6
9. REFUGE	120m ²	1

NO. OF PEOPLE 48
 NO. OF BEDS 24
 NO. OF PARKING BAYS 34

- BUILDINGS
- WATER TANKS No. 2x RC140 3xRC80 TOTAL 831,430Lt
- FIRE WATER TANKS No. 1x RC80 1xRC20 TOTAL 144,474Lt
- WALK PATHS
- ROADS
- Vancouver springs setback
- 2061 Coastal Erosion hazard line
- 75m Horizontal setback datum
- Single story development setback
- Lot Boundary realignment
- Refuge area



STAGE ONE SITE PLAN
 1 : 1000

Rev	Description	Date

CODE	SUITABILITY DESCRIPTION
STATUS	PURPOSE OF ISSUE

PROJECT

1823 FRENCHMAN BAY ROAD,
 FRENCHMANS BAY

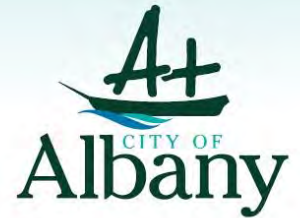
TITLE
 DEVELOPMENT SITE PLAN STAGE
 1

CLIENT
 HUB PROPERTY GROUP

DRAWN BY TYSON HARRIS	CHECKED BY Checker	DATE 01/23/07
SCALE (@ A1) 1 : 1000		PROJECT NUMBER Project Number
DRAWING NUMBER A100	REV	

ATTACHMENT B

CURRENTLY APPROVED LDP



Our Ref: LDP1/PA112029/LDP1
Cross Ref:
Enquiries: Dylan Ashboth Planning Officer

9 January 2023

Ayton Planning
PO Box 5476
Albany WA 6332

Dear Sir/Madam

PROPOSED LOCAL DEVELOPMENT PLAN - LOT 1 & 2 FRENCHMAN BAY ROAD, FRENCHMAN BAY WA 6330

I am pleased to advise that your application for Local Development Plan - Lot 1 & 2 Frenchman Bay Road, Frenchman Bay and associated provisions has been approved.

You are advised that prior to commencing construction works, any relevant planning conditions must be fulfilled and a building permit obtained. Please note that your proposal may be required to comply with:

- The *Building Code of Australia*;
- *Australian Standard 1428 – Design for access and mobility*; and
- The *Disability (Access to Premises – Buildings) Standards 2010*.

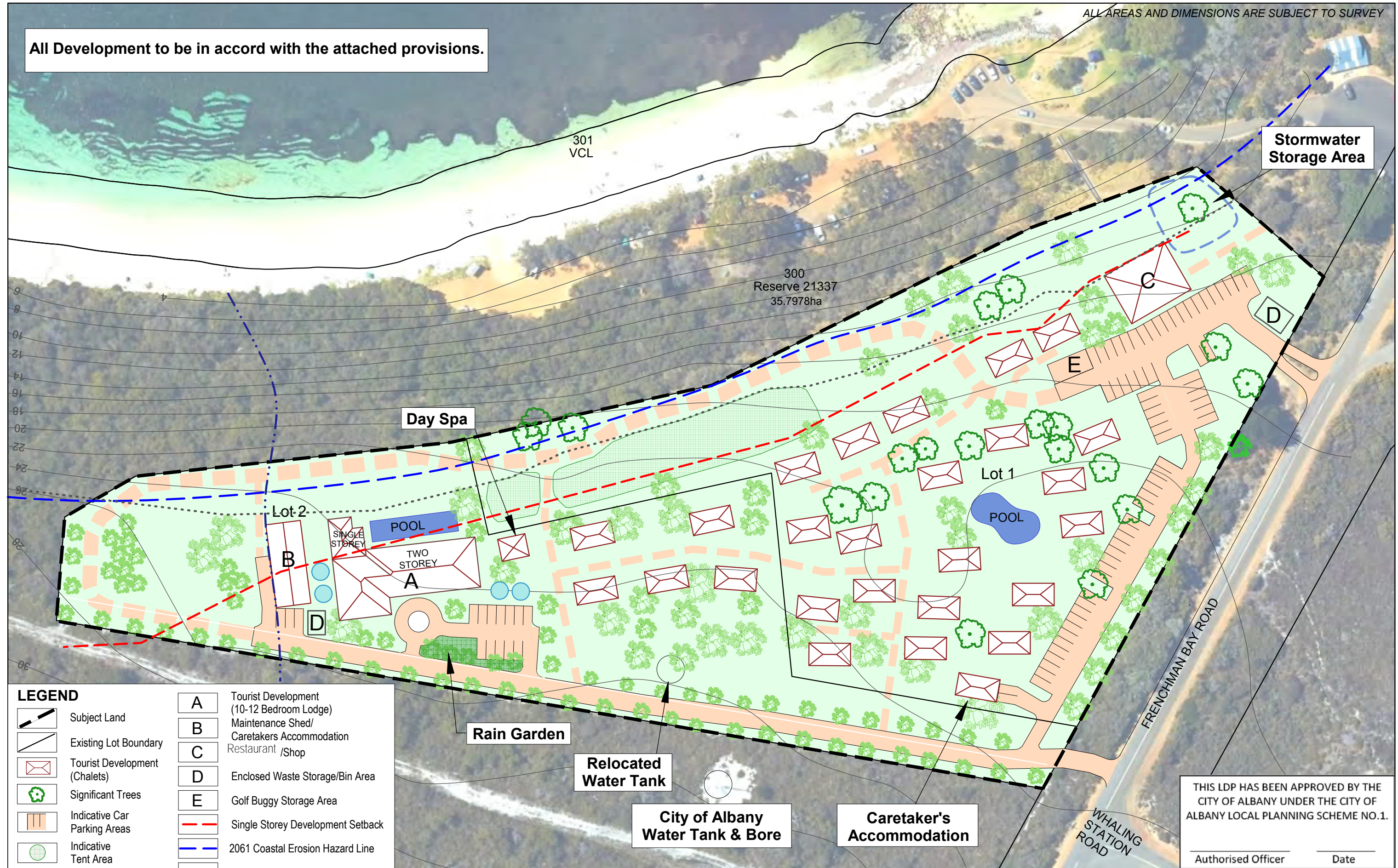
Development is also required to comply with all relevant environmental health regulations. Please see the attached information sheet for further detail.

Should you have any queries or wish to discuss this matter, please do not hesitate to contact me on 6820 3061 or via email planning@albany.wa.gov.au.

Yours faithfully

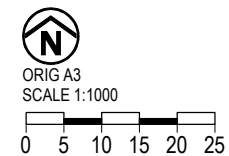
Dylan Ashboth
Planning Officer

All Development to be in accord with the attached provisions.



LEGEND

- Subject Land
- Existing Lot Boundary
- Tourist Development (Chalets)
- Significant Trees
- Indicative Car Parking Areas
- Indicative Tent Area
- A Tourist Development (10-12 Bedroom Lodge)
- B Maintenance Shed/ Caretakers Accommodation Restaurant /Shop
- C Enclosed Waste Storage/Bin Area
- E Golf Buggy Storage Area
- Single Storey Development Setback
- 2061 Coastal Erosion Hazard Line
- 65m Vancouver Spring Setback
- 75m Horizontal Setback Datum
- Lane Way / Fire Access
- Potable Water Tanks



THIS LDP HAS BEEN APPROVED BY THE CITY OF ALBANY UNDER THE CITY OF ALBANY LOCAL PLANNING SCHEME NO.1.

 Authorised Officer Date

LOCAL DEVELOPMENT PLAN : TOURIST DEVELOPMENT
 Lots 1 & 2 Frenchman Bay Road, Frenchman Bay
 City of Albany OCTOBER 2022

Local Development Plan No. 1 Provisions for Lots 1 and 2 Frenchman Bay Road, Frenchman Bay (Tourist Development, Caravan Park (Glamping) And Restaurant)

Heritage

- 1. Future development of the LDP1 area needs to ensure that the heritage significance of the site and adjacent heritage-protected places *Frenchman Bay Whaling Station (ruin)* (P16612) and *Kep Mardjit / Vancouver Spring & Dam* (P15602) is retained.**
- 2. Any proposed works within the curtilage of adjacent heritage-protected places shall require submission of a development application, including formal referral to the Heritage Council of WA for consideration.**
- 3. Future development in the LDP1 area adjacent to the heritage-protected places *Frenchman Bay Whaling Station (ruin)* (P16612) and *Kep-Mardjit / Vancouver Spring & Dam* (P15602) should consider any relevant policies and recommendations outlined in the *Archaeological Management Plan for Frenchman Bay Whaling Station (ruin)* (Archae-aus, 2022).**

Land use

- 4. The Local Development Plan shall be updated to replace reference to 'Bar/Kitchen/Shop' with 'Restaurant/Shop'.**

Advice: The LDP should not reference land uses that are unable to be considered under the City of Albany Local Planning Scheme No.1

- 5. No building is permitted to be used/occupied as a caretaker's dwelling until such time as a tourist development on the same lot has commenced operations.**
- 6. More than one caretaker's dwelling as part of facilities for the management of a tourist development in the LDP1 area may be considered, subject to the following:**
 - Where separate owned and managed tourist developments operating within the LDP1 area demonstrate that on-site caretaker's dwelling is required to support management of the facilities, and cannot otherwise be addressed through alternative arrangements;**
 - A caretaker's dwelling shall be on the same lot as the tourist development it is directly associated with;**
 - If further subdivision or amalgamation of the lots within the LDP1 area occurs, a caretaker's dwelling shall remain to be contained on the same lot as the tourist development it is directly associated with;**
 - Should any of the tourist developments operating within the LDP1 area amalgamate with another tourist development within the LDP1 area or cease operations, any approved caretaker's dwelling directly associated with the tourist development shall also cease and be required to be removed, or converted to form part of the tourist development.**

Car parking

- 7. Car parking shall be provided in accordance with Local Planning Scheme requirements and AS 2890.**

Water

8. All development shall be connected to a reticulated water supply, unless evidence of a viable alternative source can be provided with a development application and subsequently agreed to in writing by the City of Albany, following consultation with appropriate authorities.

Environmental

9. A Fauna Management Plan is to be prepared and implemented, consistent with the requirements of the Department of Biodiversity Conservation and Attractions, to manage threatened species during each stage of development works.
10. Prior to the commencement of any tourist development, surface and groundwater monitoring shall be undertaken in accordance with the approved Surface Water and Ground Water Monitoring Plan.
11. Development water cycle management shall be in accordance with the approved Local Water Management Strategy.
12. All necessary approvals shall be obtained prior to any clearing of vegetation outside of lot boundaries.

Advice:

- *The applicant should contact the City of Albany Reserves to commence arranging obtaining relevant approvals.*
- *State and Federal clearing approval may also be required.*

13. Prior to submitting any development application for the tourist development, in-situ soil infiltration testing shall be undertaken to the satisfaction of the Department of Water and Environmental Regulation. If required, the Site and Soil Evaluation Report shall be updated to reflect amended land application areas and shall be submitted to the City of Albany for approval.

Advice:

- *Further referrals to State Agencies may be required.*

14. All on-site wastewater systems are to comply with relevant Health Regulations, *Government Sewerage Policy 2019*, and *Health (Miscellaneous Provisions) Act 1911 Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*. Land application areas must be located a minimum of 100m from the Vancouver Spring Catchment Area.

Amenity

15. All dwellings, outbuildings and other structures (such as water tanks) shall be designed and constructed of material which allows them to blend into the landscape of the site. The use of natural materials such as stone and timber will be encouraged.
16. In order to protect visual amenity and reduce glare from a building (including water tanks) the use of reflective materials and white/off-white colours shall not be permitted.

Built form

17. Building heights within the 'single storey development setback' shall generally be consistent with the maximum heights (from natural ground level) established within

Table 3: Maximum Building Heights – Category A of SPP3.7 – Residential Design Codes Volume 1.

Advice: This provision provides guidance on the application of the Local Planning Scheme height requirements.

18. Building heights outside the ‘single storey development setback’ shall generally be consistent with the maximum heights (from natural ground level) established within Table 3: Maximum Building Heights – Category B of SPP3.7 – Residential Design Codes Volume 1.

Advice: This provision provides guidance on the application of the Local Planning Scheme height requirements.

Bushfire

19. Prior to the lodgement of any development application for the site, a written declaration shall be submitted to the City of Albany by a Level 3 bushfire consultant, confirming that a suitable area for on-site shelter, with radiant heat flux not exceeding 10kW/m² can be provided on-site to support all proposed future development (lodge, chalets, restaurant, day spa and associated caretaker’s dwellings).

Advice:

- *The ability to achieve a suitable area for on-site shelter, with a radiant heat flux not exceeding 10kW/m² should not be dependent on clearance/vegetation maintenance outside of lot boundaries, unless the necessary approvals have been obtained.*
- *The purpose of this condition is to confirm the development can safely proceed (capacity restrictions may still apply) without a suitable destination being identified, given concerns as to whether a suitable destination could be arranged.*
- *This condition does not preclude a suitable destination being explored or proposed within an amended Bushfire Management Plan.*

20. Prior to lodgement of a development application for any tourism development, an updated Bushfire Management Plan and Bushfire Emergency Evacuation Plan, demonstrating compliance with *State Planning Policy 3.7- Planning in Bushfire Prone Areas*, shall be submitted for endorsement by the City of Albany, in consultation with relevant state government agencies, with the requirements implemented thereafter.

Advice:

- *The current Bushfire Management Plan dated #### does not demonstrate compliance with the requirements of SPP3.7 and has therefore not been endorsed by the City of Albany.*
- *Given the unlikelihood in a compliant ‘suitable destination’ becoming available within a reasonable timeframe, and the proponent’s expectation to accommodate more than 100 guests on-site, it is recommended that preparation of an updated BMP is commenced as soon as possible, to mitigate potential delays in consideration of a future development application for any tourist development.*

- *Clearing of vegetation outside of lot boundaries shall not be relied upon unless the appropriate approvals have been obtained.*
21. Total site capacity (guests, staff and caretakers) shall be limited to a maximum of 100 persons unless a greater capacity is supported under *State Planning Policy 3.7 - Planning in Bushfire Prone Areas* and associated Guidelines, and subsequently agreed to in writing by the City of Albany, and following consultation with relevant state government agencies.
 22. On-site shelter shall be provided in accordance with an approved Bushfire Management Plan and shall be designed and constructed in accordance with the National Construction Code and the ABCB Community Shelter handbook, unless an alternative is supported under the *State Planning Policy 3.7 - Planning in Bushfire Prone Areas* and associated Guidelines, subject to agreement in writing by the City of Albany and following consultation with relevant state government agencies.
 23. Indicative tent area is permitted subject to compliance with *State Planning Policy 3.7 - Planning in Bushfire Prone Areas*.
 24. Strategic on-site water shall be provided in accordance with the *State Planning Policy 3.7 - Planning in Bushfire Prone Areas* and associated Guidelines.
 25. Prior to lodgement of a development application for any tourism development, a notification pursuant to Section 70A of the Transfer of Land Act 1893 is to be placed on the Certificate of Title of the proposed development lots advising of the existence of a hazard. 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 subject to a Bushfire Management Plan. Additional planning and building requirements may apply to development on this land.”

Coastal

26. The landowner is to undertake monitoring and review the coastal hazards every five years as identified in the Frenchman Bay Coastal Hazard Risk Management and Adaptation Plan. The landowner is to provide reporting to the Local Government on this matter to the satisfaction of the Local Government.
27. Development approval will be time limited (temporary planning approval) and shall cease to have effect when any of the following situations occur:
 - a. Shoreline retreat reaches 33m from any asset
 - b. The most landward part of the Horizontal Shoreline Datum is within 15 metres of the most seaward part of the lot boundary
 - c. Public road is no longer available or able to provide legal access to the property; or
 - d. Water, sewerage or electricity to the lot is no longer available as they have been removed/decommissioned by the relevant authority due to coastal hazards.

28. Once the development approval expires in accordance with the above, the development shall be removed and:

- a. The land shall be rehabilitated to its pre-development condition, to the specifications and satisfaction of the Local Government, at the landowners cost; and
- b. The affected area (processes area and foreshore) shall be ceded to the Crown, free of cost and without any payment of compensation by the Crown; and
- c. Should managed retreat be proposed, the landowner will need to apply to relocate the development to a safe position on the lot.

Advice: Horizontal Shoreline Datum means the active limit of the shoreline under storm activity, as defined in State Planning Policy 2.6 – State Coastal Planning Policy (2013).

29. Prior to lodgement of a development application for any tourism development, suitable arrangements shall be made with the City of Albany for pedestrian access from the subject site to the foreshore/beach.

Advice:

- ***Appropriate pedestrian access may be informed by results of the Foreshore Management Plan to be prepared by the City of Albany.***
- ***The existing vehicular access to the foreshore/beach is not safe for pedestrian access.***
- ***Future access shall ensure the beach/foreshore is accessible to people with a disability.***

30. Prior to lodgement of a development application for any tourism development, a notification, pursuant to Section 70A of the Transfer of Land Act 1893 is to be placed on the Certificate of Title of the proposed development lot advising of the existence of a hazard. The notification is to state as follows:

'VULNERABLE COASTAL AREA - This lot is located in an area likely to be subject to coastal erosion and/or inundation over the next 100 years from the date this notification is registered and is subject to conditions which require removal and rehabilitation of development to pre-development conditions at the landowners cost, and ceding of the land to the Crown, free of cost and without any payment of compensation by the Crown at the time the situations specified in the Local Development Plan occur.

31. Prior to lodgement of a development application for any tourism development, the amalgamation of lots 1 & 2 should be progressed or suitable easements shall be arranged to address the following matters:

- **Reciprocal rights of access for Lot 1 over the Lot 2 (lodge) entry**
- **Access rights for emergency fire purposes in favour of the Local Government and public authority**
- **Access rights for strategic water supply for firefighting purposes**
- **Access rights to on-site shelter (if relevant); and**
- **Rights to use land outside of lot boundaries for effluent disposal application areas and associated maintenance.**

General Advice:

- i. In regard to the timing indicated on the above provisions, the ‘tourist development’ means any part of the development indicated on the LDP diagram, with the exception of the maintenance shed.***
- ii. Resolution of outstanding matters relating to bushfire management, effluent disposal, clearing outside of lot boundaries and LDP provisions may necessitate changes to the approved LDP prior to the tourist development commencing. The applicant should be advised that any required amendments to the LDP may necessitate a full assessment, advertising and referral process in accordance with statutory requirements, depending on the significance of the amendments.***
- iii. The City of Albany has no obligation to protect against coastal hazards and/or inundation, and is not liable for any harm caused by coastal hazards and/or inundation***
- iv. A Section 40 approval from the Department of Biodiversity, Conservation and attractions will be required prior to any clearance likely to disturb habitat or potential habitat for threatened species.***
- v. The DPLH recommends that proponents refer to the State’s Aboriginal Heritage Due Diligence Guidelines (Guidelines). The Guidelines can be found on the DPLH website at the following link: <https://www.dplh.wa.gov.au/information-and-services/aboriginal-heritage/land-use-under-the-aha>***
- vi. The development area is within a proclaimed groundwater area under the Rights in Water and Irrigation Act, 1914. A licence to construct a well and take water is required in most instances (DWER).***

ATTACHMENT C

BIODIVERSE SOLUTIONS (2022) SITE SOIL EVALUATION

**Lot 1 and 2 Frenchman Bay
Road, Frenchman Bay WA**

Site Soil Evaluation



Bio Diverse Solutions

07/11/2022

DOCUMENT CONTROL

TITLE: Site Soil Evaluation – Lot 1 & 2 Frenchman Bay Road, Frenchman Bay

Author (s): Chiquita Cramer (Bio Diverse Solutions)

Reviewer (s): Bianca Theyer & Nick Ayton

Job No.: MSC0403

Client: Frenchman Bay Albany Pty Ltd

REVISION RECORD

Revision	Summary	Revised By	Date
Draft Id 13/07/2021	Internal QA review	B. Theyer	13/07/2021
Draft Id 13/07/2021	Submitted to Ayton Baesjou for review	N. Ayton	13/07/2021
Final Id 03/08/2021	Submitted to Ayton Baesjou for client submission	C. Cramer	03/08/2021
Final 22/03/2022	Updated to include modified LDP	C. Cramer	22/03/2022
Final 05/04/2022	Updated to include further modified LDP	C. Cramer	12/04/2022
Final 30/08/2022	Updated to include response to DoH comments and LDP update.	C. Cramer	30/08/2022
Final 7/11/2022	Updated to include response to DWER comments and LDP update.	C. Cramer	7/11/2022



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Figure 5: Sewage Sensitive Area Mapping

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Figure 7: 2018 Soil testing hole locations

Figure 7: Hydraulic Conductivity of Soil Types (Artiola *et al*, 2004)

Figure 9: Indicative land application areas

Figure 10: Monitoring locations

Appendices

Appendix A – Site Soil Investigation (Great Southern Geotechnics, 2016)

Appendix B – Site Soil Investigation (Great Southern Geotechnics, 2018)

Appendix C – In-situ Permeability Results (BDS, 2022)

1 Introduction

Frenchman Bay Albany Pty Ltd commissioned Bio Diverse Solutions to prepare a Site Soil Evaluation (SSE) to determine onsite effluent disposal suitability for a proposed tourism development at Lot 1 and 2 Frenchman Bay Rd, Frenchman Bay WA (herein referred to as the Subject Site). This report details the site soils and suitability for on-site effluent disposal at the site in relation to the proposed development.

1.1 Alignment to Legislation, Policy and Guidelines

Bio Diverse Solutions has prepared this report aligned to the following legislation:

- State Planning Commission, Land Capability Assessment for Local Rural Strategies (1989);
- *Government Sewerage Policy (2019)*;
- *Draft Country Sewerage Policy (Amended 2003)*;
- *Health Act (1911)* and draft *Health Act (2008)*;
- *Country Area Water Supply Act 1947*;
- Code of Practise for the design, manufacture and operation of Aerobic Treatment Units (2001); and
- Australian Standard (AS)1547-2012.

1.2 Suitable Qualified Hydrologist

This SSE has been prepared by Chiquita Cramer, who has 13 years of experience working as a hydrologist and hydrogeologist.

Chiquita Cramer has the following tertiary qualifications:

- Bachelor of Science in Natural Resource Management (University of Western Australia); and
- Graduate Certificate in Hydrogeology (University of Western Australia).

Chiquita worked as a hydrologist and senior hydrologist at JDA Consultant Hydrologists in Perth for 8 years, during this time she also completed a Graduate Certificate in Hydrogeology. In 2017 she joined Bio Diverse Solutions (BDS) to provide expertise in hydrology and hydrogeology to the company. Chiquita's experience includes preparation of local and urban water management strategies, hydrological and hydraulic investigations, surface water and groundwater monitoring reports, hydrogeological reports and Site Soil Evaluations (SSE) for onsite disposal suitability. Chiquita has successfully completed numerous SSE reports for a range of developments at various planning stages. Chiquita also attended a workshop on SSE reporting organised by the Department of Health in 2021.

1.3 Location

The Subject Site is defined as Lot 1 and 2 Frenchman Bay Road, Frenchman Bay WA, within the municipality of the City of Albany (CoA). It is located approximately 21km southeast of the Albany CBD. The site is bound by Frenchman Bay Road to the east, Frenchman Bay beach to the north and CoA reserve to the south and west. The location of the Subject Site is shown on Figure 1.



Figure 1: Location Plan

2 **Development Proposal**

In September 2015, the CoA approved a Local Development Plan (LDP) for Lots 1 and 2 Frenchman Bay Road, which are designated as Special Use Site No. 13 under the provisions of the City of Albany's Local Planning Scheme No. 1. The Special Use site provides for the development of holiday accommodation, caravan park, caretaker's dwelling and a shop, and is identified as an important local strategic tourist site in the City of Albany's Local Tourism Planning Strategy. Following approval of the LDP, a development application was lodged with the Southern Joint Development Assessment Panel in December 2017 and approved in June 2018. The developer subsequently resolved not to proceed with the development and the property has more recently been acquired by Frenchman Bay Albany Pty Ltd.

Frenchman Bay Albany Pty Ltd propose an alternative development to what was previously proposed. They propose separating the site into three components consisting of:

- A luxury holiday lodge with 10-12 bedrooms;
- Up to 25 single bedroom holiday chalets, day spa and manager's accommodation; and
- A signature café/restaurant with associated kiosk/shop and reception office.

The proposed LDP is shown in Figure 2.

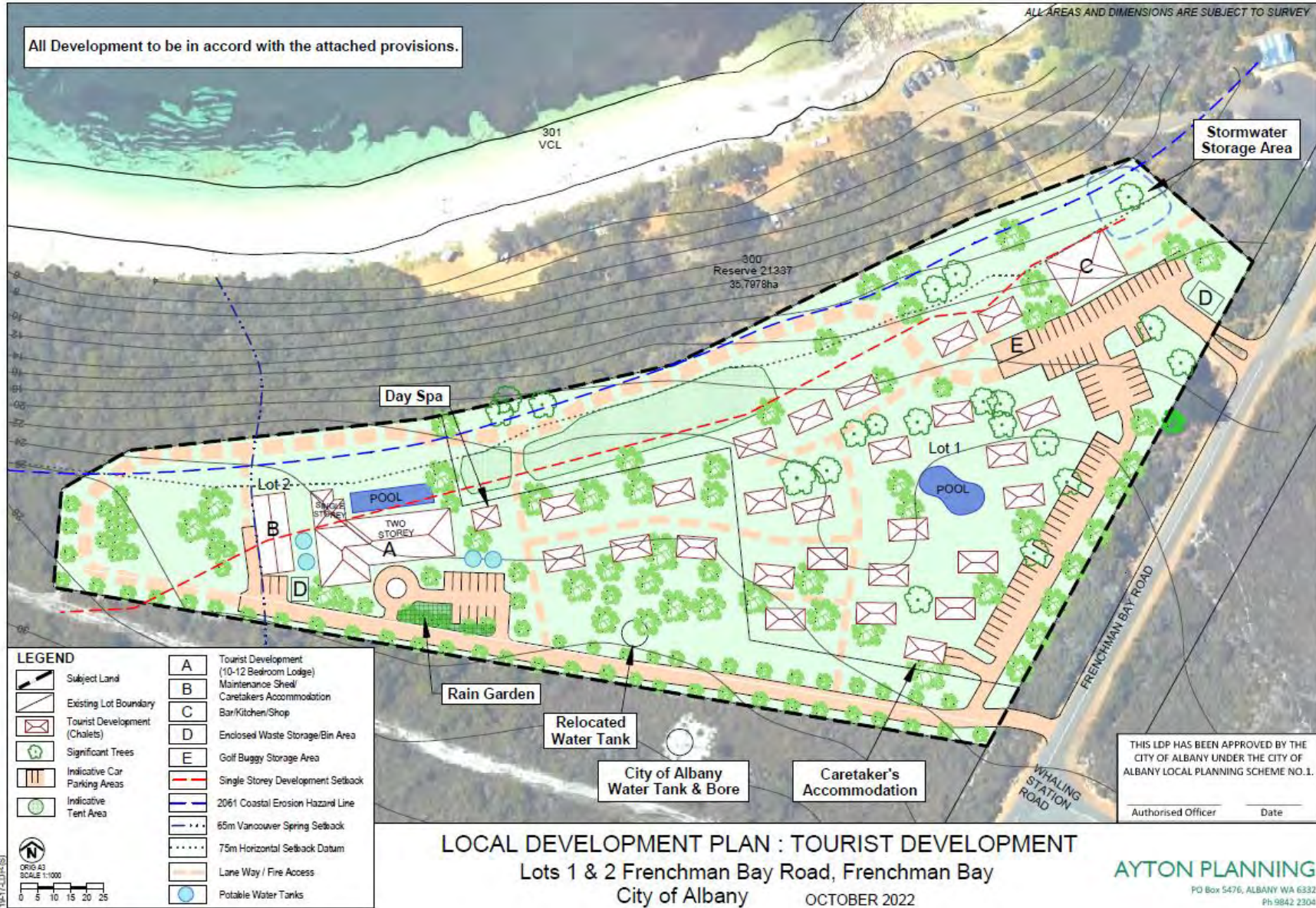


Figure 2: Proposed Local Development Plan

3 Desktop Assessment

3.1 Topography and slope

The Subject Site is situated at the top of a steep slope extending from the coast line below. Topography across the site is gently sloping, ranging in height from 14m AHD in the northeast corner of the site to 28m AHD in the southwest corner of the site. Topographic Contours are shown in Figure 3.

3.2 Geology and Soils

Soil Mapping – Zones (DPIRD, 2022) shows the Subject Site is within the Albany Sandplain Zone (242) and described as *'Gently undulating plain dissected by a number of short rivers flowing south. Eocene marine sediments overlying Proterozoic granitic and metamorphic rocks. Soils are sandy duplex soils, often alkaline and sodic, with some sands and gravels.'* (DPIRD, 2022).

The Subject Site is located within one soil system being the Mount Many Peaks System (242Mm) and described as *'Granitic hills and headlands, on the southern edge of the Albany Sandplain Zone, with shallow gravel, bare rock grey shallow sandy duplex and sandy gravel. Low woodland, scrub heath and mosses and lichens on rocks.'* (DPIRD, 2022). The Subject Site is also located within one soil sub-system being the Gardner sandy phase and described as *'Granitic hills and headlands, on the southern edge of the Albany Sandplain Zone, with shallow gravel, bare rock grey shallow sandy duplex and sandy gravel. Low woodland, scrub heath and mosses and lichens on rocks.'* (DPIRD, 2022).

In 2008 Landform Research conducted a geological study of the site for a previous proposed development. In summary six air blast drill holes were constructed to varying depths from 15 – 21 m BGL (Below Ground Level), the drill holes were tested for soil type and presence of groundwater. Soil type in all six drill holes was found to be predominantly Quaternary coastal, Aeolian sands (from 0m BGL to between 6.5 and >16 m BGL). Holes 1, 2, 3 and 5 consisted of Quaternary coastal, Aeolian sands overlying possible Pallinup Siltstone, with the depth of the siltstone layer ranging from 6.5 - 16.5 m BGL in Hole 3 to 16 - >21 m BGL in Hole 1. Peats consistent with the Werillup Formation were found at Hole 3 only, from 16.5 m BGL. The location of the drill holes is shown in Figure 3.



Figure 3: Topography and Geology

3.3 Surface Hydrology

There are no existing drainage networks or water bodies within the Subject Site. Surface water generally runs off the site in a north easterly direction towards the coast line. There are however many localised low points across the site which would trap most of the surface runoff from the site during storm event. The north-eastern portion of the site has a steeper slope with fewer localised low points and as such surface water here would drain directly off the site, via sheet flow, down the embankment towards the foreshore.

There are two natural springs (Vancouver Spring and Small Spring) located approximately 65m and 40m respectively, from the north-west corner of the Subject Site. Only a very small portion of the Subject Site in the northwest drains towards the springs.

Surface water from the section of Frenchman Bay Road adjacent to the Subject Site, including the adjoining beach car park and turn around area, is directed towards the foreshore via the road network. There are two kerb breaks in the steeper section of road directing stormwater off the road and down the embankment towards the beach. The surface water hydrology of the Subject Site is shown in Figure 4.

3.4 Hydrogeology and Groundwater

Australian Geoscience Mapping and Department of Water and Environmental Regulation (DWER) 250K Hydrogeological mapping places the Subject Site within the *Tertiary - Cainozoic - Phanerozoic period (TPw)*. The soils are described as *'Werillup Formation – bryozoans limestone, siltstone, sandstone, peat and basal conglomerate; weathered.'* The aquifer is described as *'a sedimentary aquifer with intergranular porosity – extensive aquifers, major groundwater resources'* (DWER, 2001). Hydrogeological mapping is shown on Figure 4.

DWER 250K Hydrogeological mapping is consistent with findings by Landform Research (2008) which showed peats consistent with the Werillup Formation and encountered groundwater at Drill Hole 2 (9.8m AHD), Drill Hole 3 (11.3m AHD), Drill Hole 4 (-0.7m AHD) and Drill Hole 6 (5.8m AHD). Groundwater was not encountered to 2m depth during the September 2016 or the March 2018 geotechnical investigation (Great Southern Geotechnics). The drill holes and their respective depths to groundwater are shown on Figure 4.

There is one existing production bore located on the Subject Site. The production bore was previously used for water supply to the caravan park via a 200kL tank located at the high point of the site. Subsequent to the caravan park's closing the bore was used by the City of Albany (CoA) to supply water to an adjacent public toilet facility. More recently the CoA constructed a new production bore and associated tank ~12m south of the Subject Site to service the public toilets and as such the Subject Site bore is currently unutilised. The location of the Subject Site production bore and the 200kL tank are shown in Figure 4.

Desktop analysis of the Subject Site indicates it is not located within a designated Public Drinking Water Source Area (PDWSA) as defined by the *Country Areas Water Supply Act 1947*. The closest designated PDWSA is located 1.4km to the southwest, being Limeburners Creek Catchment (Priority 1) (DWER, 2022).

3.5 Flooding Potential

The Subject Site is not subjected to regular flooding given the elevation of the Subject Site and separation to groundwater.



Subject Site	Production Bore	Drill holes & Groundwater Level (Landform Research 2008)	Pre-development surface water catchment	Surface water flow direction	5m topographic contours (MAHD)	TPw (250K Hydrogeological Mapping (DrWI))	Scale 1:2,000@A4			39 Hercules Crescent Albany, WA 6330 Australia Tel: 08 9842 1575 Fax: 08 9842 1575	CLIENT Frenchman Bay Albany Pty Ltd Lot 1 & 2 Frenchman Bay Road Albany WA 6330
Figure 4: Surface water and groundwater hydrology											
STATUS FINAL	F.I.E. M 300403	DATE 22/03/2022									

3.1 Environmentally Sensitive Areas

The Subject Site is located 212m away from the nearest Environmentally Sensitive Area (ESA) being; Torndirrup National Park. This meets the usual requirement of 100m separation for developments from ESA's. Additionally the proposed development poses minimal risk to the ESA given the Subject Site is located down-gradient of the ESA.

3.2 Sewage Sensitive Areas

The Subject Site is not located in a Sewage Sensitive Area. The *Government Sewerage Policy* (DPLH, 2019a) outlines Sewage Sensitive Areas as:

'Land that drains to and is within two kilometres of Irwin Inlet, Wilson Inlet, Torbay Inlet, Manarup Lagoon, Lake Powell, Princess Royal Harbour and Oyster Harbour'.

and

'Within one kilometre up-groundwater- gradient and 250 metres down-groundwater-gradient of a significant wetland; or where the groundwater gradient is unknown or seasonably variable within one kilometre of the significant wetland'.

The Subject Site is outside of Princess Royal Harbour and not within close proximity of a wetland classified as significant and therefore is not within a Sewage Sensitive Area. Sewage Sensitive Area mapping is shown in Figure 5.

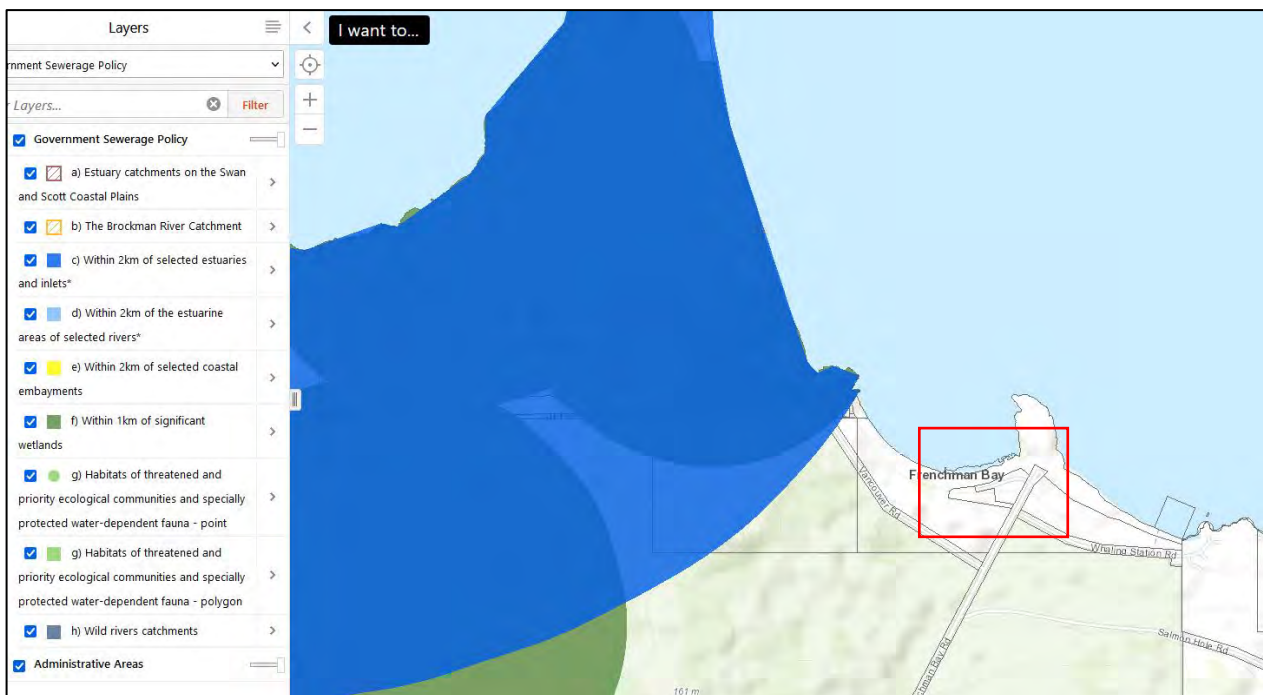


Figure 5: Sewage Sensitive Area Mapping

4 Soil Testing

4.1 Soil Testing Method

A Site Soil Investigation was conducted on the 30th September 2016 by Great Southern Geotechnics (GSG) and Bio Diverse Solutions as part of the previously proposed and approved development. The site investigation included the construction of six test holes to a depth of 2.0 metres, photographing and logging of soils to the depth of the holes, and inspection and measuring of the water table if found to be present. The location of the six soil test holes is shown in Figure 6 and the Site Soil Investigation (GSG, 2016) report showing the bore hole logs is included as Appendix A.



Figure 6: Soil testing hole locations

A follow up Site Soil Investigation to capture soil characteristics along the eastern and southern boundaries was conducted on the 22nd March 2018. The site investigation included the construction of a further six test holes to a depth of 2.0metres, photographing and logging of soils to the depth of the holes and inspection and measuring of the water table. The location of the additional six soil test holes is shown in Figure 7 and the Site Soil Investigation (GSG, 2018) report is included as Appendix B.



Figure 7: 2018 Soil testing hole locations

Soil test holes during both the 2016 and 2018 investigation were excavated to a depth of 2.0 metres using a Kubota KX41-3V mini excavator with a 300mm auger. The boreholes were logged and left open for a minimum of 1 hour to examine any water table or water seepage into the soil profile.

Analysis of the site for suitability of effluent disposal was undertaken with a desktop assessment of publicly available databases and assessment of the site soils in relation to the Government Sewerage Policy (DPLH, 2019a) and AS1547-2012.

4.2 Soil Testing Results

The 12 test holes revealed that soils across the site were relatively consistent and consisted predominantly of sand with silt from the surface to the depth of the hole.

Details of the 2016 site soils as classified by Great Southern Geotechnics are provided in Table 1 and the details of the 2018 site soils is provided in Table 2. The 2016 and 2018 Site Soil Investigation Reports (including bore logs) are shown in Appendix A and B, respectively.

Table 1: Soil Testing Results (GSG, 2016)

Test Pit	Depth (mm)	Soil Type	Soil Description
TP1	0-500mm 500-1800mm	Sand with silt Sand with silt	Dark grey to grey, fine to medium grained, roots and root fibres. Light grey/white, fine to medium grained. No water table was encountered.
TP2	0-300mm 300-800mm 800-1800mm	Sandy gravel Sand with silt Sand with silt	Brown, fine to medium gravel, sub-rounded to sub angular, fine to medium grained sand, roots and root fibres. Dark grey to grey, fine to medium grained, roots and root fibres. Grey to light grey/white, fine to medium grained. No water table was encountered.
TP3	0-300mm 300-1800mm	Sand with gravel Sand with silt	Brown/grey, fine to medium grained sand, fine to medium grained gravel, subrounded to sub-angular, roots and root fibres. Light grey/white, fine to medium grained, roots and root fibres. No water table was encountered.
TP4	0-600mm 600-1800mm 1800-1900mm	Sand with silt Sand with silt Sand with silt	Dark grey to grey, fine to medium grained, roots and root fibres. Dark grey to grey, fine to medium grained. Light grey/light brown, fine to medium grained with pockets of dark brown fine to medium grained, cemented SAND. No water table was encountered.
TP5	0-200mm 200-1200mm 1200-1800mm	Sandy gravel Sand with silt Sand with silt	Grey/brown, fine to medium gravel, sub-rounded to sub-rounded, fine to medium grained sand, roots and root fibres. Light grey/white, fine to medium grained. Light brown/yellow, fine to medium grained, mottled dark brown fine to medium grained, cemented SAND with silt. No water table was encountered.
TP6	0-1200mm 1200-1800mm	Sand with silt Sand with silt	light grey, fine to medium grained, roots and root fibres. Light brown/yellow, fine to medium grained, mottled dark brown fine to medium grained, cemented SAND with silt. No water table was encountered.

Table 2: Soil Testing Results (GSG, 2018)

Test Pit	Depth (mm)	Soil Type	Soil Description
TP1 (2)	0-400mm 400-800mm 800-2000mm	Sand with silt Sand with silt Sand with silt	Dark grey, fine to medium grained. Roots and root fibres. Grey, fine to medium grained. Light grey to white, fine to medium grained. No water table was encountered.
TP2 (2)	0-1600mm 1600-2000mm	Sand with silt Sand with silt	Light grey/white, fine to medium grained. Light brown/grey, fine to medium grained. No water table was encountered.
TP3 (2)	0-400mm 400-1000mm 1000-2000mm	Sand with silt Sand with silt Sand with silt	Grey, fine to medium grained, roots and root fibres. Light grey, fine to medium grained. White fine to medium grained. No water table was encountered.
TP4 (2)	0-500mm 500-1000mm 1000-2000mm	Sand with silt Sand with silt Sand with silt	Grey, fine to medium grained, roots and root fibres. Light grey, fine to medium grained. Light grey/white, fine to medium grained. No water table was encountered.
TP5 (2)	0-300mm 300-800mm 800-2000mm	Sand with silt Sand with silt Sand with silt	Grey, fine to medium grained with roots and root fibres. Light grey/white, fine to medium grained. Light grey/white, fine to medium grained. No water table was encountered.
TP6 (2)	0-300mm 300-1700mm 1700-2000mm	Sand with silt Sand with silt Sand with silt	Grey, fine to medium grained, with roots and root fibres. Light grey, fine to medium grained. Brown/grey, fine to medium grained. No water table was encountered.

4.3 Soil Permeability

Silts and clay soils generally record poor permeability results whereas coarse sands and loose gravels generally record high permeability, as shown in Figure 7.

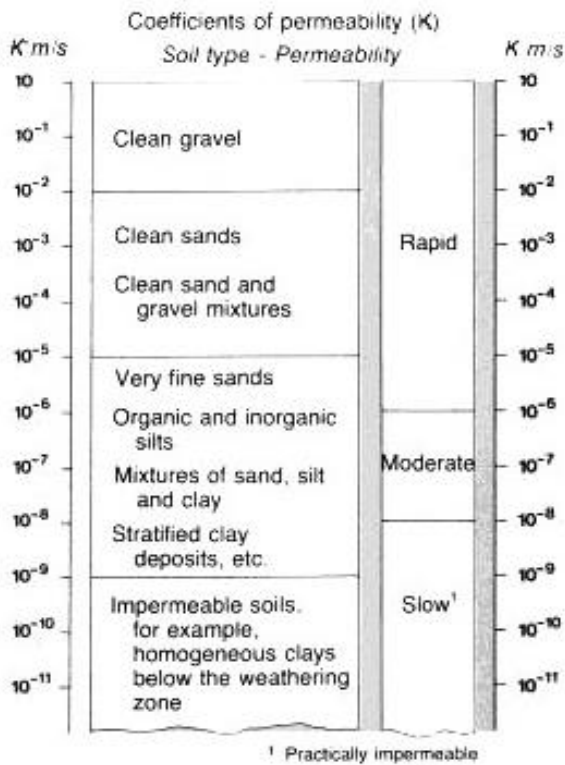


Figure 8: Hydraulic Conductivity of Soil Types (Artiola et al, 2004)

In-field permeability testing was conducted on the 25th October 2022 at 2 locations within the proposed land application areas (Figure 9). Permeability testing was conducted using the Talsma-Hallam method. Hydraulic conductivity at IT1 (Figure 9) was found to be 4.03m/day (4.7×10^{-5} m/sec) and hydraulic conductivity at IT2 was found to be 1.21m/day (1.4×10^{-5} m/s), the hydraulic conductivity raw data and calculations is shown in Appendix C. Both hydraulic conductivities are considered to be rapid as shown in Figure 7. The hydraulic conductivity found at IT1 was found to be consistent with that of Soil Category 1 - Sand/gravel and the hydraulic conductivity at IT2 was found to be consistent with that of Soil Category 3 – Loams as per Table L1 of AS/NZS 1547:2012. The lower hydraulic conductivity encountered at IT2 was likely due to the compaction of the soil at this location due to vehicle movement given its close proximity to the site entrance. The soil at this location was also impacted by the presence of the surrounding established Norfolk pines, with soil mounding evident here due to the pine tree’s root system. The soil hydraulic conductivity at IT1 within natural bushland was more indicative of that likely encountered across the majority of the site.

4.4 Phosphorus Retention Index

Phosphorous Retention Index (PRI) is the ability of soils to absorb and treat nutrients within the soil (i.e. soil microbe disinfecting ability). Soils with a PRI less than 1 have a very poor ability to treat effluent waters, whilst soils with a PRI of >5 having a high ability to treat effluent waters (nutrients).

PRI testing was conducted by CSBP on the sand with silt layer from TP1 (0-500mm depth) and TP6 (0-1200mm depth) during the 2016 soil investigation. The test results indicate that the site soils have a very low ability of treating effluent waters and to fix nutrients within the soil. TP1 had a PRI of 0.1 and TP6 had a PRI of 0.7.

5 **Site Suitability**

The Subject Site is situated in an area that does not have access to deep or reticulated sewerage. The health and environmental requirements for wastewater treatment and disposal for developments not serviced by deep sewerage systems are contained in the *Government Sewerage Policy*, (DPLH, 2019a). The *Government Sewerage Policy* (DPLH, 2019a) states minimum requirements apply for all on-site sewage disposal systems.

Soil testing conducted by Landform Research (2008) and Great Southern Geotechnics (2016 and 2018) showed soils across the Subject Site were consistent and comprised predominantly of sand with silt with a moderate permeability. This soil type is suitable for onsite effluent disposal allowing for adequate infiltration to prevent backing up of the system and water logging. The PRI of the soil was found to be low (0.1 to 0.7) it is recommended a soil amendment be incorporated into the land application areas to increase PRI to a minimum of 5. The soil amendment will also assist with the capacity of the soil to hold effluent water, promoting evapotranspiration and preventing the leaching of nutrients and contaminants from the effluent.

Groundwater was not encountered to a depth of 2 metres during the 2016 and 2018 soil investigation (GSG) and the 2008 investigation by Landform Research showed groundwater to be >6m BGL across the site. There were also no confining or semi-confining layers encountered close to surface (<2m BGL) at the site and therefore any perching of water during wetter months is unlikely. Groundwater is therefore not likely to have any impact on effluent disposal across the site.

The Subject Site has a gentle slope and does not exceed the minimum grade requirements (1:5) for disposal as outlined in Table 3 of the Draft Government Sewerage Policy (2019). It is recommended that the Land Application Areas (LAA) for onsite effluent disposal are adequately setback from the steep slope between the Subject Site and the Frenchman Bay foreshore to the north.

There are no waterways, water bodies or wetlands within the Subject Site. Vancouver and Small Springs are situated 65 and 40m, respectively, to the northwest of the Subject Site. Despite the springs being within 100m from the Subject Site boundary land application for effluent disposal for the proposed development can be and shall be achieved outside of the 100m separation setback from the springs. A 100m setback from the coastline to all LAA shall also apply, adequate LAAs are achievable within the Subject Site >100m from the coastline.

There is one private production bore within the Subject Site, this bore will be decommissioned as part of the development. There is also a City of Albany (CoA) production bore located ~12m south of the Subject Site boundary, at least 30m separation between the proposed LAA and the CoA bore shall be provided. Any future bore installed on the site shall be situated a minimum of 30m from LAAs, this is achievable within the Subject Site.

In summary the Subject Site and proposed development is deemed suitable for on-site effluent disposal given effluent disposal systems are installed consistent with (AS)1547-2012.

Table 4 outlines a summary of policy and compliance of the site to minimum requirements as outlined in the Government Sewerage Policy (DPLH, 2019a).

Table 3: Minimum requirements for all on-site wastewater disposal systems and design specific standards

Site Feature	Minimum Requirement	Requirement met
Separation from waterways	a wellhead protection zone or on Crown land within a reservoir protection zone; 100 metres of the high-water mark of a reservoir or 100 metres of any bore used for public drinking water supply where: — a wellhead protection zone or reservoir protection zone has not been assigned; or — where existing lots would be rendered undevelopable by the wellhead protection zone.	Yes The Subject Site is not located within the vicinity of a Priority Drinking Water Source Area (PDWSA) and associated wellheads. The nearest PDWSA is 1.4kms away being the South Coast Water Reserve and Limeburners Creek Catchment Area.
	30 metres of a private bore used for household/ drinking water purposes.	Yes There is one existing production bore on site, this bore will be decommissioned as part of development works. At least 30m shall be provided between the CoA bore and the site's proposed LAAs. Any proposed production bores shall be located a minimum of 30m from the designated LAAs.
	100 metres of a waterway or significant wetland and not within a waterway foreshore area or wetland buffer. The separation distance should be measured outwards from the outer edge of riparian or wetland vegetation.	Yes The nearest waterway is Vancouver and Small Spring located approximately 65 and 40 metres from the Subject Site. The LAAs shall be located a minimum of 100m from the springs. LAAs shall also be located 100m from the coastline.
	100 metres of a drainage system that discharges directly into a waterway or significant wetland without treatment.	Yes There are no additional drainage systems, to those mentioned above, within 100m of the proposed development.
	Any area subject to inundation and/or flooding in a 10 per cent Annual Exceedance Probability (AEP) rainfall event.	Yes The Subject Site is elevated in the landscape and not subjected to flooding in a 10% AEP.
Separation from groundwater – outside of public drinking water source areas.	Where land is not within a public drinking water source area or a sewage sensitive area, the discharge point of the on-site sewage system should be located the following distances above the highest groundwater level: <ul style="list-style-type: none"> • for loams and heavy soils, at least 0.6 metres. • for gravels, at least one metre. • for sands, at least 1.5 metres. Where a nutrient retentive secondary treatment system is used, at least 0.6 metres. 	Yes Site soil survey conducted by Landform Research in 2008 showed the highest known groundwater level is 6.8m BGL. There is no evidence of any perching of groundwater at the Subject Site.

Table 4 continued.

Site Feature	Minimum Requirement	Requirement met
Land Application Area	A land application area should be provided for all development in accordance with tables 2 and 3 of this schedule for the disposal of sewage.	<p>Yes</p> <p>The proposed LAAs are shown in Figure 9 and have been calculated in accordance with the Government Sewerage Policy & AS/NZS 1547:2012.</p> <p>The LAAs are indicative only and should be confirmed upon final design of the development.</p>
	The land application area includes the area restricted to the distribution of treated sewage only and should be kept free of any temporary or permanent structures.	<p>Yes</p> <p>The future proposed LAAs shall be kept free of any temporary or permanent structures.</p> <p>The LAAs shall be placed in an area so that requirements are met. Site plans to be forwarded to the CoA and Department of Health (DoH) prior to approval.</p>
	<p>Activities within the land application area shall not interfere with the function of the current and future land application system and people should avoid potential contact with effluent residues. Unless allowed for in the design, the land application area should:</p> <ul style="list-style-type: none"> • not be built on or paved in a manner which precludes reasonable access; • not be subject to vehicular traffic (other than a pedestrian-controlled lawnmower); • not be subject to regular foot traffic such as pathways and clothes line areas; and • should be kept in a manner which enables servicing and maintenance of the disposal system. 	<p>Yes</p> <p>The proposed LAAs are a sufficient distance to areas that are utilized for activity or pedestrian traffic.</p> <p>The LAAs shall be placed in an area so that requirements are met. Site plan to be forwarded to CoA/DoH prior to approval.</p>
Gradient of the land application area	Where slope exceeds one in five (1:5), the land application area should be engineered to prevent run-off from the land application area. Surface contours should be provided on the site plan.	<p>Yes</p> <p>The proposed LAAs are situated on relatively flat land that does not exceed 1:5 gradient.</p> <p>Natural and finished gradients of LAAs shall not exceed 1:5 gradient. Site plan to be forwarded to CoA/DoH prior to approval.</p>
Location of land application area within building envelope	Local government may approve the location of land application areas outside building envelopes where proposed location meets requirements outlined above.	<p>Noted</p>

6 Land Application Areas

Land application areas have been calculated for each accommodation type within the proposed development. Estimated land application areas for the proposed development are presented in Table 5 and shown in Figure 9.

Table 4: Estimated Land Application Areas for proposed development

Accommodation Type	Expected Maximum occupancy (No. of people at any given time)	Human waste hydraulic loading rates (L/person/day)	Estimated occupancy rate (%)	Conversion factor	Land Application Area (m ²)
Luxury holiday lodge consisting of 10-12 bedrooms	24	140	100	0.2	672
25 x single bedroom chalets	50	140	100	0.2	1,400
Signature café/restaurant with associated shop and reception	100	30	100	0.2	600
Day spa	8*	30	100	0.2	48
Manager's accommodation	2	150	100	0.2	60

*Assumed day spa visitors are also accommodation guests.

The location of the land application areas shown in Figure 9 are indicative only, the final location of the land application areas shall be confirmed during detailed design and shall be in accordance with the Government Sewerage Policy (DPLH, 2019a), this Site Soil Evaluation and the effluent disposal system shall be installed in accordance with (AS)1547-2012.

The following assumptions were used to estimate the land application areas for the development:

- The human waste hydraulic loading rates (Table 5) used to calculate land application areas are derived from Regulation 29 and Schedule 9 of the Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974.
- The estimated occupancy rate used for the accommodation is 100% this is conservative and takes into consideration the worst-case scenario.
- The conversion factor used to estimate the land application area is derived from the Government Sewerage Policy (DPLH, 2019). This factor is based on the use of a secondary treatment system and the application of effluent water to Soil Category 1 – sand/gravel (as determined in Section 4: Soil Testing).

It is recommended a secondary treatment system be utilised for all effluent disposal due to the large scale of the development and its proximity to the Frenchman Bay foreshore area and Vancouver and Small Springs. A secondary treatment system is a wastewater treatment system which produces treated effluent of secondary standard i.e. 20 mg/L of Biochemical Oxygen Demand (BOD), 30 mg/L of Total suspended solids (TSS) and 10 cfu/100 mL of Escherichia (E) coli. Due to the treatment and disinfection process, the treated wastewater from secondary treatment systems may be used for garden irrigation.

Tertiary treatment systems may also be required to ensure the final effluent meets nutrient reduction targets specified within Water Quality Protection Note # 88 relating to Rural Tourist Accommodation (WQPN 88). The nutrient loading targets specified in the WQPN 88 are a maximum inorganic nitrogen (as N) application of 9mg/L and a maximum reactive phosphorus (as P) application of 0.6mg/L. Nutrient loading targets are consistent with Risk Category A due to the sandy nature of the site soils and the proximity of the site to Vancouver and Small Springs and the coast line.

Both Conventional leach drains and subsurface irrigation systems are both suitable systems for the Subject Site based on soil properties and separation to groundwater. A subsurface irrigation system is recommended at the site given the landscaping proposal (driveways/carparks lined with trees and parkland style gardens). In addition the sub-surface irrigation system relies not only on infiltration but also evapotranspiration allowing for a reduction in leaching and the potential for uptake of nutrients/contaminants by plants.

Irrigation systems shall be designed to ensure that effluent is not applied at rates which exceed the absorption capacity of the soil. Care shall be taken to ensure that the application rate does not lead to:

- Adverse effects on soil properties and plant growth through excess salt accumulation in the root zone during extended dry periods;
- Harmful long-term environmental effects to the soil of the land application system or the adjacent surface water and groundwater; or
- Increased risk to public health from surface ponding in the land application area or channeling or seepage beyond the land application area.

The subsurface irrigation system shall be designed to promote evapotranspiration. Care shall be taken to ensure that the irrigation area is well planted with plant species that are:

- Water tolerant;
- Appropriate for the site conditions; and
- Planted at an appropriate density for effective evapotranspiration.

In summary onsite effluent disposal for the proposed development is achievable in accordance with the relevant guidelines with the use of a secondary and if required a tertiary treatment system. A sub-surface irrigation system is the most suitable land application system for the development proposal. Land application area estimates will require revision given any proposed extensions or major changes to the development.



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Overview Map Scale 1:100,000

Legend

- Subject Site
- + CoA Production Bore
- Vancouver and Small Springs
- 100m setback to springs
- production bore setback
- 100m setback to coast line
- Indicative Land Application Area

Local Development Plan

- Camp Area
- Stormwater Storage
- Car bays
- Carrage
- Buildings
- Pool
- Significant Trees
- Trees



Scale
1:1,500 @ A3
GDA MGA 94 Zone 50

Data Sources
Aerial Imagery: WA Now, Landgate Subscription Imagery
Cadastre, Relief Contours and Roads: Landgate 2017
IRIS Road Network: Main Roads Western Australia 2017
Overview Map: World Topographic map service, ESRI 2012

CLIENT
Frenchman Bay Albany Pty Ltd
Lot 1 and 2 Frenchman Bay
Frenchman Bay, WA 6330

Figure 9: Indicative land application areas

	QA Check KK	Drawn by CC
STATUS FINAL	FILE MSC403	DATE 7/11/2022

7 Monitoring

Water quality monitoring of Vancouver Springs (SP01) and Small Springs (SP02), and three shallow groundwater monitoring bores (SB01, SB02 and SB03) within the Subject Site (Figure 10) was conducted quarterly for a period of two years from 2018 to 2019. The pre-development monitoring of the groundwater and surface water sites was conducted to establish base line water quality data for the site.

Pre-development and post-development monitoring at Lots 1 and 2 Frenchman Bay Road, Frenchman Bay as part of the proposed Local Development Plan shall be in accordance with Table 5. Water quality results shall be compared to ANZECC & ARMICANZ (2000) water quality trigger values for freshwater (95% level of protection) and ANZECC & ARMICANZ (2000) water quality guidelines for freshwater lakes and reservoirs in South-west Australia. Water quality results shall also be compared to baseline data to evaluate whether any significant changes in water quality or quantity have occurred at the site.

Table 5: Monitoring Program

Development Proposal	Monitoring Proposal	Monitoring Parameters	Approximate Timeframe
Pre-development: Prior to construction of Stage 1 (the lodge) and Stage 2 (the retreat and café).	<ul style="list-style-type: none"> Conduct quarterly sampling of three deep bores (DB1, DB2 and DB3) for 1yr to establish baseline data for the local aquifer. The location of the proposed bores is shown in Figure 10 and includes monitoring of the exiting site bore, the existing CoA bore and establishment of an additional bore. Conduct fixed point photography, 2 directions at each proposed location (FP1-FP6, as shown in Figure 10) biannually (April and October) to assess vegetation condition. No pre-development monitoring of the springs (SP01 & SP02) or shallow bores (SB01-SB03) proposed. Baseline data was established in 2018/2019. 	<ul style="list-style-type: none"> Vegetation condition (fixed point photography) Water levels In-situ: pH, EC, TDS & Dissolved Oxygen Thermotolerant Coliforms & E. coli Nutrient suite Heavy metals 	January 2023 to January 2024
Post-development: Following practical completion of both Stage 1 (the lodge) and Stage 2 (the retreat and cafe).	<ul style="list-style-type: none"> Quarterly monitoring of all monitoring sites for a period of 2 years (SP01, SP02, SB1 - SB3, DB1 - DB3, FP1 - FP6). Location of monitoring sites is shown in Figure 10 	<ul style="list-style-type: none"> Vegetation condition (fixed point photography) Water levels In-situ: pH, EC, TDS & Dissolved Oxygen Thermotolerant Coliforms & E. coli Nutrient suite Heavy metals 	To be determined
Following 2 years of post-development monitoring a review of the monitoring program in consultation with DWER to occur.			To be determined

Results and findings from the monitoring program shall be presented in an annual monitoring report and submitted to all relevant government agencies (DWER, DoH and CoA). Water quality monitoring shall be conducted by a NATA accredited laboratory.

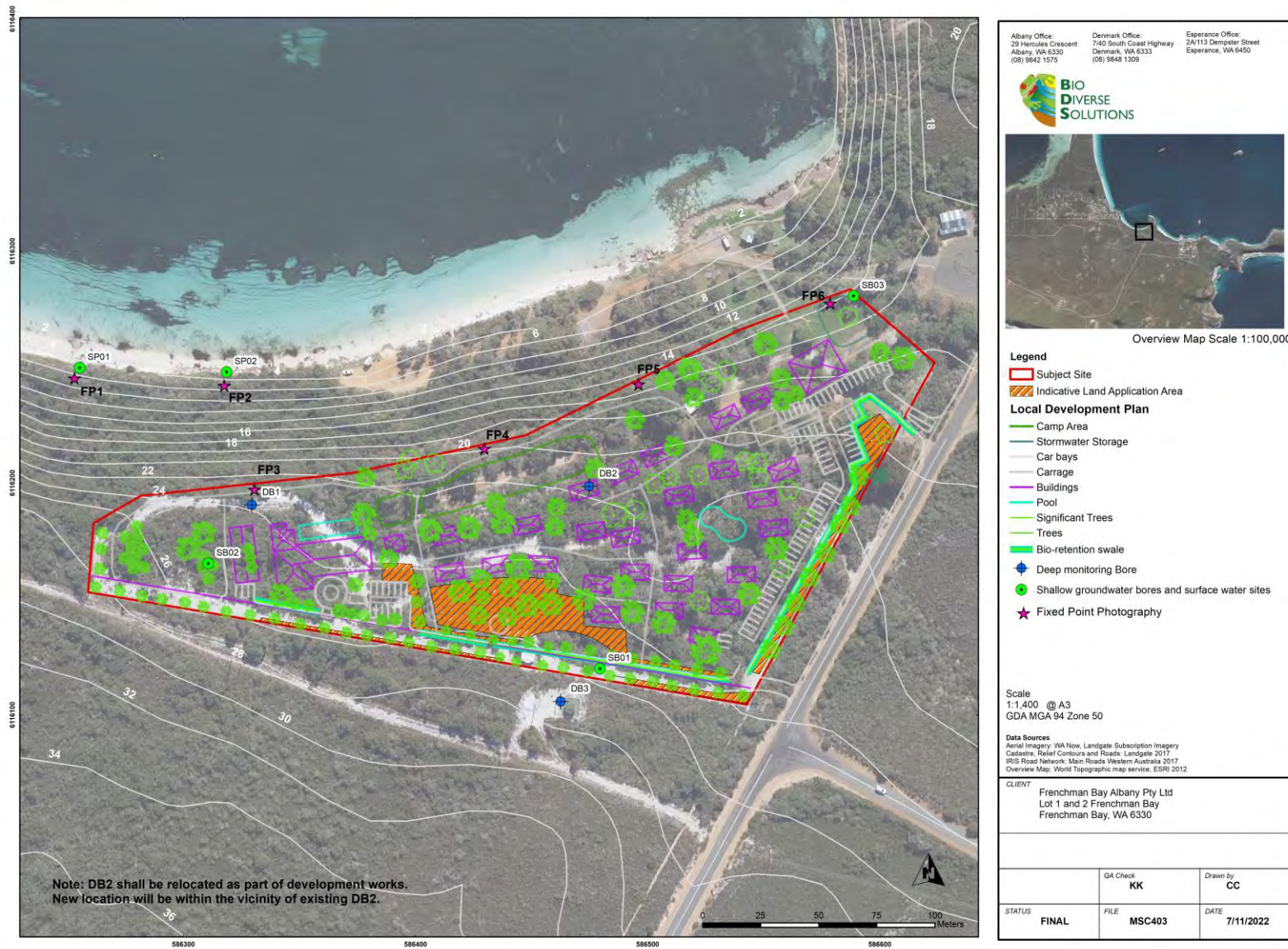


Figure 10: Monitoring locations

8 **References**

Australian Standard AS1547:2012 Onsite domestic wastewater management. Sai Global Licence to Bio Diverse Solutions, 2015.

Department of Health (2020) *Schedule 9 - Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974*.

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Appendix A

Site Soil Investigation – Great Southern Geotechnics (2016)

VERSION 1
OCTOBER 19, 2016



GEOTECHNICAL INVESTIGATION







LOTS 1 & 2 FRENCHMAN BAY ROAD, ALBANY WA

PRESENTED BY: M.COFFEY

GREAT SOUTHERN GEOTECHNICS
5A 209 CHESTER PASS RD, ALBANY WA

ACN: 613 485 644 ABN: 77 613 485 644
Info@gsgeotechnics.com

COLOURS

	BLACK - BROWN (bk)		BLUE (bl)		ORANGE (or)
	BROWN (br)		BLUE - GREEN (bl/gr)		RED (rd)
	GREY - BROWN (gy/br)		GREEN (gr)		RED - BROWN (rd/br)
	GREY (gy)		YELLOW (yl)		PINK (pk)
	BLUE - GREY (bl/gy)		YELLOW - BROWN (yl/br)		PURPLE (pr)

MOISTURE CONDITION OF SOIL

TERM	DESCRIPTION
Dry	Cohesive soils; hard and friable or powdery, well dry of plastic limit. Granular soils; cohesionless and free-running.
Moist	Soil feels cool, darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	Soil feels cool, darkened in colour. Cohesive soils usually weakened and free water forms on hands when handling. Granular soils tend to cohere and free water forms on hands when handling.

PARTICLE SHAPES

ANGULAR	SUB-ANGULAR	SUB-ROUNDED	ROUNDED
			

PARTICLE SIZES

BOULDERS	COBBLES	COARSE GRAVEL	MEDIUM GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY
>200mm	63-200mm	20-63mm	6-20mm	2.36-6mm	0.6-2.36mm	0.2-0.6mm	0.075-0.2mm	0.002-0.075mm	<0.002mm

GRAIN SIZE

SOIL TYPE (ABBREV.)	CLAY (CL)	SILT (SI)	SAND (SA)			GRAVEL (GR)		COBBLES (CO)	
SIZE	< 2µm	2-75µm	Fine 0.075-0.2mm	Medium 0.2-0.6mm	Coarse 0.6-2.36mm	Fine 2.36-6mm	Medium 6-20mm	Coarse 20-63mm	63-200mm
SHAPE & TEXTURE	Shiny	Dull	← angular or subangular or subrounded or rounded →						
FIELD GUIDE	Not visible under 10x	Visible under 10x	Visible by eye	Visible at < 1m	Visible at < 3m	Visible at < 5m	Road gravel	Rail ballast	Beaching

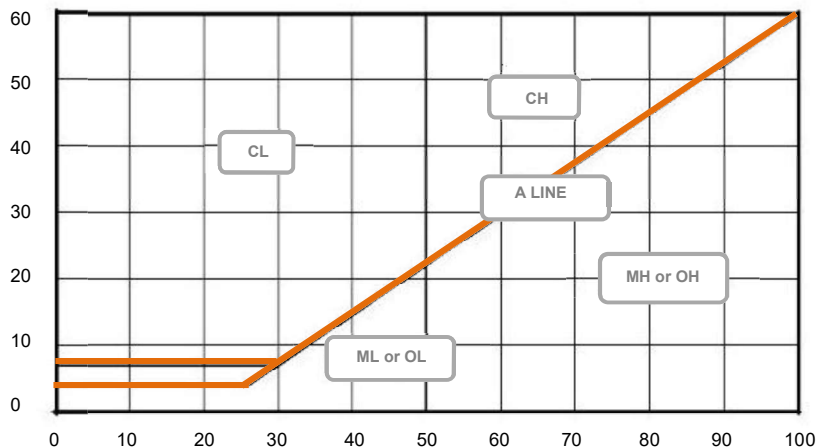
CLASSIFICATION CHART

Explanatory Notes

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60mm and basing fractions on estimated mass)				GROUP SYMBOLS	TYPICAL NAMES	
COARSE GRAINED SOILS More than 50% of material less than 63 mm is larger than 0.075 mm	GRAVELS More than 50% of coarse fraction is larger than 2.36mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	GW	Well graded gravels, gravel-sand mixtures, little or no fines	
		GRAVELS WITH FINES (Appreciable amount of fines)	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	GP	Poorly Graded gravels and gravel-sand mixtures, little or no fines, uniform gravels	
			'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	GM	Silty gravels, gravel-sand-silt mixtures	
		SANDS More than 50% of coarse fraction is smaller than 2.36mm	CLEAN SANDS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	SW	Well graded sands, gravelly sands, little or no fines
	SANDS WITH FINES (Appreciable amount of fines)		Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	
		SANDS WITH FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	SM	Silty sands, sand-silt mixtures	
	SANDS WITH FINES (Appreciable amount of fines)		'Dirty' materials with excess of plastic fines, medium to high dry strength	SC	Clayey sands, sand-clay mixtures	
		FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2mm			
	SILTS AND CLAYS Liquid limit less than 50		DRY STRENGTH	DILATANCY	TOUGHNESS	
None to low			Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit.
Medium to high			None to very slow	Medium	CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
SILTS AND CLAYS Liquid limit greater than 50	Low to medium		Slow	Low	OL	Organic silts and organic silt-clays of low to medium plasticity.
	Low to medium		Slow to none	Low to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.
	High to very high		None	High	CH	Inorganic clays of high plasticity.
SILTS AND CLAYS Liquid limit greater than 50	Medium to high		None to very slow	Low to medium	OH	Organic clays of high plasticity
	HIGHLY ORGANIC SOILS Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	Peat and other highly organic soils	

PLASTICITY CHART

For laboratory classification of fine grained soils



PLASTICITY

DESCRIPTIVE TERM	OF LOW PLASTICITY	OF MEDIUM PLASTICITY	OF HIGH PLASTICITY
Range Of Liquid Limit (%)	≤ 35	> 35 ≤ 50	> 50

DESCRIPTION OF ORGANIC OR ARTIFICIAL MATERIALS

PREFERRED TERMS	SECONDARY DESCRIPTION
Organic Matter	Fibrous Peat/ Charcoal/ Wood Fragments/ Roots (greater than approximately 2mm diameter)/ Root Fibres (less than approximately 2mm diameter)
Waste Fill	Domestic Refuse/ Oil/ Bitumen/ Brickbats/ Concrete Rubble/ Fibrous Plaster/ Wood Pieces/ Wood Shavings/ Sawdust/ Iron Filings/ Drums/ Steel Bars/ Steel Scrap/ Bottles/ Broken Glass/ Leather

CONSISTENCY - Cohesive soils

TERM	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
Symbol	VS	S	F	St	VSt	H
Undrained Shear Strength (kPa)	< 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
SPT (N) Blowcount	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30
Field Guide	Exudes between the fingers when squeezed	Can be moulded by light finger pressure	Can be moulded by strong finger pressure	Cannot be moulded by fingers. Can be indented by thumb nail	Can be indented by thumb nail	Can be indented with difficulty with thumb nail

CONSISTENCY - Non-cohesive soils

TERM	VERY LOOSE	LOOSE	MEDIUM DENSE	DENSE	VERY DENSE	COMPACT
Symbol	VL	L	MD	D	VD	CO
SPT (N) Blowcount	0 - 4	4 - 10	10 - 30	30 - 50	50 - 100	> 50/150 mm
Density Index (%)	< 15	15 - 35	35 - 65	65 - 85	85 - 95	> 95
Field Guide	Ravels	Shovels easily	Shovelling very difficult	Pick required	Pick difficult	Cannot be picked

MINOR COMPONENTS

TERM	TRACE	WITH
% Minor Component	Coarse grained soils: < 5% Fine grained soils: <15%	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%
Field Guide	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary components	Presence easily detectable by feel or eye, soil properties little different to general properties of primary component

GEOLOGICAL ORIGIN

	TYPE	DETAILS
TRANSPORTED SOILS	Aeolian Soils	Deposited by wind
	Alluvial Soils	Deposited by streams and rivers
	Colluvial Soils	Deposited on slopes
	Lacustrine Soils	Deposited by lakes
	Marine Soils	Deposited in ocean, bays, beaches and estuaries
FILL MATERIALS	Soil Fill	Describe soil type, UCS symbol and add 'FILL'
	Rock Fill	Rock type, degree of weathering, and word 'FILL'.
	Domestic Fill	Percent soil or rock, whether pretrucible or not.
	Industrial Fill	Percent soil, whether contaminated, particle size & type of waste product, i.e. brick, concrete, metal


STRENGTH OF ROCK MATERIAL

TERM	SYMBOL	IS (50)	(MPA)	FIELD GUIDE TO STRENGTH
Extremely Low	EL	≤0.03		Easily remoulded by hand to a material with soil properties.
Very Low	VL	>0.03	≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxle sample by hand. Pieces up to 3 cm thick can be broken by finger pressure.
Low	L	>0.1	≤0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3	≤1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	H	>1	≤3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	>3	≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High	EH	>10		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.


ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water.
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. Rock may be highly discoloured, usually be ironstaining. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.

Test Pit Report

			Report No. 006/1	Job No. 006	Sheet 1 of 6								
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a			Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP1										
Excavation Method : Excavation			Target Depth (mm) 1800mm	Sample No.	16G035								
Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm			Date Commenced: 30/09/2016	GPS Reference									
Operator/Contractor: Great Southern Geotechnics			Date Completed: 30/09/2016	E 117°56'57.66									
Excavation Dimensions:			Logged By: M.Coffey	S 35°5'34.35									
Length 1.6 (m) Width 0.35 (m)			Checked By: M.Coffey	Elevation									
			-										
Depth (mm)	Material Description SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	Is ⁽⁵⁰⁾ (MPa)	Water Level	Classification Symbol	Sample/Test	Comments
0 - 500	SAND with silt: Dark grey to grey, fine to medium grained, roots and root fibres.	0.5			M								
500 - 1800	SAND with silt: Light grey to white, fine to medium grained.	1.0			M								water level not encountered
		1.5											
		2.0											
		2.5											
Materials Consistency/Strength				Sample / Test				Pit Terminated at: (mm) below ground level					
Cohesive	NonCohesive	Rock						✓ or ✗					
VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	Ux - Undist. Tube Sample D - Disturbed Sample R - Rock Sample DCP - Dynamic Cone Pen. P - Pocket Penetrometer PSP - Perth Sand Penet. Is (50) - Point load Index				Target Depth	✓	1800				
							Cave In						
							Refusal						
							Near Refusal						
							Flooding						
							Lack of Reach						
Cementation				Method of Excavation				Weathering					
IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented	N - Natural Exposure H - Hand E - Existing Excavation BH - Backhoe Bucket BHE - Excavator B - Bulldozer Blade			RS - Residual Soil XW - Extremely Weathered DW - Distinctly Weathered SW - Slightly Weathered FRST - Fresh with Stained Surfaces FR - Fresh				Water Water first Encountered					
							Moisture						
							D - Dry M - Moist W - Wet						
							General						
							N/A - Not Applicable N/D - Not Determined PASS - Potential Acid Sulfate Soils						


Test Pit Report

		Report No. 006/1	Job No. 006	Sheet 2 of 6
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a		Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP2		
Excavation Method : Excavation Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm		Target Depth (mm) 1800mm	Sample No. 16G036	GPS Reference E 117°56'56.12 S 35°5'35.03
Operator/Contractor: Great Southern Geotechnics		Date Commenced: 30/09/2016 Date Completed: 30/09/2016		Elevation -
Excavation Dimensions: Length 1.6 (m) Width 0.35 (m)		Logged By: M.Coffey Checked By: M.Coffey		


Depth (mm)	Material Description SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	IS ₍₆₀₎ (MPa)	Water Level	Classification Symbol	Sample/Test	Comments
0 - 300	Sandy GRAVEL: Brown, fine to medium gravel, sub-rounded to sub angular, fine to medium grained sand, roots and root fibres	0.5			M								
300 - 800	SAND with silt: Dark grey to grey, fine to medium grained, roots and root fibres.	1.0			M								Water level not encountered.
800 - 1800	SAND with silt: Grey to light grey/white, fine to medium grained.	1.5			M								
2.0		2.0											
2.5		2.5											

Materials Consistency/Strength			Sample / Test	Pit Terminated at: (mm) below ground level	
Cohesive	NonCohesive	Rock		✓	✗
VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	Ux - Undist. Tube Sample D - Disturbed Sample R - Rock Sample DCP - Dynamic Cone Pen. P - Pocket Penetrometer PSP - Perth Sand Penet. Is (50) - Point load Index	Target Depth Cave In Refusal Near Refusal Flooding Lack of Reach	1800
Cementation IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented			Method of Excavation N - Natural Exposure H - Hand E - Existing Excavation BH - Backhoe Bucket BHE - Excavator B - Bulldozer Blade		Weathering RS - Residual Soil XW - Extremely Weathered DW - Distinctly Weathered SW - Slightly Weathered FRST - Fresh with Stained Surfaces FR - Fresh
Water Water first Encountered					
Moisture D - Dry M - Moist W - Wet					
General N/A - Not Applicable N/D - Not Determined PASS - Potential Acid Sulfate Soils					

Test Pit Report

		Report No. 006/1	Job No. 006	Sheet 3 of 6									
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a		Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP3											
Excavation Method : Excavation		Target Depth (mm) 1800mm	Sample No.	16G037									
Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm		Date Commenced: 30/09/2016	GPS Reference										
Operator/Contractor: Great Southern Geotechnics		Date Completed: 30/09/2016	E 117°56'54.99										
Excavation Dimensions:		Logged By: M.Coffey	S 35°5'35.47										
Length 1.6 (m) Width 0.35 (m)		Checked By: M.Coffey	Elevation										
		-											
Depth (mm)	Material Description	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	Is(60) (MPa)	Water Level	Classification Symbol	Sample/Test	Comments
0 - 300	SAND with gravel: Brown/grey, fine to medium grained sand, fine to medium grained gravel, sub-rounded to sub-angular, roots and root fibres	0.5			M								Roots noted down to 1000mm
300 - 1800	SAND with silt: light grey to white, fine to medium grained, roots and root fibres	1.0			M								
		1.5											Water level not encountered
		2.0											
		2.5											
Materials Consistency/Strength					Sample / Test					Pit Terminated at: (mm) below ground level			
Cohesive		NonCohesive		Rock						✓ or ✗			
VS - Very Soft	VL - Very Loose	EL - Extremely Low	Ux - Undist. Tube Sample					Target Depth	✓	1800			
S - Soft	L - Loose	VL - Very Low	D - Disturbed Sample					Cave In					
F - Firm	MD - Medium Dense	L - Low	R - Rock Sample					Refusal					
St - Stiff	D - Dense	M - Medium	DCP - Dynamic Cone Pen.					Near Refusal					
VSt - Very Stiff	VD - Very Dense	H - High	P - Pocket Penetrometer					Flooding					
H - Hard		VH - Very High	PSP - Perth Sand Penet.					Lack of Reach					
		EH - Extremely High	Is (50) - Point load Index										
Cementation		Method of Excavation		Weathering					Water				
IN - Indurated		N - Natural Exposure		RS - Residual Soil					▼ Water first Encountered				
PC - Poorly Cemented		H - Hand		XW - Extremely Weathered					Moisture				
MC - moderately Cemented		E - Existing Excavation		DW - Distinctly Weathered					D - Dry M - Moist W - Wet				
WC - Well Cemented		BH - Backhoe Bucket		SW - Slightly Weathered					General				
		BHE - Excavator		FRST - Fresh with Stained Surfaces					N/A - Not Applicable				
		B - Bulldozer Blade		FR - Fresh					N/D - Not Determined				
									PASS - Potential Acid Sulfate Soils				


Test Pit Report

		Report No. 006/1	Job No. 006	Sheet 4 of 6
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a		Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP4		
Excavation Method : Excavation		Target Depth (mm) 1800mm	Sample No.	16G038
Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm		Date Commenced: 30/09/2016	GPS Reference	
Operator/Contractor: Great Southern Geotechnics		Date Completed: 30/09/2016	E 117°56'53.81	
Excavation Dimensions:		Logged By: M.Coffey	S 35°5'35.73	
Length 1.6 (m) Width 0.35 (m)		Checked By: M.Coffey	Elevation	
		-		


Depth (mm)	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	Is(50) (MPa)	Water Level	Classification Symbol	Sample/Test	Comments
0 - 600	0.5			M							0.5	
SAND with silt: Dark grey to grey, fine to medium grained, roots and root fibres.												
600 - 1800	1.0			M							1.0	Water level not encountered
SAND with silt: Dark grey to grey, fine to medium grained.	1.5										1.5	
1800 - 1900	2.0			M		PC					2.0	
SAND with silt: Light grey/light brown, fine to medium grained with pockets of dark brown fine to medium grained, cemented SAND.	2.5										2.5	

Materials Consistency/Strength			Sample / Test	Pit Terminated at: (mm) below ground level	
Cohesive	NonCohesive	Rock		✓	✗
VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	Ux - Undist. Tube Sample D - Disturbed Sample R - Rock Sample DCP - Dynamic Cone Pen. P - Pocket Penetrometer PSP - Perth Sand Penet. Is (50) - Point load Index	Target Depth	✓ 1800
				Cave In	
				Refusal	
				Near Refusal	
				Flooding	
				Lack of Reach	
Cementation			Method of Excavation	Water	
IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented	N - Natural Exposure H - Hand E - Existing Excavation BH - Backhoe Bucket BHE - Excavator B - Bulldozer Blade		Weathering	▼ Water first Encountered	
			RS - Residual Soil XW - Extremely Weathered DW - Distinctly Weathered SW - Slightly Weathered FRST - Fresh with Stained Surfaces FR - Fresh	Moisture	
				D - Dry M - Moist W - Wet	
				General	
				N/A - Not Applicable N/D - Not Determined PASS - Potential Acid Sulfate Soils	

Test Pit Report

		Report No. 006/1	Job No. 006	Sheet 5 of 6										
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a		Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP5												
Excavation Method : Excavation		Target Depth (mm) 1800mm		Sample No.	16G039									
Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm		Date Commenced: 30/09/2016		GPS Reference										
Operator/Contractor: Great Southern Geotechnics		Date Completed: 30/09/2016		E 117°56'52.42										
Excavation Dimensions: Length 1.6 (m) Width 0.35 (m)		Logged By: M.Coffey		S 35°5'36.08										
		Checked By: M.Coffey		Elevation -										
Depth (mm)	Material Description SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	Is(50) (MPa)	Water Level	Classification Symbol	Sample/Test	Comments	
0 - 200	Sandy GRAVEL: Grey/brown, fine to medium gravel, sub-rounded to sub-rounded, fine to medium grained sand, roots and root fibres	0.5			M								Roots and root fibres noted down to 350mm	
200 - 1200	SAND with silt: Light grey/white, fine to medium grained.	1.0			M									
1200 - 1800	SAND with silt: Light brown/yellow, fine to medium grained, mottled dark brown fine to medium grained, cemented SAND with silt.	1.5			M		PC						Water level not encountered	
2.0		2.0												
2.5		2.5												
Materials Consistency/Strength					Sample / Test					Pit Terminated at: (mm) below ground level				
Cohesive		NonCohesive		Rock						✓ or ✗				
VS - Very Soft	VL - Very Loose	EL - Extremely Low	Ux - Undist. Tube Sample					Target Depth	✓	1800				
S - Soft	L - Loose	VL - Very Low	D - Disturbed Sample					Cave In						
F - Firm	MD - Medium Dense	L - Low	R - Rock Sample					Refusal						
St - Stiff	D - Dense	M - Medium	DCP - Dynamic Cone Pen.					Near Refusal						
VSt - Very Stiff	VD - Very Dense	H - High	P - Pocket Penetrometer					Flooding						
H - Hard		VH - Very High	PSP - Perth Sand Penet.					Lack of Reach						
		EH - Extremely High	Is (50) - Point load Index					Water						
Cementation		Method of Excavation		Weathering					▼ Water first Encountered					
IN - Indurated	N - Natural Exposure	RS - Residual Soil					Moisture							
PC - Poorly Cemented	H - Hand	XW - Extremely Weathered					D - Dry M - Moist W - Wet							
MC - moderately Cemented	E - Existing Excavation	DW - Distinctly Weathered					General							
WC - Well Cemented	BH - Backhoe Bucket	SW - Slightly Weathered					N/A - Not Applicable							
	BHE - Excavator	FRST - Fresh with Stained Surfaces					N/D - Not Determined							
	B - Bulldozer Blade	FR - Fresh					PASS - Potential Acid Sulfate Soils							

Test Pit Report

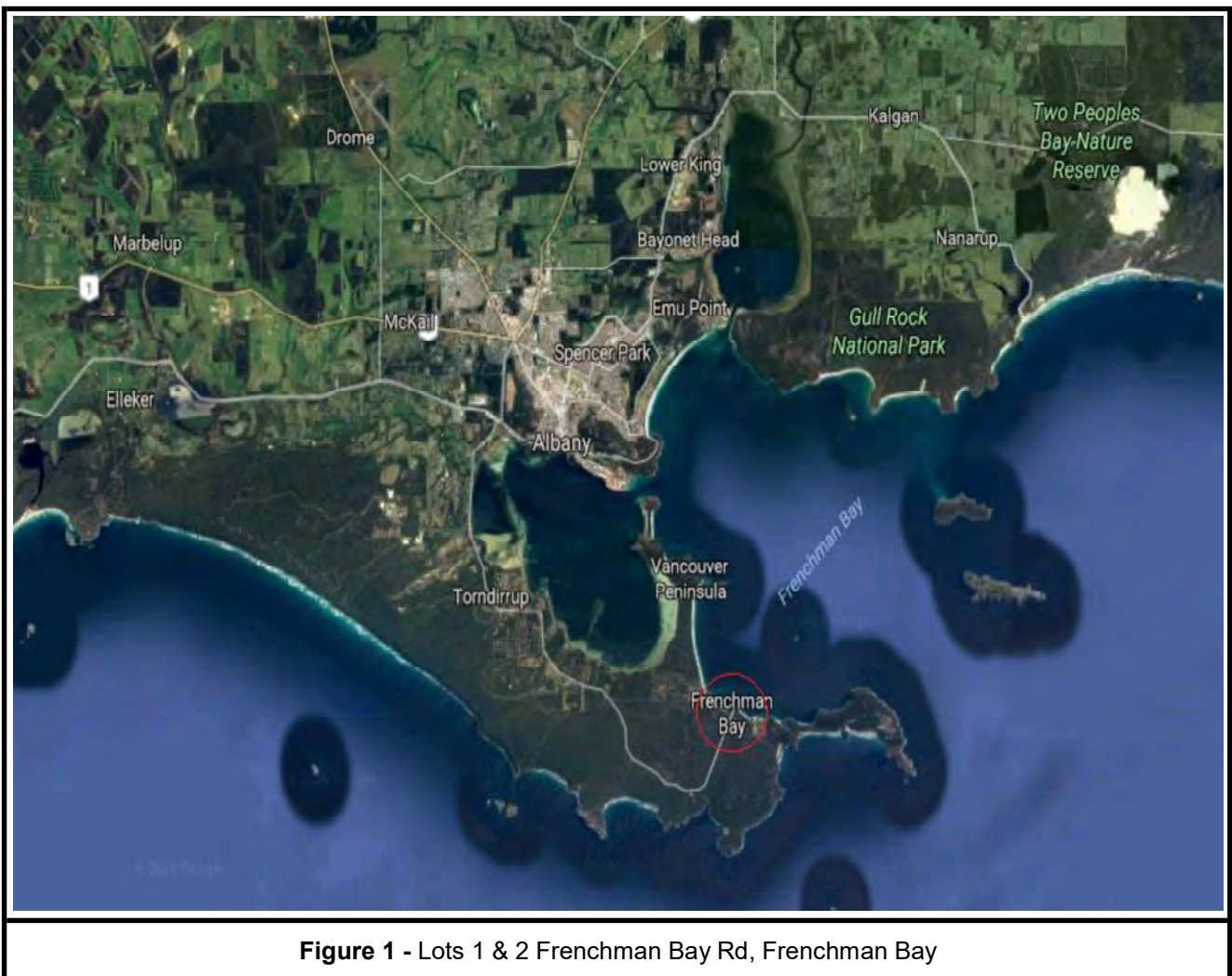
		Report No. 006/1	Job No. 006	Sheet 6 of 6
Client: Bio Diverse Solutions Project: Frenchman Bay Retreat Project No. N/a		Location / Road: Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay. Test Pit No. TP6		
Excavation Method : Excavation Equipment type: 301.4C Mini Hydraulic Excavator Bucket width 300mm		Target Depth (mm) 1800mm	Sample No. 16G040	GPS Reference E 117°56'51.09 S 35°5'36.63
Operator/Contractor: Great Southern Geotechnics		Date Commenced: 30/09/2016 Date Completed: 30/09/2016	Logged By: M.Coffey Checked By: M.Coffey	
Excavation Dimensions: Length 1.6 (m) Width 0.35 (m)		Elevation -		

Depth (mm)	Depth (m)	RL (m)	Graphic Log	Moist. Condition	Consistency/ Strength	Cementation	Weathering (Rock)	IS ₍₆₀₎ (MPa)	Water Level	Classification Symbol	Sample/Test	Comments
0 - 1200 SAND with silt: light grey, fine to medium grained, roots and root fibres	0.5 1.0			M								Roots and root fibres noted down to 500mm
1200 - 1800 SAND with silt: Light brown/yellow, fine to medium grained, mottled dark brown fine to medium grained, cemented SAND with silt.	1.5			M	PC							Water level not encountered
	2.0 2.5											

Materials Consistency/Strength			Sample / Test	Pit Terminated at: (mm) below ground level	
Cohesive	NonCohesive	Rock		✓ or ✗	level
VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	Ux - Undist. Tube Sample D - Disturbed Sample R - Rock Sample DCP - Dynamic Cone Pen. P - Pocket Penetrometer PSP - Perth Sand Penet. Is (50) - Point load Index	Target Depth Cave In Refusal Near Refusal Flooding Lack of Reach	1800
Cementation IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented			Method of Excavation N - Natural Exposure H - Hand E - Existing Excavation BH - Backhoe Bucket BHE - Excavator B - Bulldozer Blade	Water Water first Encountered	
Weathering RS - Residual Soil XW - Extremely Weathered DW - Distinctly Weathered SW - Slightly Weathered FRST - Fresh with Stained Surfaces FR - Fresh			Moisture D - Dry M - Moist W - Wet		
			General N/A - Not Applicable N/D - Not Determined PASS - Potential Acid Sulfate Soils		

Fieldwork

The fieldwork was carried out on September 30, 2016 and comprised the following:
Six (6) test pits excavated with a 301.4C Mini Hydraulic Excavator using a 300mm wide bucket to depths of 1.8 m to visually assess subsurface conditions and obtain samples for laboratory testing.
The approximate test locations are shown on **Figure 2**.



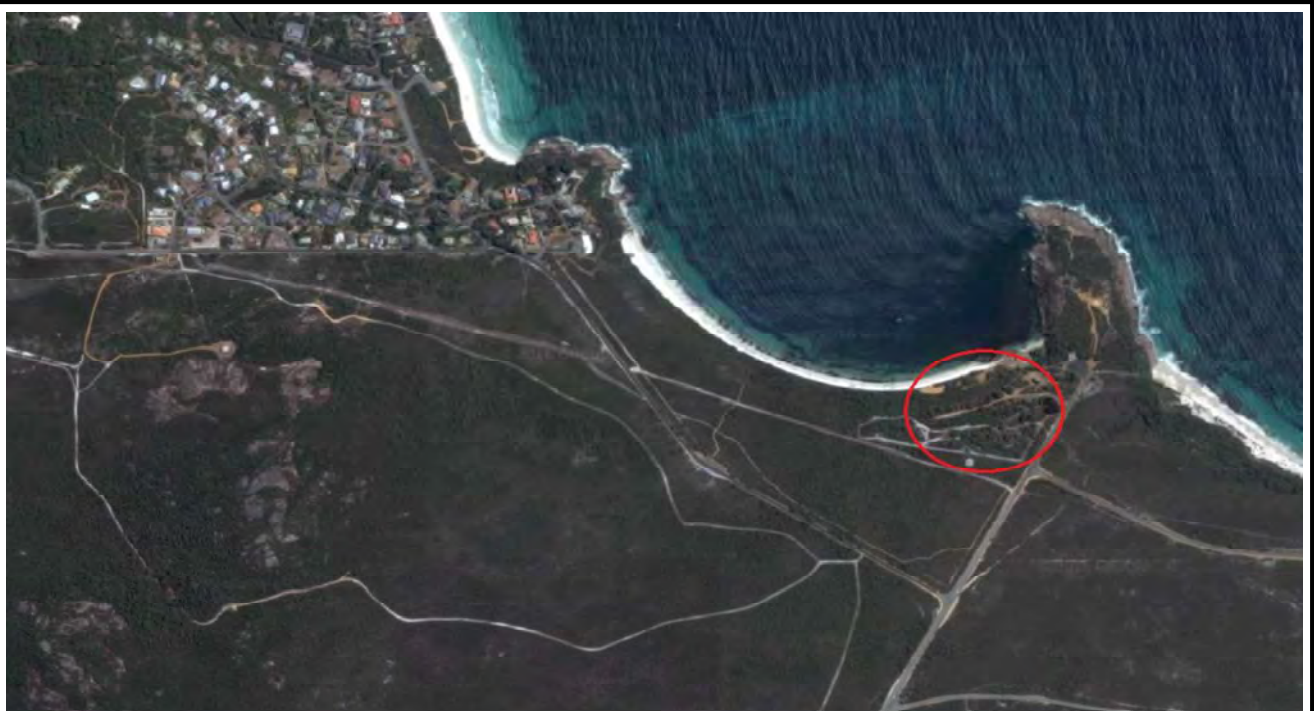


Figure 2 - Lots 1 & 2 Frenchman Bay Rd, Frenchman Bay



Test Pit No. 1 Spoil



Test Pit No. 1 Excavation



Test Pit No. 2 Spoil



Test Pit No. 2 Excavation



Test Pit No. 3 Spoil



Test Pit No. 3 Excavation



Test Pit No. 4 Spoil



Test Pit No. 4 Excavation



Test Pit No. 5 Spoil



Test Pit No. 5 Excavation



Test Pit No. 6 Spoil



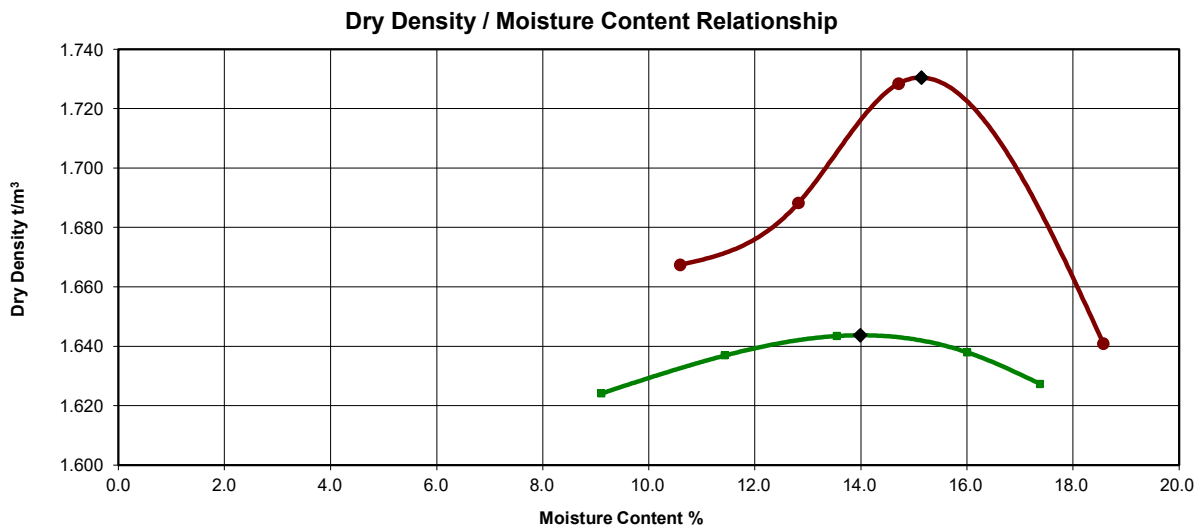
Test Pit No. 6 Excavation

Dry Density/Moisture Content Relationship Test Report

Job No. 006
 Client: Bio Diverse Solutions
 Project: Lots 1 & 2 Frenchman Bay Road Albany WA

Report No. 006/1
 Sheet 1 of 1

Sample No.	Sample Location	Field Description
16G041	Test Pit 1	SAND with silt
16G042	Test Pit 6	SAND with silt



Sample Number	16G041 ●	16G042 ●	●
Depth	0mm to 500mm	0mm to 1200mm	
Stabiliser Used			
Stabiliser Added %			
Curing Period	Water (Days)	0.00	0.00
	Stabiliser (Hrs)		
Moisture Content Method used	AS 1289.2.1.1	AS 1289.2.1.1	
Sampling Method	AS 1289.1.2.1 Proc 6.5	AS 1289.1.2.1 Proc 6.5	
Date Sampled	30/09/2016	30/09/2016	
Date Received	30/09/2016	30/09/2016	
Date Tested	4/09/2016	4/09/2016	
Test Method	AS 1289.5.2.1	AS 1289.5.2.1	
Maximum Dry Density t/m ³	1.73	1.64	
Optimum Moisture Content %	15.0	14.0	
Adjusted Maximum Dry Density t/m ³			
Adjusted Optimum Moisture Content %			
Percentage Retained % 37.5 mm	0	0	
Percentage Retained % 19.0 mm	0	0	

Comments:	N/a	Approved Signatory:	
Distribution:	Laboratory File / Kath Kinnear - Bio Diverse Solutions	Name:	M.Coffey
		Function:	Laboratory Manager
		Date:	5/10/2016



Falling Head Permeability Report

Test Method: AS 1289.6.7.2

Client:	Great Southern Geotechnics	Ticket No:	S149
Project:	Lots 1 & 2 Frenchman Bay Road (Bio Diverse Solutions)	Report No:	LL16/538_1
Location:	Albany, WA	Sample No:	LL16/538
Sample ID:	16G041 - TP1 0mm - 500mm	Issue Date:	17-October-2016

Sampling Procedure: Tested as Received

Laboratory Moisture Ratio (%) 97.5

Laboratory Density Ratio (%) 95.0

Compactive Effort Modified

Hydraulic Gradient N/A

Surcharge (kPa) 3

% Retained on 19mm Sieve 0

Coefficient of Permeability (m / sec) 2.2×10^{-6}

Client Address: 5a 209 Chester Pass Road, Albany WA 6330

Comments: MMDD/OMC supplied by client



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Approved Signature: 
Name: Matt van Herk
Function: Laboratory Manager
Date: 17-October-2016



Constant Head Permeability Report

Test Method: AS 1289.6.7.1

Client:	Great Southern Geotechnics	Ticket No:	S149
Project:	Lots 1 & 2 Frenchman Bay Road (Bio Diverse Solutions)	Report No:	LL16/539_1
Location:	Albany, WA	Sample No:	LL16/539
Sample ID:	16G042 - TP6 0mm - 1200mm	Issue Date:	17-October-2016

Sampling Procedure: Tested as Received

Laboratory Moisture Ratio (%) 101.0

Laboratory Density Ratio (%) 95.0

Compactive Effort Modified

Hydraulic Gradient 0.6

Surcharge (kPa) 3

% Retained on 19mm Sieve 0

Coefficient of Permeability (m / sec) 5.7×10^{-5}

Client Address: 5a 209 Chester Pass Road, Albany WA 6330

Comments: MMDD/OMC supplied by client



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Accredited for Compliance with ISO/IEC 17025

Approved Signature:

Name: Matt van Herk
Function: Laboratory Manager
Date: 17-October-2016



Customer Bio Diverse Solutions
Job Kathryn Kinnear
Date Rec'd 6/10/2016

Lots 1 & 2 Frenchman Bay Road, Albany WA

Lab Number	Name	Code	Customer	Depth (mm)	Phosphorus Retention Index
2TS16095	Pit 1	Job#2 - MSC125	Frenchman Bay Retreat	0-500	0.1
2TS16096	Pit 6	Job#2 - MSC125	Frenchman Bay Retreat	0-1200	0.7

Appendix B

Site Soil Investigation – Great Southern Geotechnics (2018)

VERSION 1
Report No 302/1
APRIL 11, 2018



SITE INVESTIGATION

Bio Diverse Solutions

Lots 1 & 2 Frenchman Bay Rd, Albany WA 6330

PRESENTED BY: M.COFFEY

GREAT SOUTHERN GEOTECHNICS
5A 209 CHESTER PASS RD, ALBANY WA

ACN: 613 485 644 ABN: 77 613 485 644
Info@gsgeotechnics.com

1.0 INTRODUCTION

As authorised by Kathryn Kinnear of Bio Diverse Solutions, a site investigation for the proposed development at Lots 1 & 2 Frenchman Bay Rd, Albany WA 6330A 6324 was performed on the 22nd of March, 2017.

2.0 GENERAL

This purpose of the investigation was to determine the following:

- Surface site conditions
- Subsurface soil profiles
- Depth of ground water tables .
- Permeability rates of soils encountered .

3.0 SITE INVESTIGATION

Site conditions and Test pit locations were recorded and are shown in Appendix 1

The field investigation consisted of six test pits excavated on-site to depths of up to 2.0m using a Kubota KX41-3V Mini Excavator with a 300mm wide Hydraulic open flight auger attachment.
















All soil layers encountered were visually assessed and classified on-site

The subsurface soil profiles are shown on the Test pit logs located in Appendix 1

IMPORTANT NOTE: We have endeavoured to locate the test pits so that they are representative of the subsurface materials across the site. However, soil conditions may change dramatically over short distances and our investigations may not locate all soil variations across the site.

This report and associated documentation was undertaken for the specific purpose described in the report and shall not be relied on for other purposes. This report was prepared solely for the use by Bio Diverse Solutions and any reliance assumed by other parties on this report shall be at such parties own risk.


COLOURS

	BLACK - BROWN (bk)		BLUE (bl)		ORANGE (or)
	BROWN (br)		BLUE - GREEN (bl/gr)		RED (rd)
	GREY - BROWN (gy/br)		GREEN (gr)		RED - BROWN (rd/br)
	GREY (gy)		YELLOW (yl)		PINK (pk)
	BLUE - GREY (bl/gy)		YELLOW - BROWN (yl/br)		PURPLE (pr)

MOISTURE CONDITION OF SOIL

TERM	DESCRIPTION
Dry	Cohesive soils; hard and friable or powdery, well dry of plastic limit. Granular soils; cohesionless and free-running.
Moist	Soil feels cool, darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere.
Wet	Soil feels cool, darkened in colour. Cohesive soils usually weakened and free water forms on hands when handling. Granular soils tend to cohere and free water forms on hands when handling.

PARTICLE SHAPES

ANGULAR	SUB-ANGULAR	SUB-ROUNDED	ROUNDED
			

PARTICLE SIZES

BOULDERS	COBBLES	COARSE GRAVEL	MEDIUM GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY
>200mm	63-200mm	20-63mm	6-20mm	2.36-6mm	0.6-2.36mm	0.2-0.6mm	0.075-0.2mm	0.002-0.075mm	<0.002mm

GRAIN SIZE

SOIL TYPE (ABBREV.)	CLAY (CL)	SILT (SI)	SAND (SA)			GRAVEL (GR)		COBBLES (CO)	
SIZE	< 2µm	2-75µm	Fine 0.075-0.2mm	Medium 0.2-0.6mm	Coarse 0.6-2.36mm	Fine 2.36-6mm	Medium 6-20mm	Coarse 20-63mm	63-200mm
SHAPE & TEXTURE	Shiny	Dull	← angular or subangular or subrounded or rounded →						
FIELD GUIDE	Not visible under 10x	Visible under 10x	Visible by eye	Visible at < 1m	Visible at < 3m	Visible at < 5m	Road gravel	Rail ballast	Beaching

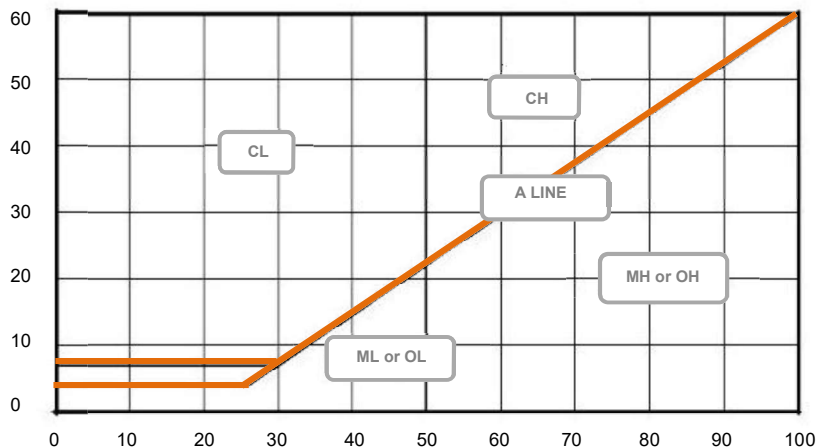
CLASSIFICATION CHART

Explanatory Notes

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 60mm and basing fractions on estimated mass)				GROUP SYMBOLS	TYPICAL NAMES	
COARSE GRAINED SOILS More than 50% of material less than 63 mm is larger than 0.075 mm	GRAVELS More than 50% of coarse fraction is larger than 2.36mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	GW	Well graded gravels, gravel-sand mixtures, little or no fines	
		GRAVELS WITH FINES (Appreciable amount of fines)	Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	GP	Poorly Graded gravels and gravel-sand mixtures, little or no fines, uniform gravels	
			'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	GM	Silty gravels, gravel-sand-silt mixtures	
		SANDS More than 50% of coarse fraction is smaller than 2.36mm	CLEAN SANDS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate sizes, not enough fines to bind coarse grains, no dry strength	SW	Well graded sands, gravelly sands, little or no fines
	SANDS WITH FINES (Appreciable amount of fines)		Predominantly one size or range of sizes with some intermediate sizes missing, not enough fines to bind coarse grains, no dry strength	SP	Poorly graded sands and gravelly sands; little or no fines, uniform sands	
		SANDS WITH FINES (Appreciable amount of fines)	'Dirty' materials with excess of non-plastic fines, zero to medium dry strength	SM	Silty sands, sand-silt mixtures	
	SANDS WITH FINES (Appreciable amount of fines)		'Dirty' materials with excess of plastic fines, medium to high dry strength	SC	Clayey sands, sand-clay mixtures	
		FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm	IDENTIFICATION PROCEDURES ON FRACTIONS <0.2mm			
	SILTS AND CLAYS Liquid limit less than 50		DRY STRENGTH	DILATANCY	TOUGHNESS	
None to low			Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with low plasticity. Silts of low to medium Liquid Limit.
Medium to high			None to very slow	Medium	CL, CI	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays.
SILTS AND CLAYS Liquid limit greater than 50	Low to medium		Slow	Low	OL	Organic silts and organic silt-clays of low to medium plasticity.
	Low to medium		Slow to none	Low to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, silts of high Liquid Limit.
	High to very high		None	High	CH	Inorganic clays of high plasticity.
SILTS AND CLAYS Liquid limit greater than 50	Medium to high		None to very slow	Low to medium	OH	Organic clays of high plasticity
	Readily identified by colour, odour, spongy feel and frequently by fibrous texture			Pt	Peat and other highly organic soils	

PLASTICITY CHART

For laboratory classification of fine grained soils



PLASTICITY

DESCRIPTIVE TERM	OF LOW PLASTICITY	OF MEDIUM PLASTICITY	OF HIGH PLASTICITY
Range Of Liquid Limit (%)	≤ 35	> 35 ≤ 50	> 50

DESCRIPTION OF ORGANIC OR ARTIFICIAL MATERIALS

PREFERRED TERMS	SECONDARY DESCRIPTION
Organic Matter	Fibrous Peat/ Charcoal/ Wood Fragments/ Roots (greater than approximately 2mm diameter)/ Root Fibres (less than approximately 2mm diameter)
Waste Fill	Domestic Refuse/ Oil/ Bitumen/ Brickbats/ Concrete Rubble/ Fibrous Plaster/ Wood Pieces/ Wood Shavings/ Sawdust/ Iron Filings/ Drums/ Steel Bars/ Steel Scrap/ Bottles/ Broken Glass/ Leather

CONSISTENCY - Cohesive soils

TERM	VERY SOFT	SOFT	FIRM	STIFF	VERY STIFF	HARD
Symbol	VS	S	F	St	VSt	H
Undrained Shear Strength (kPa)	< 12	12 - 25	25 - 50	50 - 100	100 - 200	> 200
SPT (N) Blowcount	0 - 2	2 - 4	4 - 8	8 - 15	15 - 30	> 30
Field Guide	Exudes between the fingers when squeezed	Can be moulded by light finger pressure	Can be moulded by strong finger pressure	Cannot be moulded by fingers. Can be indented by thumb nail	Can be indented by thumb nail	Can be indented with difficulty with thumb nail

CONSISTENCY - Non-cohesive soils

TERM	VERY LOOSE	LOOSE	MEDIUM DENSE	DENSE	VERY DENSE	COMPACT
Symbol	VL	L	MD	D	VD	CO
SPT (N) Blowcount	0 - 4	4 - 10	10 - 30	30 - 50	50 - 100	> 50/150 mm
Density Index (%)	< 15	15 - 35	35 - 65	65 - 85	85 - 95	> 95
Field Guide	Ravels	Shovels easily	Shovelling very difficult	Pick required	Pick difficult	Cannot be picked

MINOR COMPONENTS

TERM	TRACE	WITH
% Minor Component	Coarse grained soils: < 5% Fine grained soils: <15%	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%
Field Guide	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary components	Presence easily detectable by feel or eye, soil properties little different to general properties of primary component

GEOLOGICAL ORIGIN

	TYPE	DETAILS
TRANSPORTED SOILS	Aeolian Soils	Deposited by wind
	Alluvial Soils	Deposited by streams and rivers
	Colluvial Soils	Deposited on slopes
	Lacustrine Soils	Deposited by lakes
	Marine Soils	Deposited in ocean, bays, beaches and estuaries
FILL MATERIALS	Soil Fill	Describe soil type, UCS symbol and add 'FILL'
	Rock Fill	Rock type, degree of weathering, and word 'FILL'.
	Domestic Fill	Percent soil or rock, whether pretrucible or not.
	Industrial Fill	Percent soil, whether contaminated, particle size & type of waste product, i.e. brick, concrete, metal

STRENGTH OF ROCK MATERIAL

TERM	SYMBOL	IS (50)	(MPA)	FIELD GUIDE TO STRENGTH
Extremely Low	EL	≤0.03		Easily remoulded by hand to a material with soil properties.
Very Low	VL	>0.03	≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxle sample by hand. Pieces up to 3 cm thick can be broken by finger pressure.
Low	L	>0.1	≤0.3	Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
Medium	M	>0.3	≤1.0	Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty.
High	H	>1	≤3	A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
Very High	VH	>3	≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer.
Extremely High	EH	>10		Specimen requires many blows with geological pick to break through intact material; rock rings under hammer.

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water.
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. Rock may be highly discoloured, usually be ironstaining. Porosity may be increased by leaching or may be decreased due to deposition of weathering products in pores.
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh Rock	FR	Rock shows no sign of decomposition or staining.



Appendix 1

Test Pit Logs

Figure 1 - Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330

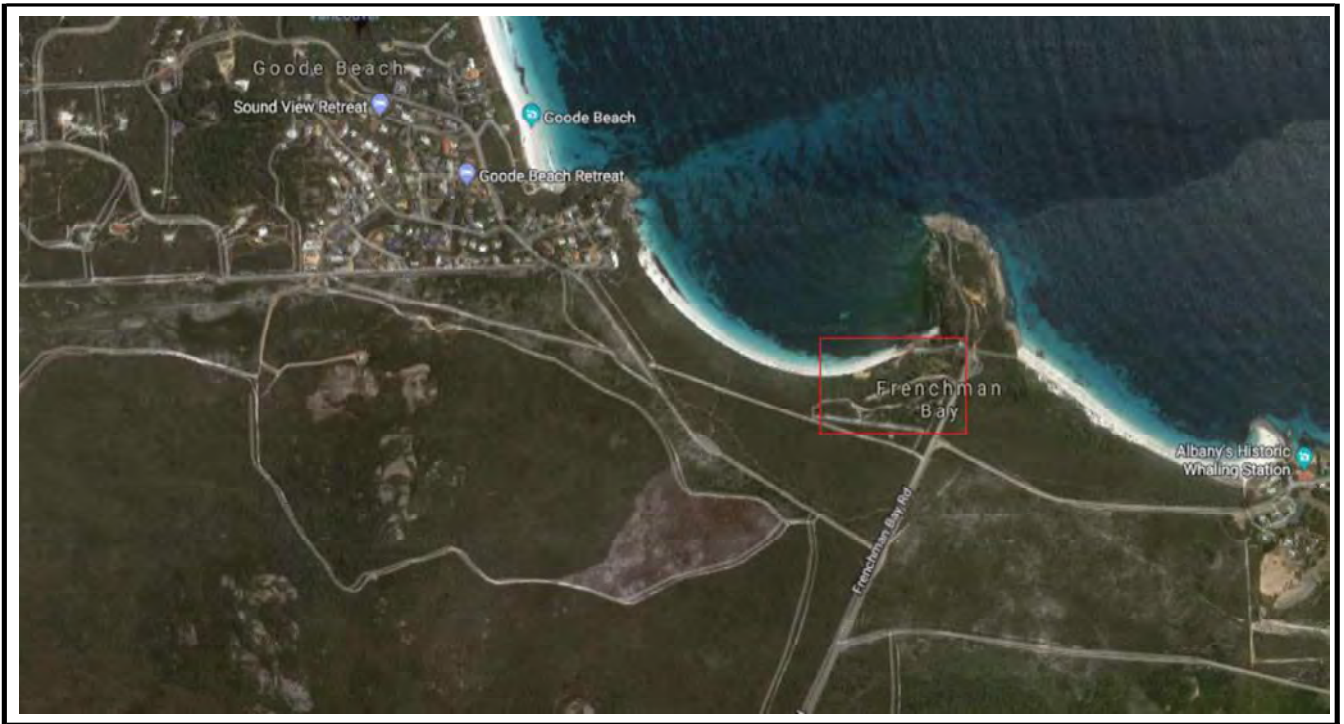



Figure 2 - Approximate Test Pit Locations




		Job No 302	Report No 302/1	Sheet 1 of 6				
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP1 Sample No. 18G671			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586602 6116250 Elevation: n/a					
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)				
Depth Below Surface (mm)	Layer Depth (mm)	Material Description <small>SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components</small>	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test
0 - 400	400	(Topsoil) SAND with silt: Dark grey, fine to medium. Roots & root fibres.	M	L		No water table encountered.		
400 - 800	400	SAND with silt: Grey, fine to medium.	M	L				
800 - 2000	1200	SAND with silt: Light grey to white, fine to medium.	M	L				
Comments			Pit Terminated at: (mm) below ground level ✓ or *					
			Target Depth <input checked="" type="checkbox"/> 2000					
			Cave In <input type="checkbox"/>					
			Refusal <input type="checkbox"/>					
			Near Refusal <input type="checkbox"/>					
			Flooding <input type="checkbox"/>					
			Lack of Reach <input type="checkbox"/>					
Materials Consistency/Strength		Rock	Cementation		Water Water first Encountered			
Cohesive VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	Non-Cohesive VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense CO - Compact	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented		Moisture D - Dry M - Moist W - Wet General N/A - Not Applicable N/D - Not Determined			

Test Pit No. 1 - Excavation



Test Pit No. 1 - Spoil




		Job No 302	Report No 302/1	Sheet 2 of 6				
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP2 Sample No. 18G672			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586582 6116174 Elevation: n/a					
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)				
Depth Below Surface (mm)	Layer Depth (mm)	Material Description SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test
0 - 1600	1600	SAND with silt: Light grey/white, fine to medium.	D-M	L		No water table encountered.		
1600 - 2000	400	SAND with silt: Light brown/grey, fine to medium.	M	L	PC			
Comments			Pit Terminated at: (mm) below ground level ✓ or *					
			Target Depth	✓	2000			
			Cave In					
			Refusal					
			Near Refusal					
			Flooding					
			Lack of Reach					
Materials Consistency/Strength			Rock		Cementation		Water	
Cohesive		Non-Cohesive		Water		Moisture		
VS - Very Soft	VL - Very Loose	EL - Extremely Low	IN - Indurated	Water first Encountered		D - Dry M - Moist W - Wet		
S - Soft	L - Loose	VL - Very Low	PC - Poorly Cemented	General		N/A - Not Applicable		
F - Firm	MD - Medium Dense	L - Low	MC - moderately Cemented	N/D - Not Determined				
St - Stiff	D - Dense	M - Medium	WC - Well Cemented					
VSt - Very Stiff	VD - Very Dense	H - High						
H - Hard	CO - Compact	VH - Very High						
		EH - Extremely High						

Test Pit No. 2 - Excavation



Test Pit No.2 - Spoil




		Job No 302	Report No 302/1	Sheet 3 of 6				
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP3 Sample No. 18G673			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586542 6116110 Elevation: n/a					
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)				
Depth Below Surface (mm)	Layer Depth (mm)	Material Description <small>SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components</small>	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test
0 - 400	400	(Topsoil) SAND with silt: Grey, fine to medium. Roots & root fibres.	M	L		No water table encountered.		
400 - 1000	600	SAND with silt: Light grey, fine to medium.	M	L				PERM
1000 - 2000	1000	SAND with silt: White, fine to medium.	M	L				
Comments			Pit Terminated at: (mm) below ground level ✓ or *					
			Target Depth <input checked="" type="checkbox"/> 2000					
			Cave In <input type="checkbox"/>					
			Refusal <input type="checkbox"/>					
			Near Refusal <input type="checkbox"/>					
			Flooding <input type="checkbox"/>					
			Lack of Reach <input type="checkbox"/>					
Materials Consistency/Strength		Rock	Cementation		Water Water first Encountered			
Cohesive VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	Non-Cohesive VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense CO - Compact	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented		Moisture D - Dry M - Moist W - Wet General N/A - Not Applicable N/D - Not Determined			


Test Pit No. 3 - Excavation



Test Pit No. 3 - Spoil



 GREAT SOUTHERN GEOTECHNICS CONSTRUCTION MATERIALS TESTING	Job No: 302	Test Pit No: TP3
	Client: Bio Diverse Solutions	
	Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330	


		Job No 302	Report No 302/1	Sheet 4 of 6				
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP4 Sample No. 18G674			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586479 6116121 Elevation: n/a					
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)				
Depth Below Surface (mm)	Layer Depth (mm)	Material Description <small>SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components</small>	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test
0 - 500	500	(Topsoil) SAND with silt: Grey, fine to medium. Roots & root fibres.	D	L		No water table encountered.		
500 - 1000	500	SAND with silt: Light grey, fine to medium.	D	L				
1000 - 2000	1000	SAND with silt: Light grey/white, fine to medium.	M	L				
Comments			Pit Terminated at: (mm) below ground level ✓ or *		Target Depth <input checked="" type="checkbox"/> 2000 Cave In <input type="checkbox"/> Refusal <input type="checkbox"/> Near Refusal <input type="checkbox"/> Flooding <input type="checkbox"/> Lack of Reach <input type="checkbox"/>			
Materials Consistency/Strength		Rock	Cementation		Water Water first Encountered			
VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense CO - Compact	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented		Moisture D - Dry M - Moist W - Wet			
					General N/A - Not Applicable N/D - Not Determined			


Test Pit No. 4 - Excavation



Test Pit No. 4 - Spoil



 GREAT SOUTHERN GEOTECHNICS CONSTRUCTION MATERIALS TESTING	Job No: 302	Test Pit No: TP4
	Client: Bio Diverse Solutions	
	Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330	


		Job No 302	Report No 302/1	Sheet 5 of 6					
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP5 Sample No. 18G675			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586373 6116140 Elevation: n/a						
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)					
Depth Below Surface (mm)	Layer Depth (mm)	Material Description <small>SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components</small>	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test	
0 - 300	300	(Topsoil) SAND with silt: Grey, fine to medium. Roots & root fibres.	D	L		No water table encountered.			
300 - 800	500	SAND with silt: Light grey/white, fine to medium.	M	L					
800 - 2000	1200	SAND with silt: Light grey/yellow, fine to medium.	M	L	PC			PERM	
Comments			Pit Terminated at: (mm) below ground level ✓ or *						
			Target Depth <input checked="" type="checkbox"/> 2000						
			Cave In <input type="checkbox"/>						
			Refusal <input type="checkbox"/>						
			Near Refusal <input type="checkbox"/>						
			Flooding <input type="checkbox"/>						
			Lack of Reach <input type="checkbox"/>						
Materials Consistency/Strength		Rock	Cementation		Water				
Cohesive VS - Very Soft S - Soft F - Firm St - Stiff VSt - Very Stiff H - Hard	Non-Cohesive VL - Very Loose L - Loose MD - Medium Dense D - Dense VD - Very Dense CO - Compact	EL - Extremely Low VL - Very Low L - Low M - Medium H - High VH - Very High EH - Extremely High	IN - Indurated PC - Poorly Cemented MC - moderately Cemented WC - Well Cemented		Water first Encountered Moisture D - Dry M - Moist W - Wet General N/A - Not Applicable N/D - Not Determined				


Test Pit No. 5 - Excavation



Test Pit No. 5 - Spoil



 GREAT SOUTHERN GEOTECHNICS CONSTRUCTION MATERIALS TESTING	Job No: 302	Test Pit No: TP5
	Client: Bio Diverse Solutions	
	Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330	


		Job No 302	Report No 302/1	Sheet 6 of 6				
Client: Bio Diverse Solutions Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330 Project No: N/A Location: Proposed Building Envelope Test Pit No.: TP6 Sample No. 18G676			Operator/Contractor: GSG Equipment type: Kubota KX41-3V Excavation Method : 300mm Auger Position: 50 H 586309 6116153 Elevation: n/a					
Date Commenced: 22.03.2018 Date Completed: 22.03.2018		Logged By: M.Coffey Checked By: M.Coffey		Excavation Dimensions: Depth 2.0 (m) Width 0.3 (m)				
Depth Below Surface (mm)	Layer Depth (mm)	Material Description <small>SOIL TYPE, Plasticity, Colour, Particle characteristics, Secondary and other minor components</small>	Moist. Condition	Consistency / Strength	Cementation	Water Table	Classification Symbol	Sample/Test
0 - 300	300	(Topsoil) SAND with silt: Grey, fine to medium. Roots & root fibres.	D	L		No water table encountered.		
300 - 1700	1400	SAND with silt: Light grey, fine to medium.	M	L				
1700 - 2000	300	SAND with silt: Brown/grey, fine to medium.	M	L-MD	PC			
Comments			Pit Terminated at: (mm) below ground level ✓ or *					
			Target Depth	✓	2000			
			Cave In					
			Refusal					
			Near Refusal					
			Flooding					
			Lack of Reach					
Materials Consistency/Strength			Rock		Cementation		Water	
Cohesive		Non-Cohesive		Water		Moisture		
VS - Very Soft	VL - Very Loose	EL - Extremely Low	IN - Indurated	Water first Encountered		D - Dry M - Moist W - Wet		
S - Soft	L - Loose	VL - Very Low	PC - Poorly Cemented	General		N/A - Not Applicable		
F - Firm	MD - Medium Dense	L - Low	MC - moderately Cemented	N/D - Not Determined				
St - Stiff	D - Dense	M - Medium	WC - Well Cemented					
VSt - Very Stiff	VD - Very Dense	H - High						
H - Hard	CO - Compact	VH - Very High						
		EH - Extremely High						

Test Pit No. 6 - Excavation



Test Pit No. 6 - Spoil



 GREAT SOUTHERN GEOTECHNICS CONSTRUCTION MATERIALS TESTING	Job No: 302	Test Pit No: TP6
	Client: Bio Diverse Solutions	
	Project: Lots 1 & 2 Fenchman Bay Rd, Albany WA 6330	



Appendix 2

Test Results

GREAT SOUTHERN GEOTECHNICS

5a 209 Chester Pass Road, Milpara WA 6330
 Mobile: 0407 903 297 Email: Info@gsgotechnics.com



Dry Density / Moisture Content Relationship Test Report

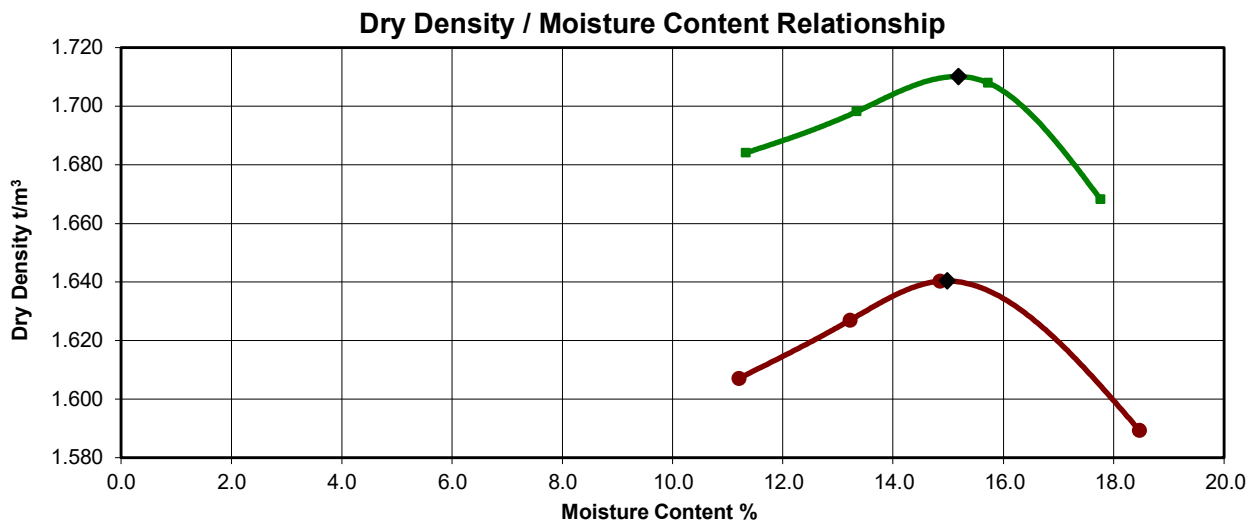
Sheet 1 of 1

Report No. 302/1

Job No. 302

Client: Bio Diverse Solutions
 Project: Lots 1 & 2 Frenchman Bay Road
 Road: Frenchman Bay Road
 Section: N/A

Sample No.	Sample Location	Field Description
18G677	Test Pit 3	SAND
18G678	Test Pit 5	SAND



Sample Number	18G677	18G678	
Depth	400mm to 1000mm	800mm to 2000mm	
Stabiliser Used			
Stabiliser Added %			
Curing Period	Water (Days)	0.08	0.08
	Stabiliser (Hrs)		
Moisture Content Method used	AS 1289.2.1.1	AS 1289.2.1.1	
Sampling Method	AS 1289.1.2.1 Proc 6.5	AS 1289.1.2.1 Proc 6.5	
Date Sampled	22.03.2018	22.03.2018	
Date Received	22.03.2018	22.03.2018	
Date Tested	24.03.2018	24.03.2018	
Test Method	AS 1289.5.2.1	AS 1289.5.2.1	
Maximum Dry Density t/m ³	1.64	1.71	
Optimum Moisture Content %	15.0	15.0	
Adjusted Maximum Dry Density t/m ³			
Adjusted Optimum Moisture Content %			
Percentage Retained %	37.5 mm	0	0
Percentage Retained %	19.0 mm	0	0

<p>Comments: N/a</p> <p>Distribution: Laboratory File / Kathryn Kinnear</p>	<p>Approved Signatory:</p> <p>Name: M.Coffey Function: Laboratory Manager Date: 11.04.2018</p>
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CONSTANT HEAD PERMEABILITY - TEST REPORT

In accordance with AS 1289.6.7.1, 2.1.1, 5.1.1

Client	Bio Diverse Solutions	Ticket No.	S1555
Client Address	-	Report No.	LLS18/1362_1_FHPERM
Project	Lots 1 & 2 Frenchman Bay Road	Sample No.	LLS18/1362
Location	Albany WA 6330	Job No.	Job No. 302
Sample Identification	Test Pit 3 - 400mm - 1000mm (18G677)		
Sampling Method:	Tested as Received		

Constant Head Permeability

Laboratory Moisture Ratio (%)	99.0
Laboratory Density Ratio (%)	94.5
Compactive Effort	Modified
Hydraulic Gradient	0.6
Surcharge (kPa)	3
% Retained on 19mm Sieve	0
Coefficient of Permeability (m/sec)	4.5×10^{-6}

Comments:

AS 1289.5.2.1 Compaction Values supplied by Great Southern Geotechnics



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Accreditation No. 19872

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Approved Signatory

Name

M. van Herk

Function

Laboratory Manager

Issue Date

11-April-2018



FALLING HEAD PERMEABILITY - TEST REPORT

In accordance with AS 1289.6.7.2, 2.1.1, 5.1.1

Client	Bio Diverse Solutions	Ticket No.	S1555
Client Address	-	Report No.	LLS18/1362_1_FHPERM
Project	Lots 1 & 2 Frenchman Bay Road	Sample No.	LLS18/1362
Location	Albany WA 6330	Job No.	Job No. 302
Sample Identification	Test Pit 5 - 800mm - 2000mm (18G678)		
Sampling Method:	Tested as Received		

Falling Head Permeability

Laboratory Moisture Ratio (%)	99.5
Laboratory Density Ratio (%)	95.0
Compactive Effort	Modified
Hydraulic Gradient	0.6
Surcharge (kPa)	3
% Retained on 19mm Sieve	0
Coefficient of Permeability (m/sec)	2.6×10^{-6}

Comments:

AS 1289.5.2.1 Compaction Values supplied by Great Southern Geotechnics



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Approved Signatory

Name

M. van Herk

Function

Laboratory Manager

Issue Date

11-April-2018

Appendix C

In-situ Permeability Testing - BDS (2022)



Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	51.8
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	383.28
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.2523
Saturated Hydraulic Conductivity (m/day)	K _{sat}	3.63

Confirm data in green cells and adjust if necessary

Disclaimer: CET does not warrant data produced by use of this spreadsheet or any interpretation based on that data



Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	59.8
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	442.90
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.2915
Saturated Hydraulic Conductivity (m/day)	K _{sat}	4.20

Confirm data in green cells and adjust if necessary

Disclaimer: CET does not warrant data produced by use of this spreadsheet or any interpretation based on that data



Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	60.8
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	450.44
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.2965
Saturated Hydraulic Conductivity (m/day)	K _{sat}	4.27

Confirm data in green cells and adjust if necessary

Disclaimer: CET does not warrant data produced by use of this spreadsheet or any interpretation based on that data



Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	16.9
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	125.36
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.0825
Saturated Hydraulic Conductivity (m/day)	K _{sat}	1.19

Confirm data in green cells and adjust if necessary

Disclaimer: CET does not warrant data produced by use of this spreadsheet or any interpretation based on that data



Test #

IT2 - Test 2

Time (hr:min:sec)	Time after start (min)	Level in Tube (cm)	Drop of Level (cm)	Rate of Water Level Drop (cm/min)
	0	140.1		
	0.333333333	136.1	4.0	12.0
	0.666666667	131.2	4.9	14.7
	1	126.1	5.1	15.3
	1.333333333	121.0	5.1	15.3
	1.666666667	115.0	6.0	18.0
	2	109.5	5.5	16.5
	2.333333333	104.0	5.5	16.5
	2.666666667	99.0	5.0	15.0
	3	93.5	5.5	16.5
	3.333333333	88.1	5.4	16.2
	3.666666667	82.1	6.0	18.0
	4	76.6	5.5	16.5
	4.333333333	71.2	5.4	16.2
	4.666666667	65.6	5.6	16.8
	5	60.0	5.6	16.8
	5.333333333	54.5	5.5	16.5
	5.666666667	48.1	6.4	19.2
	6	42.8	5.3	15.9
	6.333333333	37.0	5.8	17.4
	6.666666667	30.8	6.2	18.6
			0.0	0.0
			0.0	0.0
			0.0	0.0
			0.0	0.0
			0.0	0.0
Selected Steady Rate of Water Level Drop			(cm/min)	16.4
Rate of Loss of Water from Reservoir			(cm ³ /min)	121.4

Enter data in green cells

Select Steady Rate of Water Level Drop from Rate of Water Level Drop Column (Column E) and enter in pink cell (E34). This value should be the average of three consecutive values with no more than 10% variation

Disclaimer: CET does not warrant data produced by use of this spreadsheet or any interpretation based on that data



Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	16.4
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	121.43
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.0799
Saturated Hydraulic Conductivity (m/day)	K _{sat}	1.15

Confirm data in green cells and adjust if necessary

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Parameter	Symbol	Value
Depth of Water in Test Hole (cm)	H	25
Radius of Test Hole (cm)	r	3.75
Inner Tube External Diameter (cm)	D _i	0.9
Outer Tube Internal Diameter (cm)	D _o	3.2
Rate of Water Level Drop (cm/min)	L	18.4
Inner Tube Cross Sectional Area (cm ²)	A _i	0.64
Outer Tube Cross Sectional Area (cm ²)	A _o	8.04
Flowrate (cm ³ /min)	Q	136.32
Saturated Hydraulic Conductivity (cm/min)	K _{sat}	0.0897
Saturated Hydraulic Conductivity (m/day)	K _{sat}	1.29

Confirm data in green cells and adjust if necessary

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