Waimakariri District Council
215 High Street
Private Bag 1005
Rangiora 7440, New Zealand
Phone 0800 965 468

DISTRICT PLAN REVIEW

Proposed Waimakariri District Plan - Submission

Clause 6 of Schedule 1, Resource Management Act 1991

Submitter details

*(Our preferred methods of corresponding with you are by **email** and **phone**).*

Full name: Alistair John Dougal Cameron (C/- Fred Coughlan, Davis Ogilvie & Partners Limited)

Email address: ajcameron@xtra.co.nz (fred@do.nz)

Phone (Mobile): 0274330967 (0272929239) Phone (Landline): _____

Postal Address: 66 Acacia Avenue, Rangiora, Rangiora, 7400 (PO Box 589 CHCH, 8140) Post Code: _____

Physical address: _____ Post Code: _____
(if different from above)

Please select one of the two options below:

☑ I **could not** gain an advantage in trade competition through this submission *(go to Submission details, you do not need to complete the rest of this section)*

☐ I **could** gain an advantage in trade competition through this submission *(please complete the rest of this section before continuing to Submission details)*

Please select one of the two options below:

☑ I **am** directly affected by an effect of the subject matter of the submission that:

A) Adversely affects the environment; and

B) Does not relate to trade competition or the effect of trade competition.

☐ I **am not** directly affected by an effect of the subject matter of the submission that:

A) Adversely affects the environment; and

B) Does not relate to trade competition or the effect of trade competition.

2106170979 46 - Version 1.0 - August 2021

Submission details

The specific provisions of the proposal that my submission relates to are as follows: *(please give details)*

Please refer to submission document attached

My submission is that: *(state in summary the Proposed Plan chapter subject and provision of your submission. Clearly indicate whether you support or oppose the specific provisions or wish to have amendments made, giving reasons) (please include additional pages as necessary)*

Please refer to submission document attached

I/we have included: _____ additional pages

I/we seek the following decision from the Waimakariri District Council: *(give precise details, use additional pages if required)*

Please refer to submission document attached

Submission at the Hearing

☑ I/we wish to speak in support of my/our submission

☐ I/we do not wish to speak in support of my/our submission

☐ If others make a similar further submission, I/we will consider presenting a joint case with them at the hearing

Signature

Of submitters or person authorised to sign on behalf of submitter(s)

Signature Thomas Frederic Coughlan Date 26 / 11 / 2021

(If you are making your submission electronically, a signature is not required)

Important Information

1. The Council must receive this submission before the closing date and time for submissions.

2. Please note that submissions are public. Your name and submission will be included in papers that are available to the media and public. Your submission will only be used for the purpose of the District Plan review process.

3. Only those submitters who indicate they wish to speak at the hearing will be emailed a copy of the planning officers report (please ensure you include an email address on this submission form).

If you are a person who could gain an advantage in trade competition through the submission, your right to make a submission may be limited by clause 6(4) of Part 1 of Schedule 1 of the Resource Management Act 1991.

Please note that your submission (or part of your submission) may be struck out if the authority is satisfied that at least 1 of the following applies to the submission (or part of the submission):

- It is frivolous or vexatious
- It discloses no reasonable or relevant case
- It would be an abuse of the hearing process to allow the submission (or the part) to be taken further
- It contains offensive language
- It is supported only by material that purports to be independent expert evidence, but has been prepared by a person who is not independent or who does not have sufficient specialised knowledge or skill to give expert advice on the matter.

Send your submission to: Proposed District Plan Submission
Waimakariri District Council
Private Bag 1005, Rangiora 7440

Email to: developmentplanning@wmk.govt.nz

Phone: 0800 965 468 (0800WMKGOV)

You can also deliver this submission form to one our service centres:

Rangiora Service Centre: 215 High Street, Rangiora

Kaiapoi Service Centre: Ruataniwha Kaiapoi Civic Centre, 176 Williams Street, Kaiapoi

Oxford Service Centre: 34 Main Street, Oxford

Submissions close 5pm, Friday 26 November 2021
Please refer to the Council website waimakariri.govt.nz for further updates

SUBMISSION BY ALSATAIR JOHN DOUGAL CAMERON ON THE PROPOSED WAIMAKARIRI DISTRICT PLAN

To	**Waimakariri District Council**
Address	**Private Bag 1005, Rangiora 7445**
Email	**developmentplanning@wmk.govt.nz**

Submitter Details

Full Name(s)	Alastair John Dougal Cameron
Submitter Agents Name	Davis Ogilvie & Partners
Contact Person	Fred Coughlan
Address for Service	PO Box 589 Christchurch 8041
Email	Fred@do.co.nz
Phone number	(03) 962 8572

Hearing

The submitter wishes to be heard in support of their submission.

Specific provisions that this submission relates to

The submission relates to the Proposed Waimakariri District Plan, in particular the proposed zoning of the property Lot 1 DP 394101 located at 2 Auckland Street, Ashley. The applicant wishes to submit that the proposed zoning be varied from Rural Lifestyle Zone (RLZ) as shown on the notified version of the Proposed Plan to Large Lot Residential Zone (LLRZ), alternative relief is also considered.

Fred Coughlan
BEMP, Assoc. NZPI, RMLA
Planner, Davis Ogilvie & Partners
For and on behalf of the submitter

Introduction

1. This submission has been prepared by Davis Ogilvie and Partners on behalf of Alastair John Dougal Cameron (the Submitter).

2. The submitter owns a parcel of land which is currently zoned as Rural (RU) under the Operative Waimakariri District Plan, and currently notified as Rural Lifestyle Zone (RLZ) under the Proposed Waimakariri District Plan.

3. The land is located to the east of the Ashley Township, adjoining the full length of Auckland Street on its eastern boundary. The property further is bound by Canterbury Street to the north and Lower Sefton Road to the south. The property is approximately 8 hectares in total area and legally described as Lot 1 DP 394101.

4. The subject property is illustrated in **Figure 1** below.

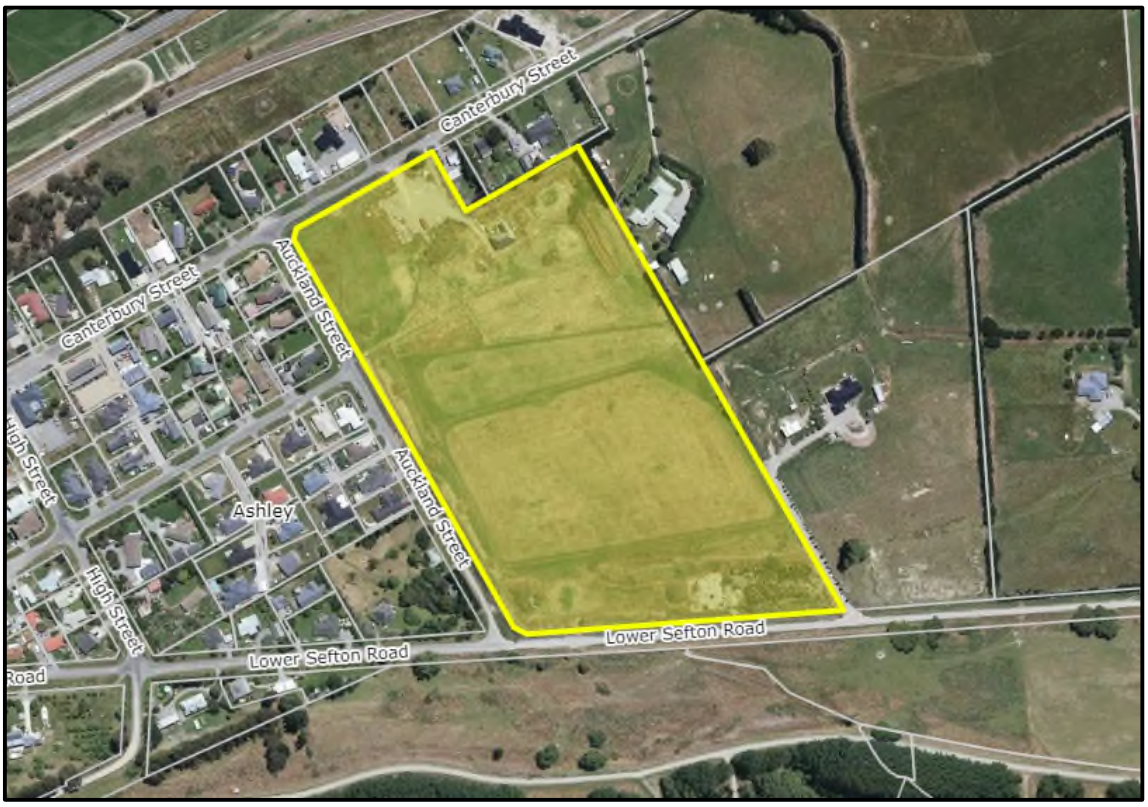

Figure 1: Property Location (Submitter Property Outlined Yellow)

5. In effect, the Proposed District Plan continues the same underlying zoning provisions in relation to the subject property, enabling rural land use at a 4 ha developed density.

6. It is the submitters position that the proposed RLZ zoning is not appropriate to the subject property, and the submitter seeks the Proposed District Plan should be amended to rezone the subject property to the Large Lot Residential Zone (LLRZ) allowing for an average development density of 1 dwelling per 0.5 ha.

7. The proposed District Plan Describes the LLRZ as follows;

> *"The purpose of the Large Lot Residential Zone is to provide residential living opportunities for predominantly detached residential units on lots larger than other Residential Zones. The Large Lot Residential Zone are located near but outside the established townships. Some opportunity is also provided for rural activities where the effects of these activities will not detract from the purpose, character and amenity values of the residential zone."*

8. The Submitter holds the position that the property is more suitable to the proposed zoning for the following reasons;

8.1. The location of the subject property is more appropriate to the LLRZ zone and its description.

8.2. The subject property has a high level of connectivity with existing residentially zoned areas currently identified by the Proposed District Plan.

8.3. The subject property can be appropriately serviced at the level of density allowed by the LLRZ zone and is appropriate for residential development.

8.4. The LLRZ zoning would allow a greater level of residential density within the subject property.

9. These points are discussed in further detail below;

Location Appropriate to LLRZ Zone

10. As noted above and illustrated in Figure 1, the subject property is located directly adjacent to the Ashley Township, opposite existing residential development to the west of Auckland Street. The implementation of the LLRZ zoning in relation to this site would provide for a balanced transition between the Rural and Urban environment not currently provided for at the edge of the existing Ashley Township. LLRZ areas are described in the Proposed District Plan as "*near but outside the established townships".* It is considered that the subject property both fits this description and location characteristics of other land proposed as LLRZ within the Proposed District Plan.

11. In addition to the zone description fit, the National Policy Statement for Urban Development Capacity requires consideration in relation to the development of well-functioning urban environments. This includes consideration of the urban form and whether the direction of growth provided will create an appropriate urban form and density. In the case of the subject property it is considered that the proposed zoning will result in the growth of Ashley Village in a logical direction and in relation to existing servicing and transport connections.

Subject Property Connectivity

12. The Subject property is able to be serviced for access from Auckland Street, Canterbury Street and Lower Sefton Road. Given the minimum average subdivision size of 0.5 ha under the zoning sought, it is likely that the construction of right of way access points from these roads would be sufficient to appropriately service the yield capable under the LLRZ zoning.

Subject Property Servicing and Suitability

13. Critical to the establishment of zoning at urban residential densities is the provision of appropriate servicing, inclusive of stormwater, wastewater, potable water, electrical and communications. Potential servicing arrangements are explored in the Davis Ogilvie Servicing Report attached as **Appendix 1**.

14. It is noted that further residential development of this site has been investigated by the submitter for some time. Servicing and site reporting provided with this submission relates to these investigations, which have canvassed a variety of density options. Discussions have also been held with Council with respect to infrastructure servicing for the site, particularly in relation to potential reticulated wastewater servicing options for higher density development of the site.

15. A summary of the relevant servicing and suitability matters is provided below.

16. Stormwater flows emanating from the development area would be directed to ground via soakpits and subject to the appropriate treatment. Any right of way areas and associated hardstand would likely be serviced by a grassed swale and soakpit system with attenuation supplied where necessary to ensure stormwater flows can be appropriately managed to avoid offsite effects. Individual allotments would discharge to ground internally via soakpits.

17. In relation to wastewater discharge flows, Ashley is not currently serviced by a reticulated network. As such, it is considered that at the proposed LLRZ density the provision of onsite wastewater servicing would be the most practical option for managing wastewater (although alternatives are noted in the Servicing Report attached as **Appendix 1**).

18. The applicant has carried out investigations on the site which demonstrate that onsite wastewater discharge from residential activities is feasible. The Wastewater Report prepared by Whiterock Consulting is provided as **Appendix 2**.

19. Potable water would be supplied by the existing Hurunui District Council (HDC) administered scheme which currently services the Ashley township. Extension of the existing main to the site would need to be undertaken from Auckland Street. HDC have undertaken supply modelling and have confirmed that the council reticulation network has adequate flow and pressure to supply up to an additional 30 water units to the proposed development for both residential and firefighting use. Confirmation from HDC of this capacity is attached as part of **Appendix 1.**

20. Electrical reticulation will be supplied by Mainpower and communications (fibre) by Chorus. Capacity for these services has been confirmed by both providers, with this confirmation attached as part of **Appendix 1**.

21. Overall, it is considered that servicing provisions are appropriate to a residential zoning and where services are managed onsite servicing effects can be appropriately mitigated, subject to approvals from the Canterbury Regional Council.

22. The subject property has been demonstrated to be geotechnically suitable for development, the appropriate geotechnical investigations have been undertaken by the applicant and are detailed in the Geotechnical Report attached as **Appendix 3**.

23. In relation to flooding, small portions of the subject property are shown within the 'low probability' 1 in 200 year hazard overlay of the Waimakariri District Council Flood Model. Similarly, small portions of the site are located within the 'low probability' 1 in 500 year hazard overlay. The modelling shows no overland flow paths or significant flooding within the site. This is illustrated in Figure 2 below, and further discussed in the Geotechnical Report attached as **Appendix 3.**

Figure 2: Waimakariri District Council Flood Modelling (Site Outlined Yellow)

24. In relation to the NES-CS, the existing underlying use of the property is rural in nature. Localised contamination may be possible as a result of historic use. A Preliminary Site Investigation and Detailed Site Investigation (if required as a result of the PSI conclusions) would be undertaken prior to any development of the site. It is noted that the ECan Listed Land Use Register shows no record of HAIL activities within the subject property.

25. It is anticipated development would be undertaken utilising the existing landform, with minimal earthworks required in relation to the formation of access, infrastructure, building platforms and appropriate secondary flow drainage pathways.

26. Overall, it is considered that property is suitable for residential development with respect to ground conditions and relevant natural hazards matters.

LLRZ Zoning Will Allow Increased Residential Density

27. The re-zoning of the subject property from Rural Lifestyle Zone to Large Lot Residential Zone will allow for an increase to the possible density of development within the subject property, and accordingly result in a transfer of land use from rural to residential. It is considered that the proposed re-zoning is of economic benefit to both the submitter and wider community.

28. The currently proposed underlying zoning allows for a minimum residential density of 1 dwelling per 4 ha. If subdivision of the overall site were to be carried out it is considered that this would provide for a yield of approximately 2 rural-residential type allotments.

29. Based on the LLRZ zoning sought, the potential yield is considered to be approximately 14 residential allotments (incorporating a 10% land requirement for access to rear lots).

30. It is considered that the increased yield resulting from a zoning change from GRUZ to LLRZ will support the intent of the objectives and policies of the proposed District Plan and the intent of the National Policy Statement on Urban Development Capacity, by advancing residential development which contributes to the Waimakariri District.

31. In relation to housing supply, it is considered that the proposed zoning change will provide for the social and economic needs of both the owners of the subject property and the residents of the Waimakariri District, which has identified short term supply constraints in relation to the District as part of the baseline reporting undertaken in relation to residential growth within the Greater Christchurch Area.

Relief Sought

32. For the reasons outlined above the submitter seeks the following relief from Council on the Proposed District Plan;

    32.1. That the subject property is rezoned from **RLZ** to **LLRZ**.

    32.2. Notwithstanding the above, should it be considered that the LLRZ zoning is not appropriate to the subject property the applicant seeks consideration of alternative relief which may include, but is not limited to;

32.3. The incorporation of a higher density overlay in relation to the RLZ provisions to enable a higher developed density under the current proposed zoning.

32.4. Rezoning of the property to Settlement Zone (SETZ) in accordance with the adjoining Ashley Township.

32.5. Such further or consequential relief including amendments to other rules, objectives and policies that may be necessary to achieve the outcomes the submitter seeks.

Dated this 26th day of November 2021

Attached;

Appendix 1 – Servicing Report (Davis Ogilvie)

Appendix 2 – Wastewater Report (Whiterock Consulting)

Appendix 3 – Geotechnical Report

DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS

PRELIMINARY SERVICES REPORT

37211 / 2 AUCKLAND STREET, ASHLEY

/ ALASTAIR CAMERON

0800 999 333
hello@do.nz

Level 1, 24 Moorhouse Avenue, Addington
PO Box 589, Christchurch 8140
www.do.nz

Davis Ogilvie & Partners Ltd

QUALITY ASSURANCE

Title:	Preliminary Services Report
Client:	Alastair Cameron
File Location:	\\dop5\jobdata\projects\37s\37211 - 2 Auckland Street, Ashley\Civil\Design\Priliminary Services Report\210407.cm.37211.Prelim Services Report.docx
Version:	1
Date:	22 November 2021
Project No:	37211

Prepared By: **Clement Maloney**
Senior Civil Engineer
BE Civil, MEngNZ

Signature:

Reviewed By: **Ross Jennings**
Senior Civil Engineer
BE (Hons), Nat Res, MEngNZ

Signature:

DISCLAIMER

This engineering report has been prepared at the specific instruction of Alastair Cameron. It outlines the design of the preliminary servicing for a proposed submission to the proposed Waimakariri District Plan for changing designation to large lot residential zone at 2 Auckland Street, Ashley.

Davis Ogilvie did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited investigation of the site and have not been taken into account in the report.

Davis Ogilvie's opinions are based upon information that existed at the time of the production of this document. Assessments made in this report are based on the conditions found onsite and published sources detailing the recommended investigation methodologies described. No warranty is included—either expressed or implied—that the actual conditions will conform to the assessments contained in this report.

Davis Ogilvie has provided an opinion based on observations, site investigations, and analysis methodologies current at the time of reporting. The report cannot be used by any third party without the written approval of Davis Ogilvie. The report cannot be used if there are changes in the referenced guidelines, analysis methodologies, laws or regulations.

Only Alastair Cameron and the Local and Regional Territorial Authorities are entitled to rely upon this engineering report. Davis Ogilvie & Partners Ltd accepts no liability to anyone else in any way in relation to this report and the content of it and any direct or indirect effect this engineering report may have. Davis Ogilvie & Partners Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

Should anyone wish to discuss the content of this report with Davis Ogilvie & Partners Ltd, they are welcome to contact us on (03) 366 1653 or at Level 1, 24 Moorhouse Avenue, Addington, Christchurch.

TABLE OF CONTENTS

1.0 PURPOSE OF REPORT

The purpose of this report is to support of a submission to the proposed Waimakariri District plan. The purpose of this report is to outline the preliminary engineering design concepts to support a request for zone change from the proposed Rural Zone (RLZ) to Large Lot Residential Zone (LLRZ) for 2 Auckland Street, Ashley.

This design report has been prepared to summarise:

- Proposed civil engineering design for the development at 2 Auckland Street, Ashley.
- Existing infrastructure around the site.
- Proposed conformance to national standards, Waimakariri District Council's (WDC) policies and best practices relating to subdivision development, in particular:
    - Waterways, Wetlands and Drainage Guide (WWDG).
    - WDC's Engineering Code of Practise (WDC ECOP).
    - Hurunui District Council's Development Engineering Standard (HDC DES).
    - NZS4404:2010 – Land Development and Subdivision Infrastructure.

2.0 PROPOSAL DESCRIPTION

The site, 2 Auckland Street Ashley, is located within a rural area and is bounded by Canterbury Street to the north, Auckland Street to the west, Lower Sefton Road to the south and undeveloped land to the east. The total area of the site is 8.0 ha.

Based on a minimum lot size of 5,000 m², we have a potential yield of 16 lots if zoned LLRZ. The site is currently zoned RLZ, is rural in character and the land grades generally to the south. The site is legally known as Lot 1 DP 394101 (Title 376526).

Figure 1: Proposed Development Area.

The development site is currently undeveloped rural land in character, with one house and associated sheds located on-site. The house will be retained and incorporated into one of the new Lots.

3.0 EXISTING INFRASTRUCTURE

The only existing WDC infrastructure within the site is an existing stormwater drain located, within the lot, along the north-eastern boundary.

There is currently no WDC sewer reticulation within the Ashley township. Further discussion of sewer infrastructure is found in Section 5.0.

Another stormwater drain is located directly adjacent to the south-western edge of the proposed site. Further discussion of stormwater is found in Section 6.0.

Hurunui District council water supply infrastructure is located within Canterbury and Auckland Streets. Further discussion of water supply is found in Section 7.0.

4.0 EARTHWORKS

The Listed Land Use Register (LLUR) maintained by ECan, documents sites that have had potentially hazardous land uses according to the Ministry for the Environment (MfE) Hazardous Activities and Industries List (HAIL). No HAIL activity within the site was documented in the LLUR statements.

To allow for the stormwater secondary flow network to function correctly parts of the site will require cutting, and/or filling.

In addition to the activities listed above, common services trenches, sewer and stormwater infrastructure will require excavation for installation. The trenches will be backfilled with site material and imported material where necessary. Minor lot regrading will need to be undertaken over the majority of the development.

All earthworks will be undertaken in accordance with the requirements of NZS 4431:1989 (Code of Practice for Earth Fill for Residential Development), WDC, Environment Canterbury and the proposed Site Management Plan.

Final design, volumes and more detailed plans will be provided to Council during the engineering approval processes. A detailed erosion and sediment control plan and report will be submitted for approval as part of these processes.

5.0 SEWER

The sanitary sewer network will be designed, in accordance with the SDC ECOP, to service all lots in the development.

The exact nature of the sewer servicing will be determined following further consultation with both the regional and territorial authorities but can take several forms. See below for possible servicing strategies:

- Low pressure sewer discharging to council reticulation located on Cones Road,
- Gravity reticulation paired with a new sewer pump station and rising main also discharging to council reticulation located on Cones Road, or
- On-site treatment and disposal.

Verbal confirmation has been given from WDC that confirms the council reticulation located on Cones Road has capacity for the proposed development.

All works will be designed and constructed in accordance with the WDC ECOP. Final details and design will be provided through the engineering approval process.

6.0 STORMWATER

Stormwater reticulation will be designed in accordance with the WDC ECOP, the Christchurch City Council Waterways, Wetlands and Drainage Guide (WWDG) and engineering best practice. Stormwater management systems will be designed to comply with the requirements of the ECan consent CRC213567, which is awaiting issue from ECan.

Potential stormwater management will utilise stormwater soakpits within each lot for discharge of roof stormwater to ground. Soakpits will be sized as per the New Zealand Building Code – Clause E1 Surface Water, Section 9.0 for 10% AEP – 1 hour rainfall events.

Further stormwater run-off will be dealt with in a manner consistent with both regional and territorial authority requirements and may contain further soakpits or stormwater management ponds. Current discharge from the site is to a drain and culvert located at the south-western corner of the site and can be utilised if required.

All works will be designed and constructed in accordance with the WDC ECOP. Final details and design will be provided through the engineering approval process.

7.0 HIGH PRESSURE WATER

A high-pressure water main network will need to be constructed within the proposed development site to service the proposed residential lots. It is understood that a new water supply main, including fire hydrants, will need to be installed by the developer with connections to the existing HDC reticulation located within Auckland Street and Canterbury Street.

HDC have undertaken supply modelling and have confirmed that the council reticulation network has adequate flow and pressure to supply up to an additional 30 water units to the proposed development. See Appendix A for service confirmation.

Fire hydrant spacing will be in accordance with SNZ PAS 4509:2008 – New Zealand Fire Service – Fire Fighting Water Supplies Code of Practice.

Final detailed design will be in accordance with the HDC DES and SNZ PAS 4509:2008 – New Zealand Fire Service, Fire Fighting Water Supplies Code of Practice.

8.0 COMMON SERVICES TRENCHING

Services including water, power and telecommunications will be installed within a common services trench to be located generally within the berm area of the road reserve immediately adjacent to the lot boundaries. Specific locations will be provided following consultation with the service authorities and plans will be provided for approval to Council prior to installation.

Chorus telecommunications have confirmed that the network has adequate capacity and can be extended to service the proposed development. See confirmation email attached in Appendix A.

Mainpower have confirmed that the network has adequate capacity and can be extended/modified to service the proposed development. See Mainpower Capacity Letter dated 21 April 2021 attached in Appendix A. Power reticulation design for the development will be undertaken by an approved Mainpower designer.

All works carried out will meet the requirements of Council and the network operators.

9.0 LIGHTING

Lighting will be designed to provide a minimum of P3 luminance on the roads and pedestrian areas. The lighting will be designed in accordance with AS/NZS 1158.3.1 Road Lighting – Pedestrian Area (Category P) lighting. LED street lighting will be provided. The lighting design will be completed by Spunlite and will be submitted to SDC for approval.

10.0 ROADING

The carriageway pavements will be designed using the *Design Graph for Flexible Pavements Chart,* Christchurch Metropolitan Area – Code of Practice for Urban Subdivision. The total compacted pavement depths will be based on the expected traffic loading and CBR values of the "in situ" material measured at the depth of the proposed subgrade.

Figure 2 below shows a typical road cross-section for the proposed development.

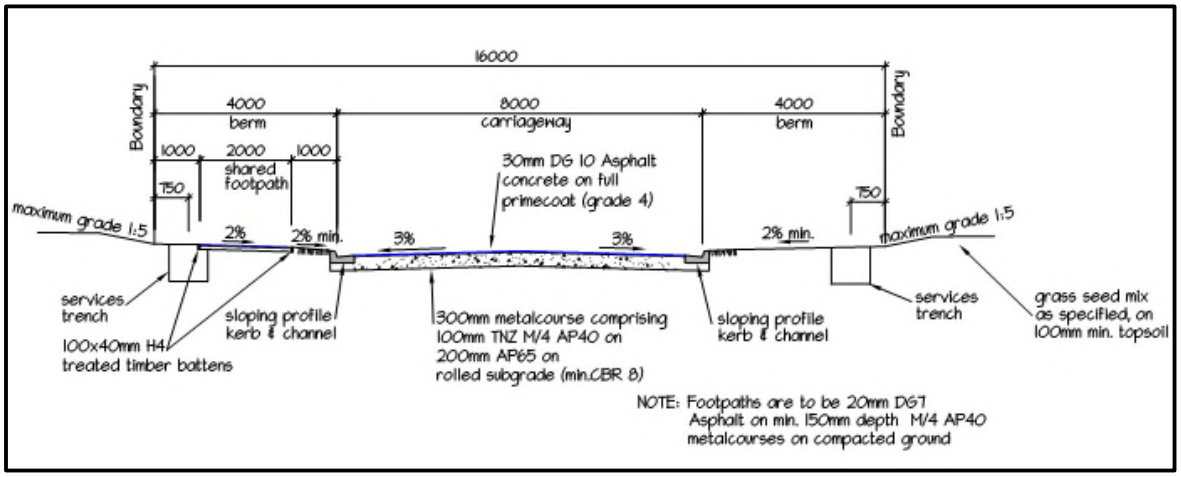

Figure 2: Typical Road Cross Section

11.0 CONCLUSION

The proposed zone changes from Rural Zone (RLZ) to Large Lot Residential Zone (LLRZ) yielding up to 16 lots at 2 Auckland Street, Ashley can be suitably serviced in accordance with WDC requirements, NZS 4404 and engineering best practice.

There are several sewer servicing options available for this site with the most appropriate being decided following further consultation with both regional and territorial authorities. Existing council sewer reticulation located on Cones Road has capacity to service the proposed site.

The proposed stormwater management will utilise stormwater soakpits within each lot for discharge of roof stormwater to ground. The balance of the proposed site will be dealt with in a manner consistent with both regional and territorial authority requirements and may contain further soakpits or stormwater management ponds with a potential discharge to the existing drain and culvert located at the south-western corner of the proposed development site.

A high-pressure water main network will be constructed within the proposed development to service the proposed residential lots. The existing HDC reticulation has capacity to service this site.

The proposed LLRZ development can be accommodated and constructed in accordance with the Waimakariri District Council's ECOP, HDC Development Engineering Standard, CCC WWDG, NZS4404:2010, NZS 4431:1989 *Code of Practice for Earthfill for Residential Development*, and best engineering practice.

APPENDIX A

Service Confirmation

Chorus Property Development Team
PO Box 9405
Waikato Mail Centre
Hamilton 3200
Telephone: 0800 782 386
Email: develop@chorus.co.nz

5 August 2021

Chorus Ref #: RR64049
Your Ref #:

C- Davis Ogilvie & Partners Ltd

Attention: **Clement Maloney**
Dear Sir / Madam

Property Development – RR: 2 Auckland Street, Ashley, Waimakariri District. 49 Lots (Lots 1-49) Simple Estimate

Thank you for your enquiry regarding the above subdivision.

Chorus is pleased to advise that, as at the date of this letter, we would be able to provide ABF telephone reticulation for this property development. In order to complete this reticulation, we require a contribution from you to Chorus' total costs of reticulating the development. Chorus' costs include the cost of network design, supply of telecommunications specific materials and supervising installation. At the date of this letter, our estimate of the contribution we would require from you is $67,620.00 (including GST).

We note that (i) the contribution required from you towards reticulation of the development, and (ii) our ability to connect the subdivision to the Chorus network, may (in each case) change over time depending on the availability of Chorus network in the relevant area and other matters.

If you decide that you wish to undertake reticulation of this property development, you will need to contact Chorus (see the contact details for Chorus Property Development Team above). We would recommend that you contact us at least 3 months prior to the commencement of construction at the subdivision. At that stage, we will provide you with the following:

- confirmation of the amount of the contribution required from you, which may change from the estimate as set out above;

- a copy of the Contract for the Supply and Installation of Telecommunications Infrastructure, which will govern our relationship with you in relation to reticulation of this property development; and

- a number of other documents which have important information regarding reticulation of the property development, including - for example - Chorus' standard subdivision lay specification.

Yours faithfully

Maia Luxford Sullivan
Property Development Coordinator

MainPower New Zealand Limited
172 Fernside Road, PO Box 346,
Rangiora 7440, New Zealand
T. +64 3 311 8300 F. +64 3 311 8301

Network Reference: M26728

21/04/21

Clement Maloney
Davis Ogilvie & Partners Ltd
Level 1, 24 Moorhouse Ave
Christchurch 8140

Dear Clement,

Re. Power Connection for Proposed Subdivision. Lot 1 DP 394101 (2 Auckland St. Ashley).

MainPower confirms that the (11kV Overhead Power Line on Auckland St. Ashley) have the capacity to supply the proposed subdivision.

Please Note that this letter is to advise you that the MainPower NZ Ltd.'s Network has the Capacity for the Proposed subdivision.
This may not mean that there is an electrical supply to the boundary of the proposed lots.

Please do not hesitate to contact the MainPower NZ Ltd NSR Team on 03 311 8311 or NSR@mainPower.co.nz if you have any questions.

Yours faithfully

Danny Vis

Network Services Representative

HURUNUI DISTRICT COUNCIL
P.O. Box 13 | Amberley | 7441 | 66 Carters Road | Amberley | 7410
Phone 03 314-8816 | Fax 03 314-9181 | Email info@hurunui.govt.nz
Web hurunui.govt.nz | facebook.com/HurunuiDistrictCouncil
Skype hdc_customer_services | twitter.com/hurunuidc

AJK Cameron
C/- Davis Ogilvie and Partners Ltd
PO Box 589
CHRISTCHURCH 8140
ATT: Clement Maloney

1 July 2021

Dear Clement,

Water Application Number WS21120 – 2 Auckland Street, Ashley

The Council can confirm that 30 additional water units are available on the Ashley Rural Water Supply for the above address. This modelling approval is conditional to an upgrade to the water line on Lower Sefton Road being completed.

Your responsibilities for the completion of these connection will include the following:

- A full water application for all new connections will be completed and submitted to Hurunui District Council.
- A DN125mm main to be installed down Auckland Street and into the new road shown on the new subdivision.
- A DN63mm sub main to be installed to the North of Auckland Street (please see attached map)

This approval is based on hydraulic modelling and if included within the conditions of a resource consent, will be valid for the duration of that consent. If not, the hydraulic modelling will be valid for the next 12 months. Should you wish to complete a full water application, the modelling fee will not be charged.

Attached please find the modelling invoice for 30 new restricted water supply connections.

Please note that no pipe installation can take place until the full water application has been received.

If you have any questions, please feel free to contact me.

Yours sincerely

Cynthia Otto
Customer and Information Advisor

Phone 03 314-8816
Email cynthia.otto@hurunui.govt.nz


DN125 12 bar main
DN63 12 bar sub main
DN63 12 bar sub main
DN125 12 bar main
DN125 12 bar main
DN125 12 bar main
(to be laid by HDC)

On-site Wastewater Treatment and Disposal at Proposed Subdivision of 2 Auckland Street, Ashley

Prepared for: Alistair Cameron

October 2020

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Quality Control Sheet

TITLE	On-site Wastewater Treatment and Disposal at Proposed Subdivision of 2 Auckland Street, Ashley
CLIENT	Alistair Cameron
JOB NUMBER	J1111

Prepared by:

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Status	Author(s)	Reviewed by	Issue Date
Draft	Fiona Ambury		6/10/2020
Final	Fiona Ambury		25/11/2020

Limitations:

This report has been prepared for Alistair Cameron, according to his instructions, for the particular objectives described in the report. The information contained in the report should not be used by anyone else or for any other purposes.

This report has been prepared on the basis of field work undertaken in June 2020 and information sourced from the Environment Canterbury GIS Database. Whiterock Consulting Ltd has not independently verified the provided information and has relied upon it as being accurate and sufficient for use by Whiterock Consulting Ltd in preparing the report. Whiterock Consulting Ltd accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the provided information.

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1. Introduction

Whiterock Consulting Ltd has been engaged by Alistair Cameron to determine the on-site wastewater options for a proposed subdivision at 2 Auckland Street, Ashley (Figure 1, Appendix A). It is proposed to subdivide the land into 29 lots varying in size from 1,210 m^2 to 8,160 m^2.

This report presents the design concepts for on-site wastewater treatment and disposal systems for the individual lots in the subdivision and assesses the potential effects on the environment from the discharge. A wastewater consent will be required because the lot sizes are less than 4 ha. This report shall be read in conjunction with the wastewater consent application prepared by Davis Ogilvie & Partners Ltd.

2. Site Details

The current site details are as follows:

- Legal description: Lot 1 DP 394101
- Site area: 80,000 m^2 [8 ha]
- Regional Council: Environment Canterbury (ECan)
- District Council: Waimakariri District Council
- Zone: Rural
- Aquifer type: Unconfined/semiconfined
- ECan Listed Land Use Register: No records
- Water supply: Reticulated district supply

A proposed layout of the subdivision is presented in Figure 2, Appendix A.

3. Description of the Environment

3.1 Soils and Geology

The Landcare soils map describes the site soils as generally deep silt loam or moderately deep silt loam. The GNS 1:250000 geological map (Map 16) shows the geology of the site to be 'grey to grey-brown river alluvium of undifferentiated Late Quaternary age (IQa)' for the majority of the site. Approximately 90 m north of the southern boundary this changes to 'grey river alluvium beneath plains or low-level terraces (Q1a)'.

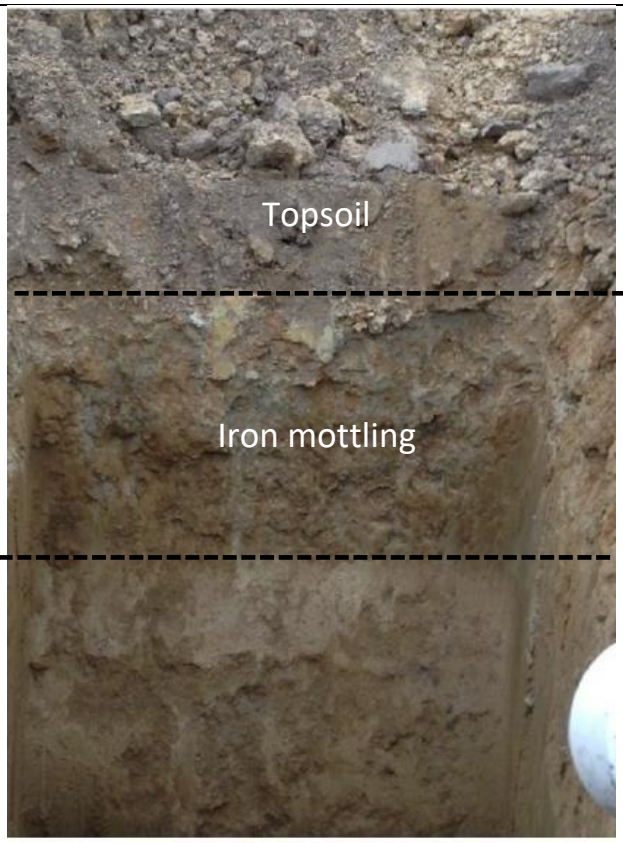
Whiterock Consulting Ltd visited the site on 24 and 25 June 2020 with Davis Ogilvie & Partners Ltd. The purpose of the site work was to dig test pits across the site to determine the subsurface conditions. Infiltration testing was undertaken in selected test holes to assist with the stormwater design. Whiterock Consulting Ltd also did simple bucket soakage tests on the underlying gravels to determine the suitability for the discharge of wastewater to land via disposal beds.

The test pit logs are described in detail in the Davis Ogilvie & Partners Ltd geotechnical report (Davis Ogilvie & Partners Ltd; 29/9/2020) and summarised below in Table 1. The test pit locations are shown on Figure 2, Appendix A.

Table 1: Test Pit Summary				
	Start depths (m)	End depths (m)		Comments
Topsoil	0.0	0.3 – 0.5		
Silt	0.3 – 0.5	1.5 – 4.0		Mottling present at the top of the silt layer and generally decreasing with depth. Indicates a pan or restriction in soakage within silt layer and not a seasonal high groundwater. **Classified as Category 5 in accordance with AS/NZS 1547:2012**
Sandy or silty gravel	1.5 - 4.0	Base of test holes		Orangey brown with dark reddish stained grey gravel. Staining could represent groundwater. Gravels had excellent soakage with respect to the discharge of wastewater. In general, the second 10 L bucket drained in less than 60 seconds. **Classified as Category 1 in accordance with AS/NZS 1547:2012**

Example photos of a test pit and excavated soils are shown below.

Photograph 1: Example test pit (TP8) with groundwater at 3.7 m



Photograph 2: Test pit showing iron mottling below topsoil

Based on the test pit findings, the following disposal methods are recommended:

- **Option 1 [Lots 1 – 13 and Lots 19 – 28]**: sand bed with trench to intercept underlying gravels. Design loading rate = 50 mm/day in accordance with AS/NZS 1547:2012, Table L1.
- **Option 2 [Lots 14 – 18 and Lot 29]**: raised drip irrigation field. Design irrigation rate = 3 mm/day in accordance with AS/NZS 1547:2012, Table L1. The drip irrigation is to be raised to ensure there is at least 600 mm from the drip lines and the iron mottling present in the silt layer.

3.2 Groundwater

Groundwater is expected to flow in a general north-west to south-east direction, sub parallel to the Ashley River. Canterbury Maps shows 10 wells within 1,000 m of the centre of the site, including 4 active wells. These wells are summarised in Table 2 and a wells plot is presented in Appendix B.

Table 2: Groundwater wells close to Lot 3 DP 528638

Well Number	Well Status	Well depth (m)	Distance and direction from centre of site	Highest groundwater reading (metres below ground level)	Number of readings	Years reading were taken
M35/7335	Active	20	470 m SW	-	0	-
M34/0631	Active	11.75	965 m NE	-1.05	4	1996 - 2007
M35/7558	Active	7	285 m SW	-	0	-
M34/0632	Active	8	900 m NE	-2.07	4	1996 - 2007
M34/0194	Not used	6.7	500 n NW	-	0	-
M35/0003	Not used	5.4	845 m SE	-1.09	20	1977 - 1986
M34/0208	Buried	9.8	680 m NW	-5.34	130	1963 - 1986
M34/0800	No info	10	990 m W	-	0	-
M35/0001	Not used	6.4	520 m SW	-	0	-
M34/0385	Not used		720 m NE	-	0	-

Comments on the water level data are summarised below:

- M34/0631: This well is located along a similar groundwater piezometric contour (30 m) as the centre of the site. The Canterbury Maps elevation tool shows that this well is approximately 4 m lower than the centre of the site. Therefore, a corresponding water level at the site is – 5.05 m [-1.05 m -4 m]
- M34/0632: This well is located on land that is shown to be approximately 6 m lower than the centre of the site. It is also located lower down the piezometric contour (approximately 28 m). Therefore, the corresponding water level at the site based on the water level data from this well is – 6.07 m [-2.07 m -6 m + 2 m].
- M35/0003: This well is located near the 25 m piezometric contour line and is approximately 7 m lower than the centre of the site. Therefore, the corresponding water level at the site based on the water level data from this well is – 3.09 m [-1.09 m -7 m + 5 m].

- M34/0208: The water level readings from this well are considered to be more representative of the potential water levels at the site. This well is located upgradient from the site with respect to land contours and piezometric contours. The land contours are expected to be similar to the groundwater piezometric contours. Therefore, the seasonal high groundwater level at the northern end of this site could be -5.34 m.

Groundwater was measured in six of the test pits across the site and the water level readings varied from -5.4 m at northern part of the site to -2.4 m at southern part of the site. There is approximately 3 m of fall across the site from north to south and a similar change in piezometric contour.

Based on the available groundwater level information, the seasonal high depth to groundwater across the site is expected to vary from 2 – 4 m below ground level.

According to Canterbury Maps, the site is located in a Nutrient Allocation Zone that is mapped as "At Risk". The nearest water quality sampling wells are M34/0631 and M34/0632. A single sample has been collected from each well on 16 May 2017 and the relevant results are summarised below:

M34/0631:

- Nitrate nitrogen: 24.2 mg/L

M34/0631:

- Nitrate nitrogen: 3.8 mg/L

There are no faecal coliform or E.Coli readings from wells within 1,000 m of the site. The high nitrate nitrogen reading in well M34/0631 of 24.2 mg/L exceeds the drinking water standard of 11.3 mg/L and is expected to be unusually high given the wider catchment is only classified as "At Risk" with respect to nutrients. This high value is therefore expected to be due to an error or from a localised high source of nitrogen.

The closest public supply wells are located approximately 2,300 m east of the site at the nearest point. With the exception of a single E.Coli sample in 2000 (1 MPN/100 ml, all other faecal coliform and E.Coli samples results were less than one. With respect to nitrate nitrogen, the concentrations range from 0.3 – 1.1 mg/L, which is very low.

3.3 Surface Waterways

Canterbury Maps shows Saltwater Creek approximately 130 m east of the site at its closest point and the Ashley River/Rakahuri approximately 330 m south of the site at its closest point. During the site visit a drain was identified running along the western site boundary. This joins with a drain flowing through the developed land to the west and flows under Lower Sefton Road. A drain runs along the eastern boundary of Lot 1 and the northern and eastern boundaries of Lot 9 before flowing east onto the neighbours property.

There are no surface water quality monitoring sites within 1,000 m of the site.

4. Proposed Wastewater Systems

4.1 Design Overview

The proposed on-site wastewater system comprises a secondary treatment plant discharging to land via either a sand bed or raised drip irrigation field. Secondary treatment has been selected to achieve a higher level of nitrogen removal than a septic tank.

The disposal system is site specific as summarised below:

- **Option 1 [Lots 1 – 13 and Lots 19 – 28]**: sand bed with trench to intercept underlying gravels. Design loading rate = 50 mm/day in accordance with AS/NZS 1547:2012, Table L1.
- **Option 2 [Lots 14 – 18 and Lot 29]**: raised drip irrigation field. Design irrigation rate = 3 mm/day in accordance with AS/NZS 1547:2012, Table L1. The drip irrigation is to be raised to ensure there is at least 600 mm from the drip lines and the iron mottling present in the silt layer.

There will only be a single dwelling per lot and whilst it is expected that they will generally have three to four bedrooms, the ECan consent should allow for up to 6 bedrooms. The design flows per dwelling are summarised below and based on a flow allowance of 200 L/person/day[1]. This will need to be confirmed during the design for individual houses as some houses may use water saving fixtures.

Table 3: Design Flows for different house sizes

Number of bedrooms	Design occupancy	Design daily flow (L/day)	Comments
1	2	400	
2	4	800	
3	5	1000	
4	7	1400	
5	8	1600	
6	10	2000	Will require specific design of the wastewater treatment plant

4.2 Secondary Treatment Unit

- Treatment performance: in accordance with AS/NZS 1546.3:2008:
    - 90% shall have a BOD_5 less than or equal to 20 g/^{3} with no sample greater than 30 g/m^3
    - 90% shall have a TSS less than or equal to 30 g/^{3} with no sample greater than 45 g/m^3

[1] AS/NZS 1547: 2012 Table H3

    - Median total nitrogen concentration shall be less than < 30 g/m^3 [OSET NTP[2] rating C or better]
    - Median faecal coliform count of 10^5 cfu/100 ml or less. This assumes a 2 log_{10} reduction through the treatment plant [OSET NTP rating C or better].
- Treatment units include:
    - Eloy Oxyfix
    - Eloy X-perco [passive filter]
    - Austin Bluewater ABS 2000
    - Alternative secondary system that meets the requirements of AS/NZS 1546.3:2008
    - Note that the above listed treatment units are not large enough for a 6 bedroom house but most technology suppliers can provide larger treatment units. This will be addressed at the design stage for each lot
- Outlet Filter: A 130 micron disc filter is only required if drip irrigation lines are used. It is not to be used if the discharge is to a sand bed.
- Pump: to be determined by on-site wastewater designer. A sand bed will require a high flow and low head pump. A drip irrigation field will require a low flow high head pump.
- Alarm: a high-water level alarm float is to be fitted. The alarm is to be audible to the house.

4.3 Land Application Design Criteria

4.3.1 Sand Bed Design Criteria

- Location: following setbacks to be maintained [these are minimum distances:
    - 10 m from the stormwater soak pits
    - 1.5 m from property boundaries
    - 10 m from drains
- Design Loading Rate to Sand: 50 mm/day [= 50 L/m^2/day]
- Sand Bed areas:
    - 1 bedroom house: 8 m^2 [400 L/day ÷ 50 L/m^2/day]
    - 2 bedroom house: 16 m^2 [800 L/day ÷ 50 L/m^2/day]
    - 3 bedroom house: 20 m^2 [1,000 L/day ÷ 50 L/m^2/day]
    - 4 bedroom house: 28 m^2 [1,400 L/day ÷ 50 L/m^2/day]
    - 5 bedroom house: 32 m^2 [1,600 L/day ÷ 50 L/m^2/day]
    - 6 bedroom house: 40 m^2 [2,000 L/day ÷ 50 L/m^2/day]
- Distribution Pipe: LPED nested 40 mm waste pipe in slotted 100 mm uPVC or 100 mm punched drain coil. Design of the hole size and spacing for the 40 mm pipe will be done during the site specific design.
- Pipe spacing: 600 mm
- Depth of 2A filter sand: 600 mm

[2] OSET NTP is the national testing facility for treatment plants and provides a rating from A to D for set parameters. It presented the results for the median concentrations and not the maximum

- Underdrainage Trench: A drainage trench shall be excavated below the 2A filter sand and shall extend at least 0.5 m into the underlying gravels. This trench shall be at least 1 m wide and extend the full length of the sand bed.

An example cross section is presented in Appendix C.

4.3.2 Raised Drip Irrigation Criteria

- Location: following setbacks to be maintained [these are minimum distances:
  - 10 m from the stormwater soak pits
  - 1.5 m from property boundaries
  - 10 m from drains
- Design Irrigation Rat: 3 mm/day [= 3 L/m^2/day]
- Irrigation Field Areas:
  - 1 bedroom house: 140 m^2 [400 L/day ÷ 3 L/m^2/day]
  - 2 bedroom house: 270 m^2 [800 L/day ÷ 3 L/m^2/day]
  - 3 bedroom house: 335 m^2 [1,000 L/day ÷ 3 L/m^2/day]
  - 4 bedroom house: 470 m^2 [1,400 L/day ÷ 3 L/m^2/day]
  - 5 bedroom house: 535 m^2 [1,600 L/day ÷ 3 L/m^2/day]
  - 6 bedroom house: 670 m^2 [2,000 L/day ÷ 3 L/m^2/day]
- Drip Irrigation Line Specifications:
  - > 2 L/hr pressure compensating, anti-siphon and root resistant drip line;
  - Emitters at 600 mm spacing;
  - Drain down emitters;
  - Example product is Rivulus D5000PC AS (2 L/hr) with copper impregnated emitter to improve root intrusion resistance.
- Pipe spacing: 1 m
- Height of Drip Line: minimum of 300 mm above natural ground level (600 mm above silt layer)
- Drip Line Cover: Minimum of 150 mm of either topsoil (grassed) or mulch if area to be planted in landscape plants.
- Manual flush valves: One flush valve per 100 m of drip line. Flush valves to be mounted on a short post.
- Fencing: drip irrigation field is to be either fenced off or planted with landscape plants in accordance with the Waimakariri District Council fencing guidelines.

An example layout is presented in Appendix C.

5. Assessment of Effects on the Environment

The site is located over an unconfined aquifer and, therefore, the key risk to the environment from an on-site discharge of wastewater to land is the potential effects on the underlying groundwater. The discharge of nitrogen and bacteria have been identified as the key contaminants of interest.

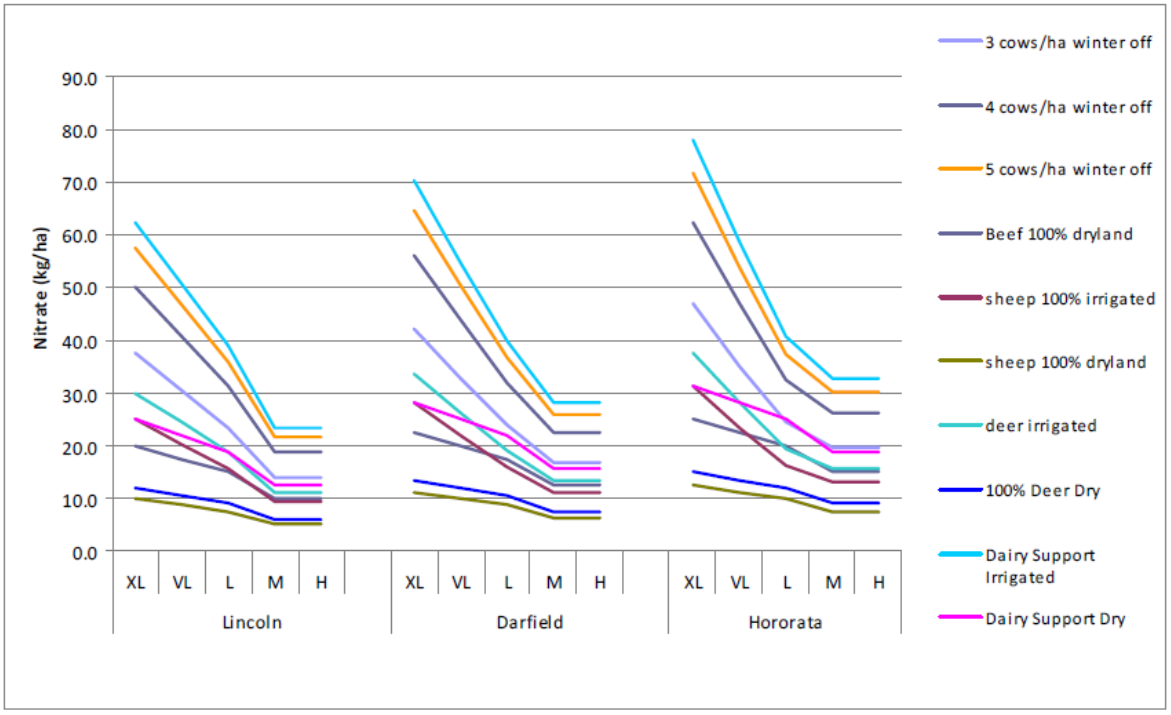
5.1 Total Nitrogen Assessment

The following tables present the Total Nitrogen and Faecal Coliform assessments for a discharge to a sand bed. This is considered to be the worst case scenario because the sand beds are located below ground so there is less separation to groundwater and because there will be no uptake of nitrogen from plants.

Table 4: Total Nitrogen Assessment Per House			
Average occupancy	2.8	people	Based on average occupancy of a domestic house
Days occupancy/year	360		
Concentration of influent	60	mg/L	Domestic wastewater from a house is assumed to have a concentration of 60 mg/L.
TN reduction at treatment plant	50%		Expected for secondary treatment
Average TN concentration after treatment plant	30	mg/L	
TN reduction in sand column	55%		Ref: Crites et al 1998, Table 11-13, p 743(1)
TN concentration after sand column	13.5	mg/L	
Total TN reduction	78%		
TN load to groundwater	**2.7**	**kgN/yr**	
Notes: (1) Crites at al 1998 suggests 45 - 82% TN reduction for secondary treated effluent discharged to a sand bed. 55% has been adopted			

Based on the above assessment, and conservatively assuming the nitrogen loading from a drip irrigation field is the same, the total nitrogen load from the development is estimated to be 78.3 kgN/yr. The total development site is 8 ha and therefore the average load has been calculated to be 9.8 kgN/ha/year [78.3 kgN/yr ÷ 8 ha].

An ECan report titled “Estimated nitrate-nitrogen leaching rates under rural land uses in Canterbury” (L. Liburne et al, September 2010) presents information on estimated nitrogen leaching for different land uses, soil types and stock type. Figure 3-2 (page 12) presents the mass leached according to soil and rainfall for different stock type. The soil type at this site is generally a deep silt loam and would fall into the M or H category used in the report. Figure 3-2 is presented below and shows the mass leaching of nitrogen (kgN/ha) ranges from less than 10 kg/ha for sheep dryland to over 30 kg/ha dairy support irrigated.



The property owner currently grazes cattle on the land and does not irrigate. Assuming 3 cows/ha grazing (winter off) the nitrate loss is estimated to range from 15 kgN/ha (Lincoln) to 20 kgN/ha (Hororata). This is less than the estimated loading from the proposed wastewater systems of 9.8 kgN/ha/yr.

With the exception of a single high nitrogen reading in well M34/0631 (960 m NE of the site), the other background nitrate nitrogen concentrations are relatively low (0.3 mg/L – 3.8 mg/L). Given the expected nitrogen load from the proposed subdivision is less than a paddock used for dry stock grazing of cows, the effects on the underlying groundwater from the discharge of nitrogen to land is expected to be less than minor.

5.2 Faecal Coliform Assessment

The discharge from the proposed wastewater systems have been assessed using the Guidelines for Separation Distances Based on Virus Transport Between Onsite Domestic Wastewater Systems and Wells, published by ESR in 2010 [referred to as the ESR Guidelines]. This report presents virus removal rates through different soil types and aquifer types. Whilst it is primarily focused on virus removal, it can be used to assess bacterial removal.

For domestic on-site systems that are not located within a community drinking water protection zone, modelling viruses is considered to be overly conservative because viruses are only present is someone is sick with the virus. This is outlined in an ECan memo from Marta Scott (5 September 2012) during the development of the Land and Water Regional Plan. Therefore, this assessment looks at the faecal coliform count beyond the property boundary.

The assessment is based on determining the Log_{10} reduction of the faecal coliforms through the following parts of the system:

- Log_{10} removal through treatment tank
- Log_{10} removal through filter sand in disposal bed
- Log_{10} removal through the unsaturated soils/sands below the disposal bed and above the water table [referred to as the vadose zone]
- Log_{10} removal through the aquifer as the groundwater moves away from the source.

Table 5: Faecal Coliform Assessment[(1)]			
Concentration in influent	1.0E+07		
Log_{10} of influent	7.0		
Log_{10} reduction at treatment	2.0		Assumed bacteria reduction through secondary treatment.
Log_{10} of treated effluent	5.0		
Spatial log reduction in sand column	4.5	Log_{10}/m	Ref: EPA932-F-067 Sept 1999[(2)]
Log_{10} reduction in sand column	2.7		
Spatial log_{10} reduction in vadose zone [sandy river run in soakage shafts and natural sandy gravels at depth]	0.8	Log_{10}/m	This is the removal rate for viruses, which are harder to remove than faecal coliforms. Therefore, it is considered to be conservative Ref: ESR Moore et al 2010, Table A17, p 230[(3)]
Log_{10} reduction through vadose zone	1.6		Assumes only 2 m vadose zone below the 2A sand layer (seasonal high groundwater of -3 m). This is the minimum expected at the site where sand beds could be used. The southern lots, where groundwater is shallower, will have a raised drip irrigation field
TOTAL FC log_{10} reduction	6.3		
FC concentration at seasonal high groundwater	**5**	**cfu/100 ml**	

Notes:
(1) ESR Modelling based on Liping Pan (2009) and C. Moore et al 2010
(2) Based on data from an intermittent sand filter
(3) Vadose zone will be sandy gravel. Due to the fines present around the gravels, the alluvial sand (coarse) has been used. Range: 0.15 - 1.52 log/m removal. 0.8 log/m adopted.

The assessment shows that the expected faecal coliform concentration at groundwater (assumed to be 3.0 m below ground level) was calculated to be 5 cfu/100ml. As the groundwater moves away from the source there will be further reduction in the saturated zone. Table A22 of the ESR Guidelines lists removal rates in the aquifer. The removal rate for alluvial gravel is 0.0139 log_{10}/m. To reach a faecal coliform count of 0 cfu/100 ml, an additional 0.7 log_{10} reduction is needed. This is achieved after only 50 m. There are no wells or surface water ways within 50 m downgradient of the lots.

Therefore, the potential effects on the underlying groundwater and surface water from the discharge of bacteria to ground is considered to be less than minor.

5.3 Cumulative Effects

Ashley township is predominately located to the west from the proposed subdivision. According to the legal title information on Canterbury there are approximately 120 sections ranging in size from 600 m^2 to 6,000 m^2. These are bounded to the north and west by larger rural lifestyle properties. There is no reticulated wastewater system for the township and therefore all of the houses will treat and dispose of wastewater to land with within the section or as part of a small cluster system. A review of nearby wastewater consents shows that most of these systems are septic tank with a sand bed. In many instances drilled soakage shafts are used to discharge the wastewater to the deeper underlying gravels after treatment in the sand bed.

The proposed subdivision is located to the east (cross gradient with respect to groundwater flow) of the densely developed part of Ashley Township. Therefore, discharges from the subdivision will not be adding nitrogen directly to the groundwater that passes beneath the densely developed part of Ashley township. This will reduce the cumulative impact on that groundwater prior to it entering the Ashley River. Whilst the discharge from the development will be contributing nitrogen into the environment, it is considered to be less than if the land was used for dry stock grazing of cows. Therefore, the cumulative effects on the receiving environment are expected to be no more than minor.

6. Conclusion

Alistair Cameron proposes to subdivide an 8 ha rural block into 29 residential lots varying in size from 1,210 m^2 to 8,160 m^2. There is no reticulated wastewater system to connect into and therefore, the domestic wastewater from each lot will be treated and disposed of to land within the lot. It is proposed to use secondary treatment systems to increase the nitrogen removal from the wastewater prior to disposal to land either via a sand bed or raised irrigation mound. This is considered to represent best practice design for this site.

An assessment of effects of the discharge of nitrogen and faecal coliforms has found that the potential effects on the environment are less than minor.

7. References

C. Moore, C. Nokes, B. Loe, M. Close, L. Pang, V. Smith, S. Osbaldiston. Guidelines for separation distances based on virus transport between on-site domestic wastewater systems and wells. ESR report No. CSC1001. 2010.

Crites, R. and G. Tchobanoglous. Small and Decentralized Wastewater Management Systems. 1998

L. Liburne, T. Webb, R. Ford, V Bidwell. Estimating nitrate-nitrogen leaching rates under rural land uses in Canterbury. Environment Canterbury report R10/127 September 2010

US EPA. Wastewater Technology Fact Sheet Intermittent Sand Filters. EPA 932-F-99-067 September 1999.

APPENDIX A: FIGURES

Figure 1: Site Location

N

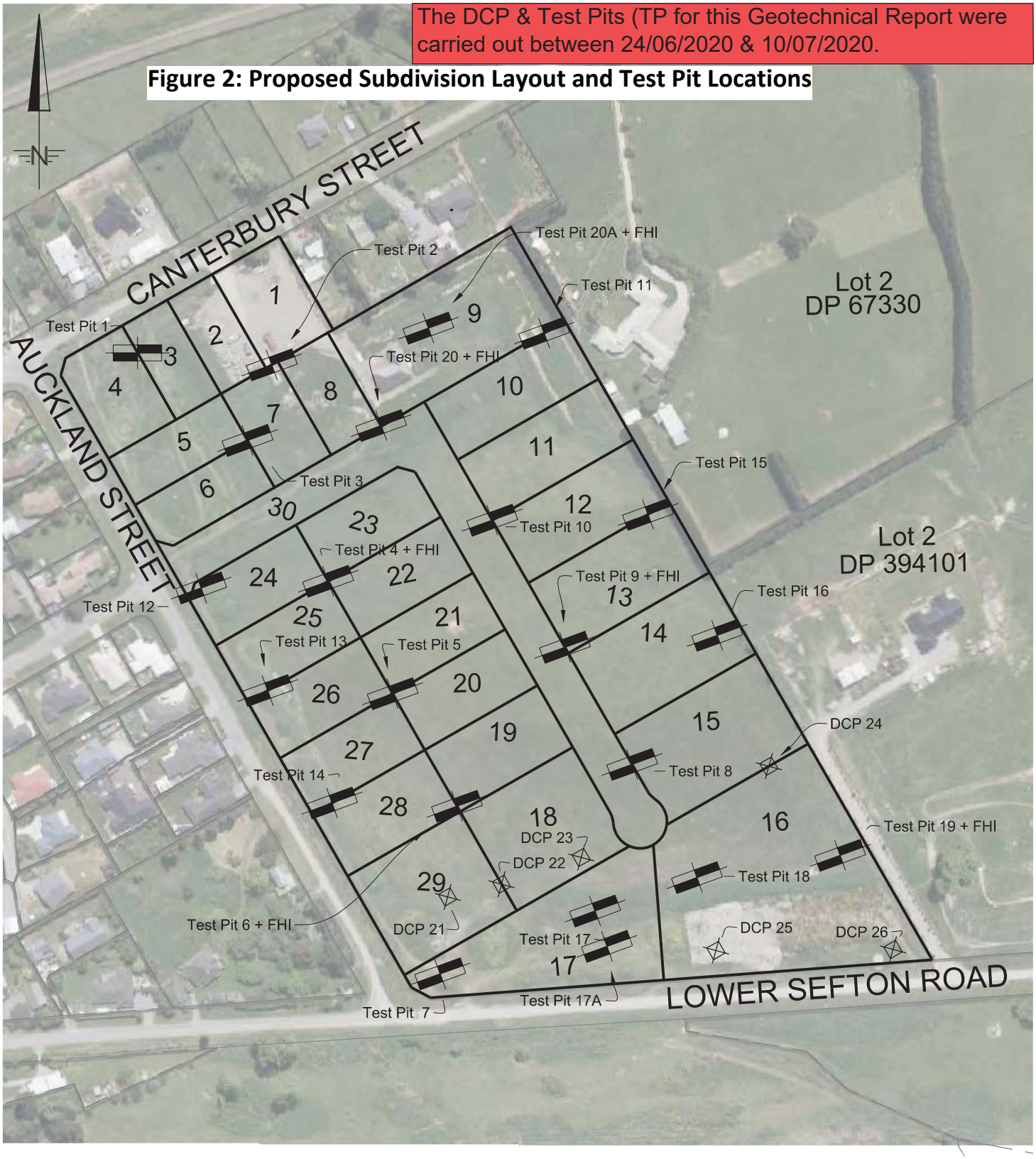
0 0.15 0.3 0.45 0.6 Kilometres

Scale: 1:12,000 @A4

Map Created by Canterbury Maps on 6/10/2020 at 4:31 PM

The DCP & Test Pits (TP for this Geotechnical Report were carried out between 24/06/2020 & 10/07/2020.

Figure 2: Proposed Subdivision Layout and Test Pit Locations



Test locations are approximate (scaled and aligned using aerial imagery).
Aerial image obtained from Canterbury Maps
Boundaries are taken from Quickmap and are indicative only.
Proposed lots taken from DO drawing GM37095 101A dated 09/2020.

0m 50m 100m 150m 200m 250m

Scale 1:2500

A	08/20	Geotechnical Report Diagram	HC
/ issue	/ date	/ reason	/ approved

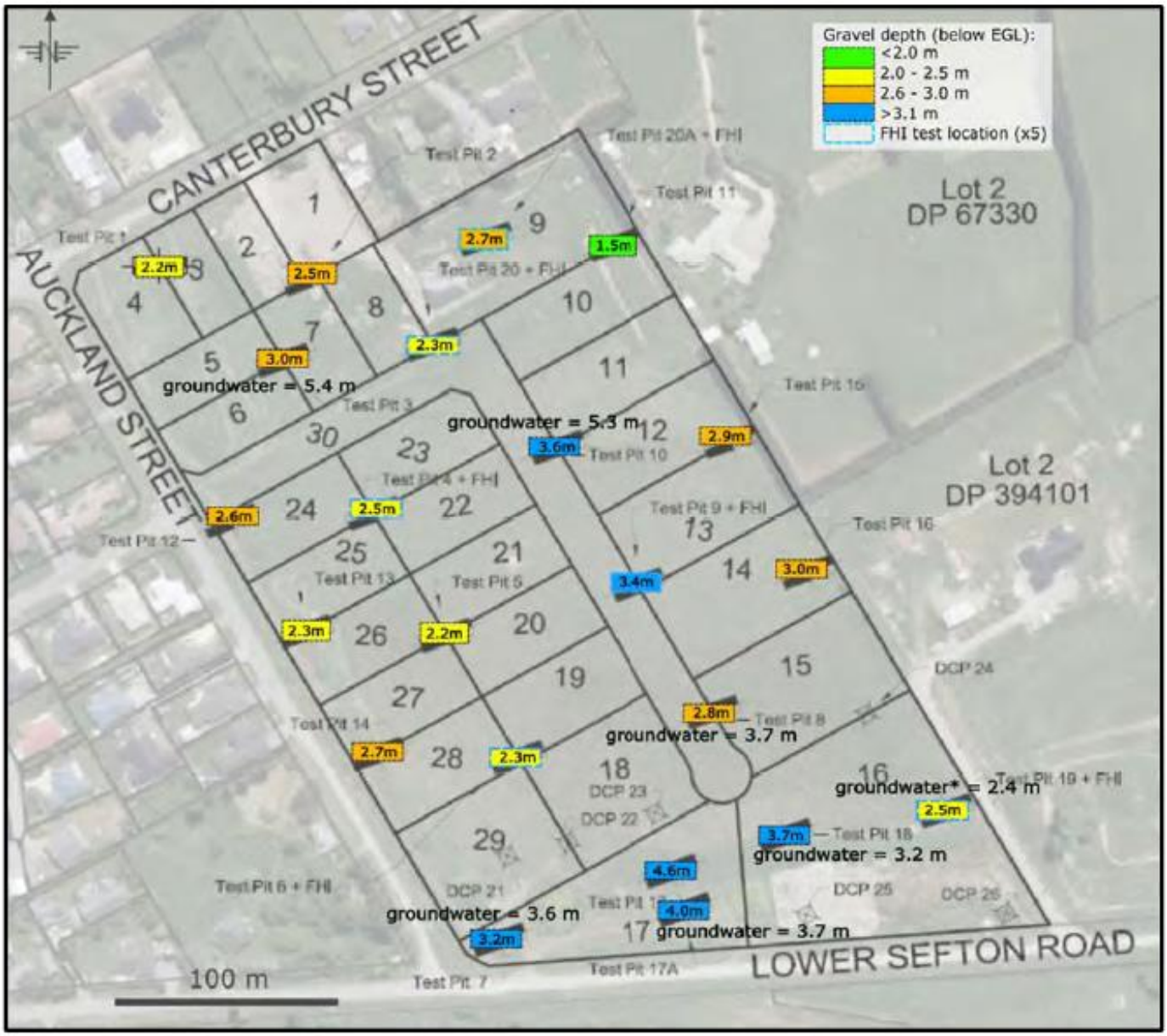
CAD ref: 37905.200617.Geotechnical Site Plan G01A

DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS
Davis Ogilvie & Partners Ltd - Ph. 0800 999 333

Geotechnical Site Plan
Auckland Street Subdivision
Lot 1 DP 394101

/ design	/ drawn	/ QA check	/ dwg
AB+HC	KL	HC	G01
/ scale @ A4	/ date	/ file	/ issue
1:2500	08/20	37211	A

Figure 3: Depth to Gravel and Recorded Groundwater Levels



Source: Davis Ogilvie, Figure 8, Geotechnical Report

APPENDIX B: WELLS PLOT

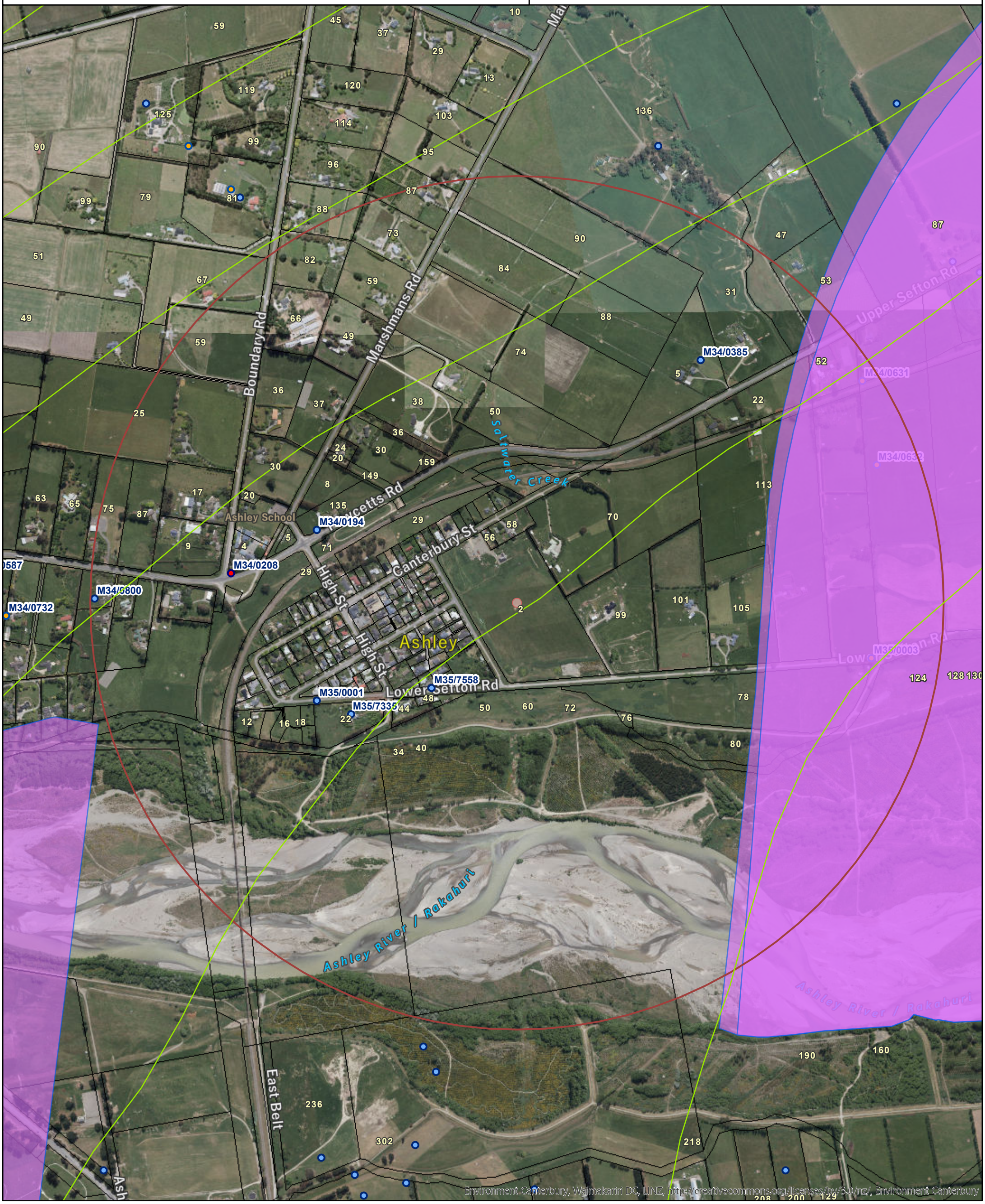
Wells Plot

N

0 0.15 0.3 0.45 0.6 Kilometres

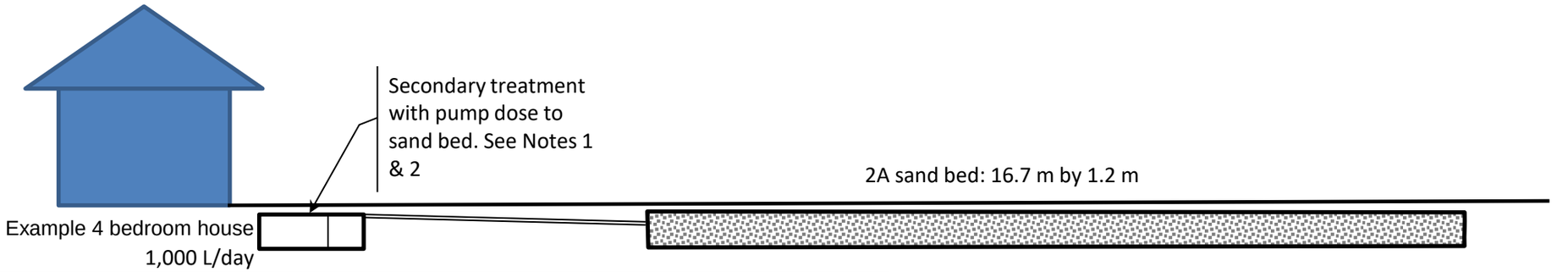
Scale: 1:8,000 @A3

Map Created by Canterbury Maps on 5/10/2020 at 4:59 PM



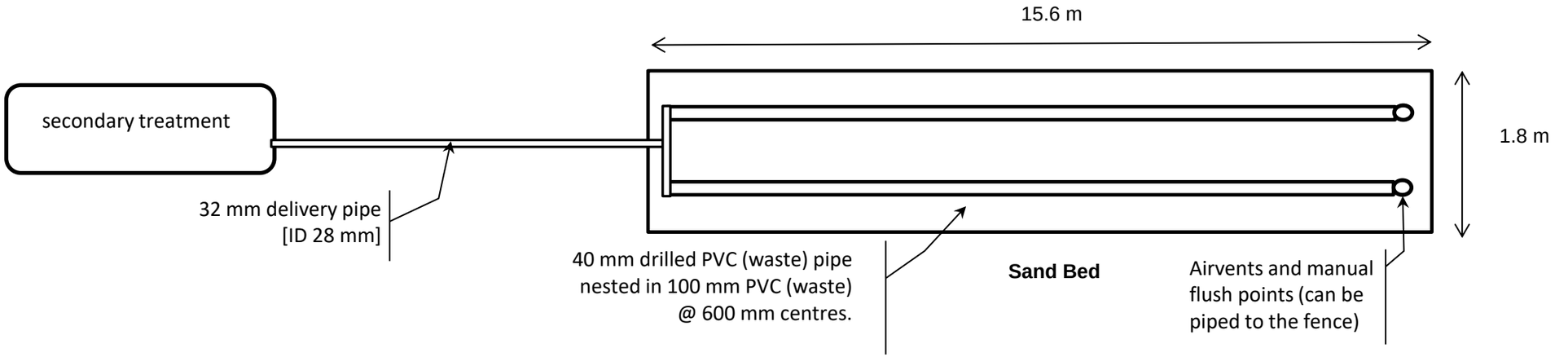
APPENDIX C: EXAMPLE WASTEWATER DISPOSAL SYSTEM CROSS SECTIONS

2 Auckland St
Flow Diagram



Notes:
1. Pump duty: 8 m head at a flow 85 L/min [BAV400 or alternative low head high flow pump]
2. Proprietary filter is within the treatment tank. Do not include disc filter

Plan View of Disposal Field



Whiterock
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Environmental Engineer
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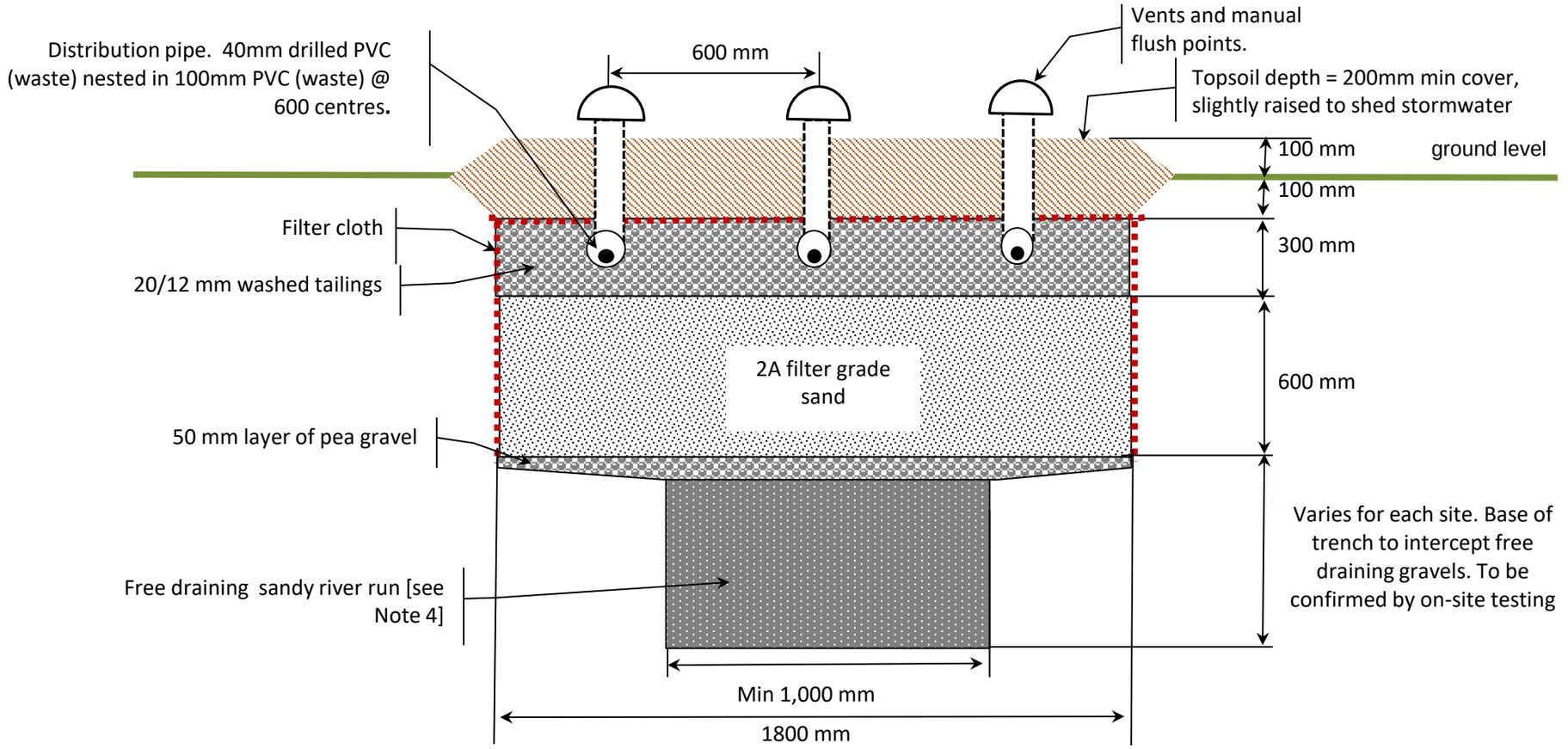
PH: 03 312 8830
Mobile: 027 480 4883
email: fiona@whiterockconsulting.co.nz

Site:	2 Auckland St	Job No:	J1111	Date:	25/11/2020
Client:	Cameron	Designed by:	FA	Scale:	NOT TO SCALE
Sheet No:	1			Version:	consenting

Example Section Through Sand Bed



Notes:

1. 100mm access vents to the surface are required at far end of the trench.
2. Access to a flushing valve or screw cap is required at the end of each of the 40mm nested distribution pipes.
3. Base of trench to be level.
4. Well graded sandy river run to contain no fines.

Whiterock

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Client:	Cameron	Designed by:	FA	Scale:	NOT TO SCALE
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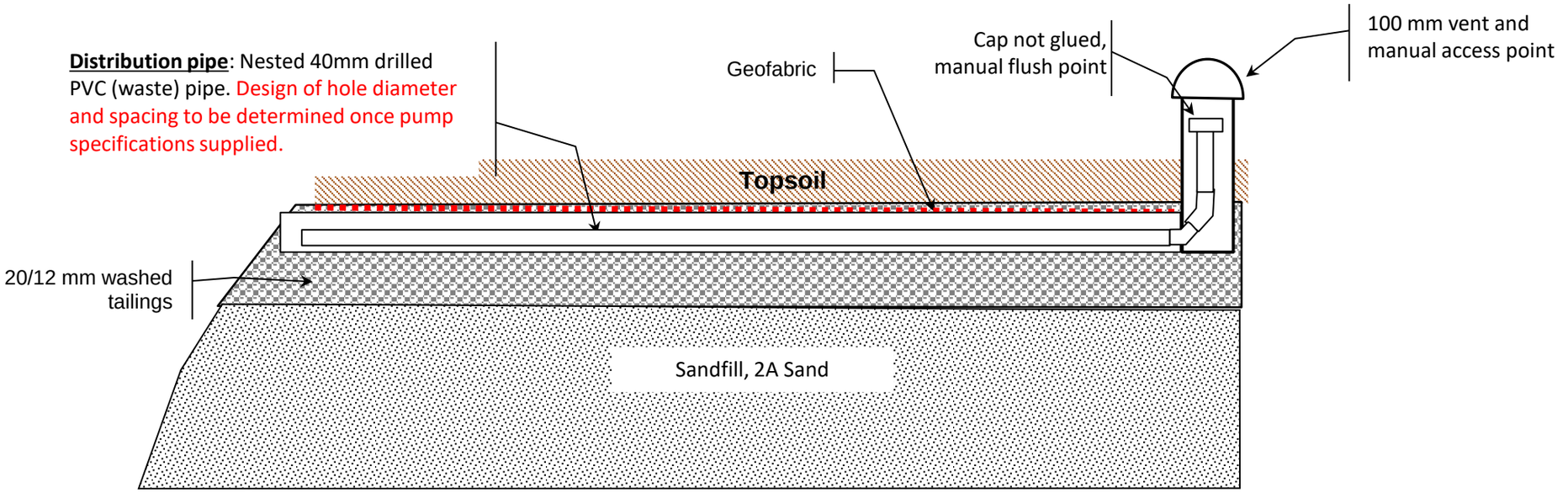
Side Elevation of Sand Bed



Important: Soakage test during installation.

When excavating the soakage trench beneath the sand bed, check soakage rate at the base as follows:

- Pre- wet the base with 10L of water.
- Allow to completely drain into soil
- Add another 10L of water and record the time for complete soakage.
- If the soakage time is greater than 3 min increase depth of trench until soakage is less than 3 min. Record test result on Installation Certificate (PS3)

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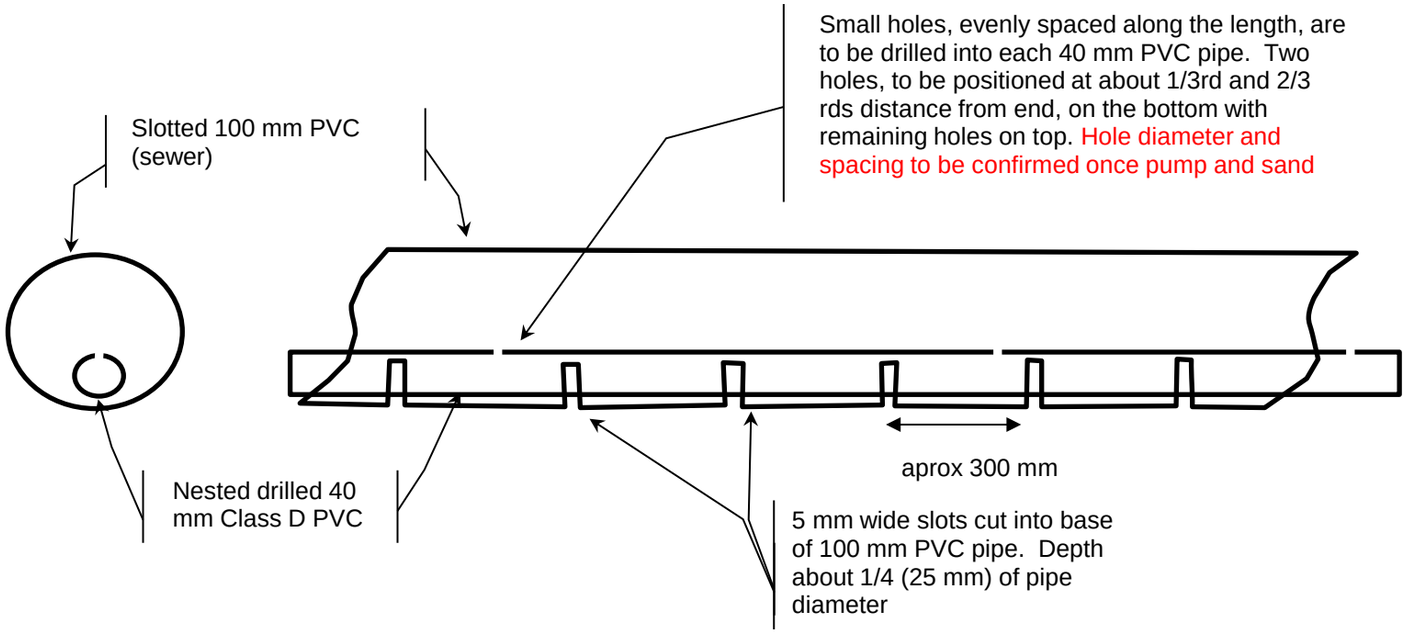
Distribution Pipe Details



Notes.
1. Distribution pipe design depends on pump specification (brand and model), distance from pump to sand trench and change in elevation. Once the final trench location is determined and the pump specification are provided Whiterock Consulting Ltd will provide the following details:
- recommended diameter of delivery pipe from pump to sand trench
- hole diameter and spacing in each 40 mm distribution pipe

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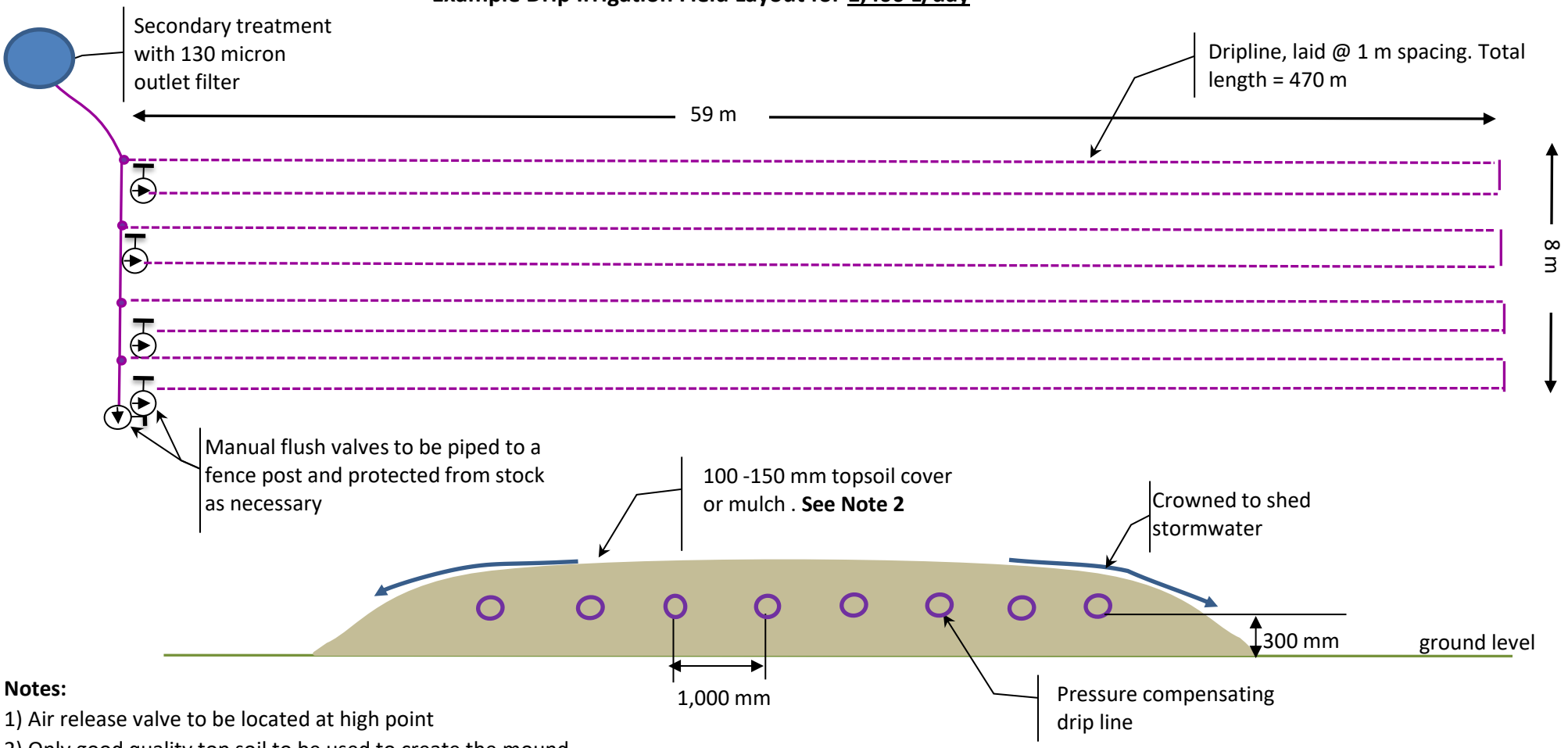
Example Drip Irrigation Field Layout for 1,400 L/day



Notes:

1) Air release valve to be located at high point
2) Only good quality top soil to be used to create the mound
3) Do not over compact the area where the effluent field will be located

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Site:	2 Auckland St	Job No:	J1111	Date:	25/11/2020
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DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS

GEOTECHNICAL REPORT FOR SUBDIVISION

37211 / 2 AUCKLAND STREET, ASHLEY / ALISTAIR CAMERON

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Davis Ogilvie & Partners Ltd

QUALITY ASSURANCE

Title:	Geotechnical Report For Subdivision: 2 Auckland Street, Ashley
Client:	Alistair Cameron
File Location:	T:\projects\37s\37211 - 2 Auckland Street, Ashley\Geotech\003 Report\200928.hc.2AucklandStreet_Geotech_FINALv1.docx
Version:	1
Date:	29 September 2020
Project No:	37211

Prepared By:	**Hamish Cattell** Engineering Geologist PhD, MEngNZ	**Signature:**
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Authorised By:	**Joanna Lea Petheram** Senior Engineering Geologist MSc (Hons), CMEngNZ (PEngGeol)	**Signature:**

DISCLAIMER

This report has been prepared at the specific instructions of Alistair Cameron, and concerns 2 Auckland Street, Ashley, Waimakariri. The site is legally described as Lot 1 DP 394101 (Title 376526). This report provides a geotechnical assessment of the land underlying the site and a review of geotechnical information.

Davis Ogilvie did not perform a complete assessment of all possible conditions or circumstances that may exist at the site. Conditions may exist which were undetectable given the limited investigation of the site. Variations in conditions may occur between test locations, and there may be conditions onsite which have not been revealed by the investigation, which have not been taken into account in the report.

Davis Ogilvie's opinions are based upon information that existed at the time of the production of the document. Assessments made in this report are based on the conditions found onsite and published sources detailing the recommended investigation methodologies described. No warranty is included; either expressed or implied that the actual conditions will conform to the assessments contained in this report.

Information herein was created from maps and/or data from the New Zealand Geotechnical Database (https://www.nzgd.org.nz) which were prepared and/or compiled for the Earthquake Commission (EQC) to assist in assessing insurance claims made under the Earthquake Commission Act 1993. The source maps and data were not intended for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability for any use of the maps and data or for the consequences of any person relying on them in any way.

Only Alistair Cameron and the Local and Regional Territorial Authorities are entitled to rely upon this engineering report. Davis Ogilvie & Partners Ltd accepts no liability to anyone other than Alistair Cameron in any way in relation to this report and the content of it and any direct or indirect effect this engineering report may have. Davis Ogilvie & Partners Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

Should anyone wish to discuss the content of this report with Davis Ogilvie & Partners Ltd, they are welcome to contact us on (03) 366 1653 or at Level 1, 24 Moorhouse Ave, Addington, Christchurch.

EXECUTIVE SUMMARY

Davis Ogilvie & Partners Ltd was engaged by Alistair Cameron to undertake a geotechnical investigation of the site at 2 Auckland Street, Ashley. The purpose of the geotechnical investigation was to investigate the underlying ground conditions, assess natural hazards, and provide recommendations regarding residential foundations and civil infrastructure to support a subdivision consent application for 28 proposed residential lots.

Across the 8.0 ha site, Davis Ogilvie oversaw the excavation of 22 Test Pits and 26 Dynamic Cone Penetrometers. The shallow soil profile generally consisted of a surficial topsoil layer overlying a unit of silt, which ranged from 1.1 to 3.7 m thick, then dense silty and sandy gravel. Groundwater was encountered at between 2.4 – 5.4 m below existing ground level (EGL). Observations of the soil and groundwater conditions indicate liquefaction-induced settlement is unlikely and a liquefaction vulnerability risk of 'very low' to 'low' is considered appropriate.

Based on the in-situ DCP testing, a static Ultimate Bearing Capacity (UBC) of 300 kPa was achieved at depths ranging from 0.5 – 2.4 m below EGL. The maximum depth to which 'good ground' has been assigned at the site is 0.6 m, above which standard (NZS 3604:2011) foundation options are considered suitable. Recommended foundation options where 'good ground' has been achieved include NZS 3604 concrete slab or piles for suspended floors founded at a depth where 300 kPa has been confirmed. In areas where the depth to 300 kPa UBC exceeds 0.6 m below EGL, an UBC of 200 kPa is recommended with Specific Engineering Design for foundations.

Flood hazard information from Waimakariri District Council suggests the site has 'no identified inundation' risk to a 'low risk of inundation'.

For pavement design, it is recommended that a subgrade Californian Bearing Ratio of 4 be adopted. Stormwater management on each lot is expected to be discharged to ground via soak pits. Falling Head Infiltration testing in the underlying gravelly soils returned average initial rates of between 1.8 – 3.0 m/hr, and ultimate rates ranged between 0.3 – 0.6 m/hr.

The site is considered suitable for residential development under Section 106 of the Resource Management Act (1991) in regards to natural hazards, subject to the following conditions:

- Site-specific geotechnical investigation at building consent stage will be required to determine the depth to an appropriate bearing capacity at the location of each dwelling;
- Finished floor levels are confirmed during the consenting process by Waimakariri District Council and/or Environment Canterbury;
- Specific engineering design, observation and certification will be required on proposed Lots 16 and 17 to address the reduced bearing capacity and possible low liquefaction risk identified in this area.

TABLE OF CONTENTS

1.0 INTRODUCTION

Davis Ogilvie & Partners Ltd (DO) was engaged by Alistair Cameron (the client), to carry out a geotechnical investigation at 2 Auckland Street, Ashley, Waimakariri District, legally known as Lot 1 DP 394101, held under title 376526. The purpose of the geotechnical investigation was to investigate the underlying ground conditions, assess natural hazards, and provide recommendations regarding residential foundations and civil infrastructure to support your subdivision consent application for 28 proposed residential lots.

1.1 Site Description

The site is located in the North Canterbury town of Ashley, approximately 6.6 km west of State Highway 1 (Main North Road), and 3.0 km north-east of Rangiora town centre (Figure 1). The land parcel is zoned 'Rural'[1] and is bounded by Canterbury Street to the north, Auckland Street to the west, Lower Sefton Road to the south, and developed rural-residential land to the east.

The 400 m wide Ashley River channel is 320 m south of the site, and is separated from the site by a raised flood bank and Lower Sefton Road. A narrow waterway, Saltwater Creek, flows through adjacent farmland, 135 m east of the site. In the north-eastern corner of the site, the original channel (that can be observed in historical aerial photographs[20]) has been diverted into a man-made drainage channel which runs along the north boundary and northern half of the eastern boundary. Bunds formed from excavation of the channel remain in this area. The channel contained still to low-flow water at the time of the site walkover. An overgrown drainage swale containing still water also runs along the western boundary, parallel to Auckland Street.

The site comprises an approximately semi-rectangular area of 8.0 hectares (80,000 m^2), and is largely undeveloped grassed farmland. Existing developed residential land parcels (Lots 1 DP 5992 and Pt RS 1294) located immediately north of the subject land area are not within the subject site; however, a recently relocated dwelling (located within proposed Lot 9) and temporary storage yard and stockpile area are included in the north of the site, as seen in Figure 2. In the south of the site and along the western boundary, the land area has also been used to stockpile topsoil and gravel. The resulting land surface is irregular and is overgrown by vegetation.

The land is generally flat to undulating, with a gentle overall slope towards the Ashley River in the south to south-east. According to an existing topographical survey of the site[2], there is an overall elevation differential of approximately 5.0 m between the north-west and south-east boundaries of the property. A recent oblique aerial photo of the site is shown in Figure 2.

[1] Waimakariri District Council – District Plan accessed via https://waimakariri.isoplan.co.nz/eplan/#/Property/15548, accessed August 2020.
[2] Survey plan provided by the client: Topography Survey of Lot 2 DP 71999 (Base Plot) - 1:1,000. Details of surveyor and date of approval are not legible in the copy provided. Based on features in the survey, it is understood to have been undertaken mid-1990s.

Figure 1: Topo50 map[3] showing the site location (red arrow) relative to nearby features. Grid size is equal to 1 km².

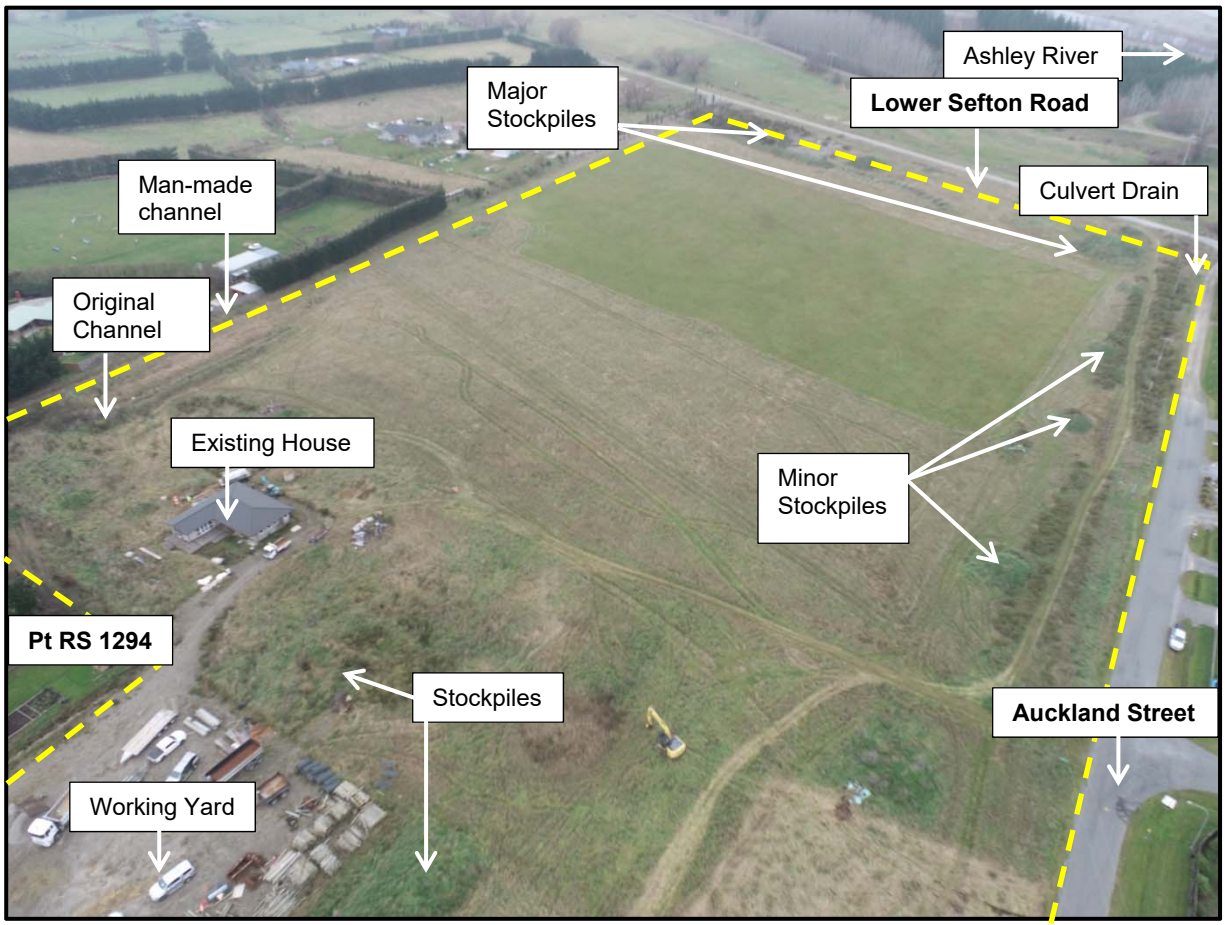

Figure 2: Oblique aerial photograph of the site (yellow dash line is approximate boundary), orientated south-east. Photo dated 24 June 2020.

[3] Topo50 Maps accessed from https://data.linz.govt.nz/layer/50767-nz-topo50-maps/

1.2 Proposed Development

Based on the scheme plan for the site, the proposed development is to include subdividing the 8.0 ha site into approximately 28 residential lots plus a stormwater disposal area in the south (Lot 17) and access road (Lot 30), as shown in Figure 3[4]. The lots are to be served by a single cul-de-sac road proposed at the existing Wellington Street and Auckland Street intersection. The proposed residential lots range between 1,210 – 9,110 m^2, with most being in the order of 1,800 – 2,600 m^2.

Figure 3: Proposed scheme plan (dated 09/20) showing test pit locations, a recent aerial image[5] and an overlay of existing topographical contour plan[2]. Contour intervals are 0.2 m (blue) and 1.0 m (red). Note that the existing "original dwelling" marked on the topographical contour plan in the area of proposed Lot 8 was removed prior to this investigation.

[4] Davis Ogilvie – GM37211 – Proposed Subdivision of Lot 1 DP394101, DWG 101-A, 2 pages, dated 09/20.
[5] Canterbury Maps Viewer – Imagery Basemaps: Latest Imagery, accessed via https://mapviewer.canterburymaps.govt.nz/

2.0 REVIEW OF PUBLISHED INFORMATION

A detailed review of published information regarding the site is provided in following sections.

2.1 Site Geology

The published geology of the site is identified as "Grey to grey-brown river alluvium of undifferentiated Late Quaternary age (lQa)" covering most of the site[6]. A mapped geological boundary is located approximately 90 m north of the southern boundary of the site, striking north-east/south-west where the geology changes to modern river (Holocene) floodplain deposits of "Grey river alluvium beneath plains or low-level terraces (Q1a)". A further geological boundary is mapped 40 m south of the site where the geology changes to active floodplain deposits of "Grey river alluvium, comprising gravel, sand and silt, in active floodplains (Q1a_af)", as shown in Figure 4.

Geomorphic mapping of the area[7] inidcates that the site is largely covered by the Okuku aggradation surface (15 – 25 Ka), with the Ashley Fan alluvial surface (<2.4 Ka) and an area of "riverbed reclaimed by stopbanks" narrowly present in the south of the site.

Presently, no existing geotechnical test information from the New Zealand Geotechnical Database (NZGD) is availble in the immediate area. Boreholes drilled near the Ashley River Bridge[8], 1.6 km west of the site, shows the deep underlying soil profile consisting of sandy gravel with several ~1.0 m thick beds of gravelly clay or gravelly silt encountered to the termaination depth at 25 m.

[6] Forsyth, P.J.; Barrell, D.J.A.; Jongens, R. (compilers) 2008. Geology of the Christchurch area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 16. 1 sheet + 67 p. Lower Hutt, New Zealand. GNS Science.
[7] Environment Canterbury (2002) *Map 4.3 Ashley River Floodplain Management Plan: Floodplain Geomorphology*. Major Revision by McPherson & Cameron Associates, Geological Field Services, Christchurch, March 2002. Drafting by Ryan Elley, GIS Section of Environment Canterbury, March 2002.
[8] NZGD boreholes BH_31944 and BH_31945 (Opus Job 6-DHLHB.00) drilled July 2013.

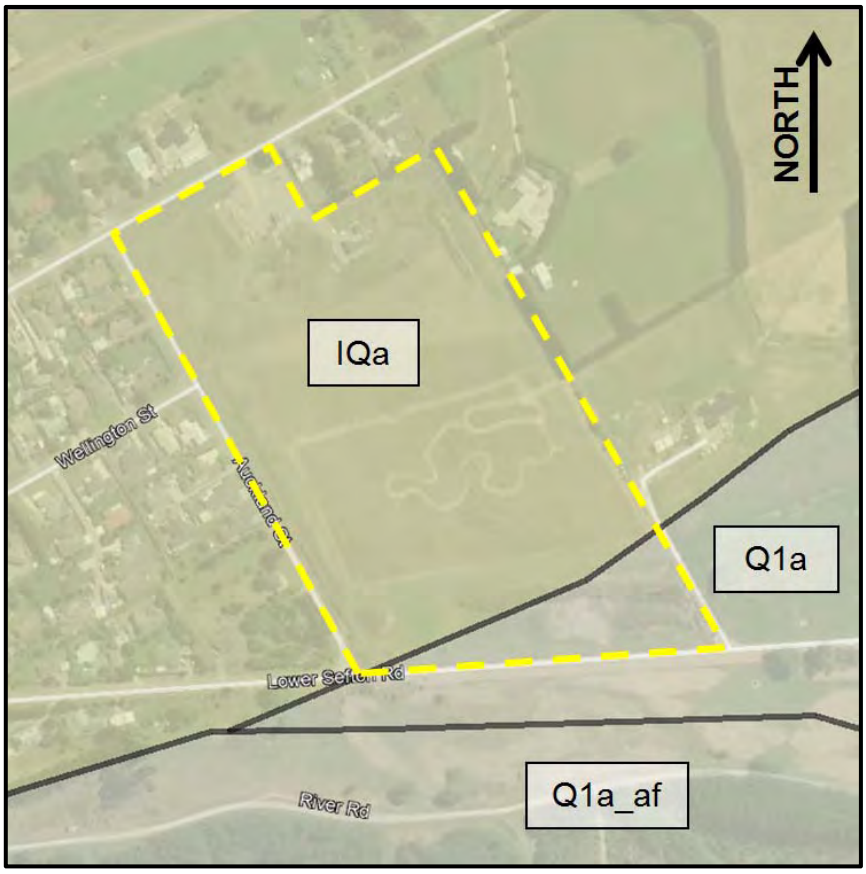

Figure 4: Mapped Geological boundaries in the area of 2 Auckland Street with labelled geological units[6]. The approximate outline of the site is shown by the yellow dashed line.

2.2 Groundwater

The closest existing groundwater wells publically available via Environment Canterbury (ECan)[9] are 160 – 410 m west of the site (M35/0001, M35/7335 and M35/7558). The wells all show a calculated (minimum 80%) depth to groundwater of approximately 3.7 m below ground level.

Groundwater depths in well M34/0208, 480 m west of the site near the intersection of Fawcetts and Boundary Roads, were recorded during a 23 year period between 1963 and 1986. The results are presented in Figure 5 and show a median depth to groundwater during this period of 5.9 m below ground level, and a minimum depth of 5.3 m at this location.

[9] ECan Well Search accessed from https://www.ecan.govt.nz/data/well-search/

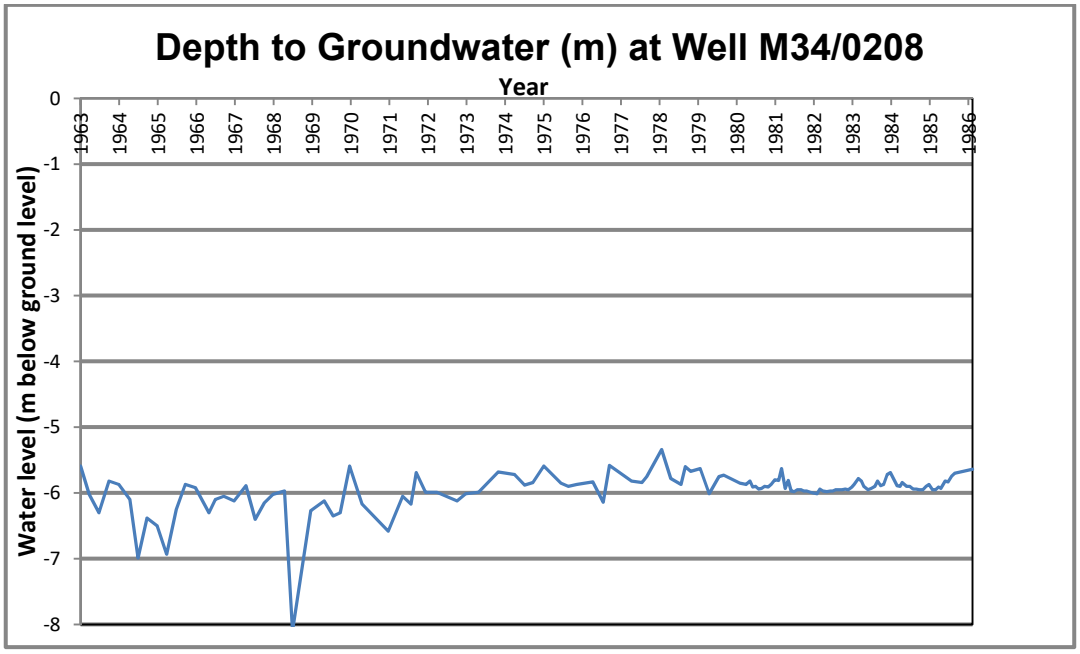

Figure 5: Groundwater monitoring data from well M34/0208 (480 m from the site) showing measured depths to groundwater below ground level (in meters) between 1963 to 1986 (generally 3 to 4 measurements recorded annually).

2.3 Seismicity and Liquefaction Hazard

The nearest known major active faults listed in the NZS 1170.5:2004 are the Alpine (100 km north-west of the site), Kakapo (70 km, north-north-west), Hope (80 km, north and north-west) and the Kelly Fault (88 km north-west).

According to the GNS Active Fault Database[10], faults below the Canterbury planes nearest to the site include the east-west trending Loburn Fault (1.3 km, north-west and north of the site) and Ashley Fault (4.0 km, west of the site). These faults are within a 'hybrid zone' of fault relative movement below a zone of dominantly thrust faulting to the north and dominantly strike-slip faulting to the south[11,12]. The site is not presently mapped by the WDC as being in a Fault Avoidance Zone[13,14].

[10] GNS Active Fault Database available at http://data.gns.cri.nz/af/
[11] R Sisson, J Campbell, J Pettinga, D Milner – Paleoseismicity of the Ashley & Loburn Faults, North Canterbury, New Zealand – Natural Hazards Research Centre, Department of Geological Sciences, University of Canterbury (EQC funded project 97/237)
[12] Pettinga, J.R., Chamberlain, C.G., Yetton, M.D., Van Dissen, R.J. and Downes, G. (1998). Earthquake Hazard and Risk Assessment Study (Stage 1 – Part A); Earthquake Source Identification and Characterisation. Canterbury Regional Council Publication U98/10.
[13] Waimakariri District Plan Hazards Map from: https://waimakariri.maps.arcgis.com/apps/webappviewer/index.html?id=a1508164fb474825bd34c34eebfadc46
[14] Canterbury Maps - Earthquake Faults Map from: https://canterburymaps.govt.nz/map?webmap=f716b840dc434c009e8f74f644a271d6

The site is mapped by the Ministry of Business of Innovation, Business and Employment (MBIE) As "N/A – Rural and Unmapped"[15]. According to the ECan Liquefaction Assessment Area map[16], the site is zoned within a broad area classified as "damaging liquefaction unlikely". The zone defined as "liquefaction assessment needed" occurs from 560 m east of the site and continues towards the coast. The nearest mapped area of "possible flooding by sediment, possibly related to liquefaction" by ECan is 50 m north of the site[17] following the 2010/2011 Christchurch Earthquake Sequence. The corresponding area of "probable observed liquefaction at the surface" is some 650 m west of the site, north of Ashley River Bridge[17].

In summary, the site is not presently mapped in any areas of concern with respect to the seismic hazard.

2.4 Flood Management Finished Floor Levels

According to the WDC 1:200 year (0.5% AEP) flood hazard map (provided in Appendix B), the site is modelled as being within an area of "no identified inundation" risk (no colour mapped) or "low risk of inundation" (mapped in green). Areas of "low" to "medium inundation risk" (mapped blue) areas are identified to the east (Saltwater Creek), south and west (unnamed waterway) of the site.

Communications with WDC staff state that *"the minimum Finished Floor Level (FFL) for a proposed dwelling site at 2 Auckland Street, Ashley (Lot 1 DP 394101) is to be set no lower than 400 mm above undisturbed ground at any point intersecting the building footprint and outside Councils mapped 0.5& AEP (1:200 year) Flood Hazard Areas."* Full communications with WDC are also included in Appendix B.

It is recommended that finished floor level requirements are confirmed with ECan and the WDC at the building consent stage.

According to the WDC Flood Hazard Management Strategy report (2008)[18], the site is not in a modelled area of an Ashley River flood breakout for the predicted 1:100 to 1:500 year events, with most modelled breakouts occurring to the south of the river (towards Rangiora).

[15] New Zealand Geotechnical Database - MBIE Residential Foundation Technical Categories - Map CGD5020.
[16] Environment Canterbury "Liquefaction assessment area map for the eastern Canterbury project area" released in January 2013. New Zealand Geotechnical Database Map CGD5140 - 19 Feb 2013.
[17] Review of liquefaction hazard information in eastern Canterbury, including Christchurch City and parts of Selwyn, Waimakariri and Hurunui Districts. Environment Canterbury Report R12/83. December 2012.
[18] Oliver, A.K.C. (2008). Waimakariri District Flood Hazard Management Strategy – Ashley River Floodplain Investigation. Environment Canterbury Report No. R08/23 ISBN 978-1- 86937-804-2. Christchurch, New Zealand.

2.5 Environment Canterbury Listed Land Use Register

The property is not included on the ECan Listed Land Use Register (LLUR). Please note, this does not confirm that the site is not contaminated; however, it does show there are no known historical listed land uses that may have caused elevated levels of potentially harmful contaminants.

2.6 Aerial Imagery

A summary of the observations made from publically available aerial imagery is provided below[19,20,21]:

- The earliest aerial imagery of the site from 1941 shows the site as mostly undeveloped agricultural land with 5 to 6 buildings on the northern half of the site. These appear to be farm buildings/sheds with a probable dwelling and auxiliary buildings central to the north of the site (proposed Lot 8 area).
- A clear channel depression crosses the north-east corner of the site (near the original dwelling), and connects to a water race in the west near Saltwater Creek.
- A silo structure appears in the 1970 photo between one of the auxiliary buildings and the dwelling. Imagery from 1994 shows all farm buildings removed, apart from the dwelling and sheds directly next to the dwelling. By 2000, the dwelling (in proposed Lot 8) was also removed.
- Ground disturbance along the north-east property boundary can be seen in the 2000 photo. The dwelling has been removed from the site by 2004 but two shed-sized buildings remain.
- The gravel work platform and soil storage area off Canterbury Street was constructed by mid-2016.
- The dwelling in the area of proposed Lot 9 (central north of site) was relocated on site and the surrounding ground was prepared in early-2017.
- Following this, no significant change at the site can be observed to the present day.

3.0 GEOTECHNICAL INVESTIGATION AND RESULTS

Davis Ogilvie conducted geotechnical testing on the site between 24 June and 10 July 2020. The testing comprised 22 machine-excavated Test Pits (TP) with 26 Dynamic Cone Penetrometer (DCP) testing.

TPs were excavated to between 1.6 to 5.4 m below Existing Ground Level (EGL). DCPs were advanced to between 1.1 and 3.9 m below EGL, terminating at practical refusal or at a target depth.

[19] Google Earth – historical imagery.
[20] Canterbury Maps – Imagery Base Maps, available at: https://mapviewer.canterburymaps.govt.nz/
[21] RetroLens historical image resource, available at: http://retrolens.nz/

Falling Head Infiltration (FHI) tests were also conducted on 5 of the TPs to assist with civil stormwater design.

A geotechnical site plan showing the test locations is provided in Appendix A.

3.1 Shallow Testing

Testing revealed a generally uniform soil profile across the site consisting of topsoil underlain by silt (with lesser sand) that generally showed an increase in consistency/density with depth and then gravel. In the far north of the site, the depth to gravel (overlain by silt) was relatively shallow (i.e., 1.5 – 2.5 m below EGL) compared to the far south of the site where gravel was measured at greater depth (i.e., 3.0 – 4.6 m below EGL).

Typical soil profiles revealed by the TPs are shown in Figure 6 and DCP profiles are presented in Figure 7. This figure shows the variation between blow counts with depth over most of the site compared to those in the south. A summary of the soil profiles encountered at each test location is provided in Table 1A-C and full logs are included in Appendix C. The depth to gravel encountered across the site is presented on a site plan in Figure 8.

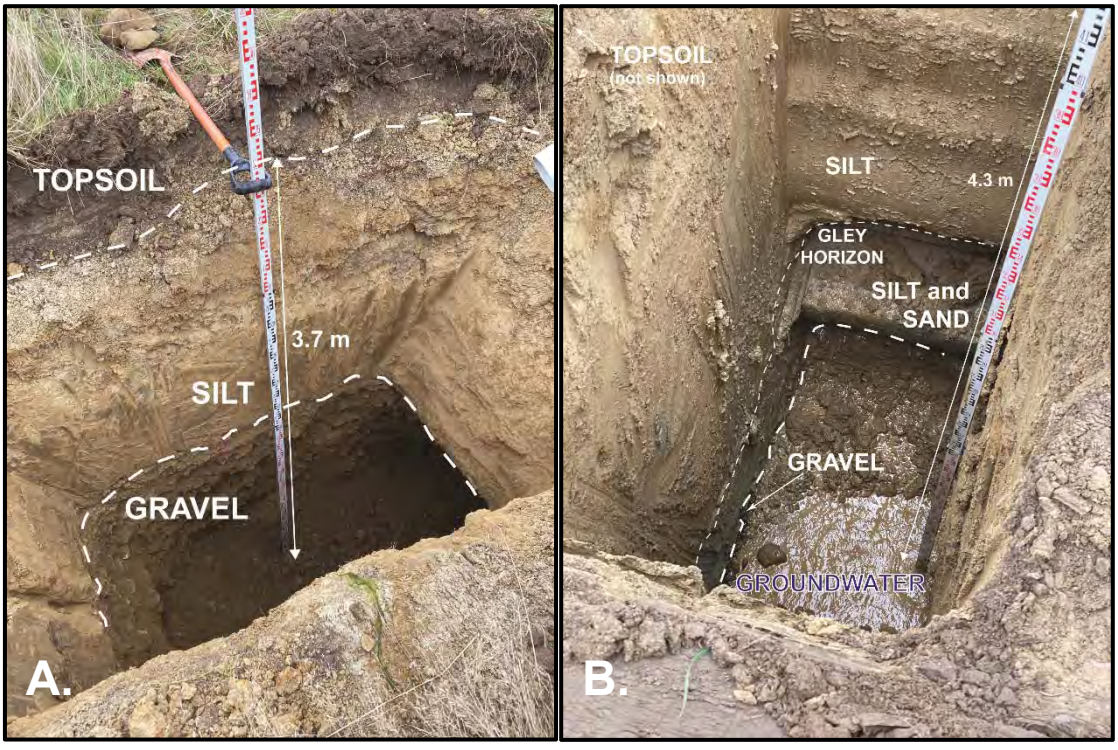

Figure 6: Examples of the soil profile encountered in the north of the site: A) TP20a, where gravel was encountered at relatively shallow depths; and south of the site: B) TP7 where gravel was encountered at greater depths beneath a saturated gley horizon.

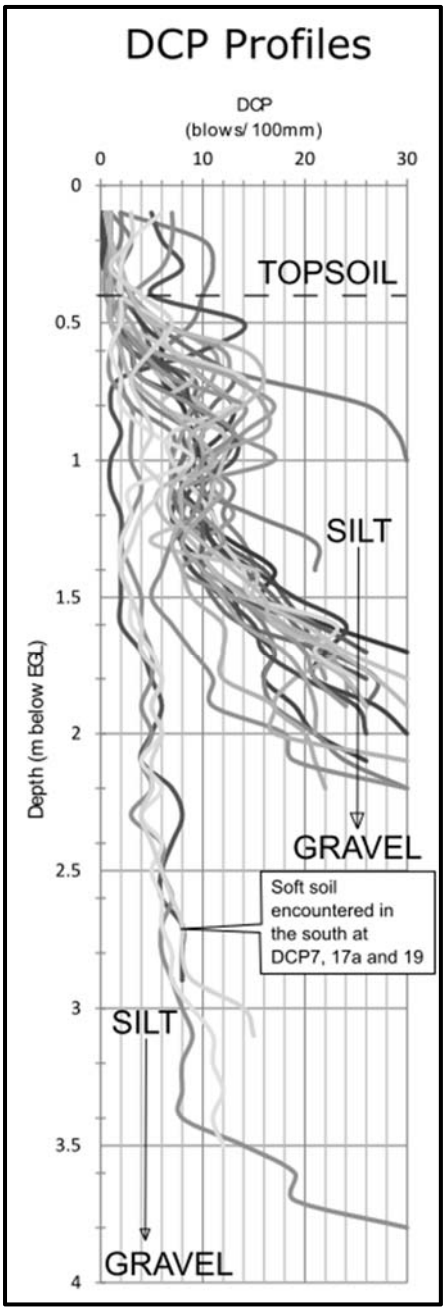

Figure 7: DCP profiles through topsoil and silt (overlying gravel, not reached by DCPs). Results show a consistent trend, except for DCP 7, 17a and 19 in the south of the site where soft, wet silt was encountered at deep.

Table 1A: Summarised Soil Profile for DCP 1 – 6

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Depth Below EGL (m)**					
			DCP1 +TP	DCP2 +TP	DCP3 +TP	DCP4 +TP	DCP5 +TP	DCP6 +TP
TOPSOIL / FILL	0 – 11	*	0.0 – 0.4	0.0 – 0.5	0.0 – 0.5	0.0 – 0.3	0.0 – 0.4	0.0 – 0.4
SILT	<1 – 7	Soft to stiff	0.4 – 0.7	0.5 – 0.8	0.5 – 0.7	0.3 – 0.8	0.4 – 0.7	0.4 – 0.6
	7 – 30 +	Very stiff to hard	0.7 – 2.2	0.8 – 2.5	0.7 – 3.0	0.8 – 2.5	0.7 – 2.2	0.6 – 2.3
Sandy or silty GRAVEL	NE	Dense to very dense***	2.2 – 2.8+	2.5 – 2.8+	3.0 – 5.4+	2.5 – 3.9+	2.2 – 3.1+	2.3 – 3.0+
Groundwater depth (m below EGL)			NE	NE	5.4	NE	NE	NE

* Relative density not assigned to topsoil or non-engineered fill due to the propensity for settlement.
** Depths rounded to the nearest 0.1 m, and may vary across the site from the test locations. Depths are not corrected for variations in topographic elevation between test locations. DCP blows per depth interval generalised to show general consistency.
*** Gravel density inferred from test pit excavations only.
NE = Not Encountered.

Table 1B: Summarised Soil Profile for DCP 7 – 13

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Depth Below EGL (m)**						
			DCP7 +TP	DCP8 +TP	DCP9 +TP	DCP10 +TP	DCP11 +TP	DCP12 +TP	DCP13 +TP
TOPSOIL/ FILL	0 – 11	*	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.4	0.0 – 0.4	0.0 – 0.3	0.0 – 0.3
SILT	<1 – 7	Soft to stiff	0.3 – 2.7	0.3 – 0.6	0.3 – 0.6	0.4 – 0.7	0.4 – 0.9	0.3 – 1.3	0.3 – 0.7
	7 – 30 +	Very stiff to hard	2.7 – 4.0	0.6 – 2.8	0.6 – 3.4	0.7 – 3.6	0.9 – 1.5	1.3 – 2.6	0.7 – 2.3
Sandy or silty GRAVEL	NE	Dense to very dense****	4.0 – 4.3+	2.8– 3.8+	3.4 – 4.0 +	3.6 – 5.3+	1.5 – 1.6+	2.6 – 3.3+	2.3 – 4.2+
Groundwater depth (m below EGL)			3.2***	3.7	NE	5.3	NE	NE	4.2

* Relative density not assigned to topsoil or non-engineered fill due to the propensity for settlement.
** Depths rounded to the nearest 0.1 m, and may vary across the site from the test locations. Depths are not corrected for variations in topographic elevation between test locations. DCP blows per depth interval generalised to show general consistency.
*** Groundwater depth taken at top of gley horizon, static groundwater measured at 3.6 m below EGL in TP7.
**** Gravel density inferred from test pit excavations only.
NE = Not Encountered.

Table 1C: Summarised Soil Profile for DCP 14 – 20

Summary of Soil Type	DCP (blows/ 100 mm)	Relative Density/ Consistency	Depth Below EGL (m)**						
			DCP14 +TP	DCP15 +TP	DCP16 +TP	DCP17A +TP	DCP18 +TP	DCP19 +TP	DCP20 +TP
TOPSOIL/ FILL	0 – 11	*	0.0 – 0.3	0.0 – 0.3	0.0 – 0.3	0.0 – 0.4	0.0 – 0.3	0.0 – 0.3	0.0 – 0.4
SILT	<1 – 7	Soft to stiff	0.3 – 0.6	0.3 – 0.7	0.3 – 0.7	0.4 – 2.9	0.3 – 0.6	0.3 – 0.7	0.4 – 0.9
	7 – 30 +	Very stiff to hard	0.6 – 2.7	0.7 – 2.9	0.7 – 3.0	2.9 – 4.0	0.6 – 3.7	0.7- 2.5	0.9 – 2.3
Sandy or silty GRAVEL	NE	Dense to very dense****	2.7 – 3.1+	2.9 – 3.7+	3.0 – 3.1+	4.0 – 4.1+	3.7 – 3.9+	2.5 – 3.0+	2.3 – 2.9+
Groundwater depth (m below EGL)			NE	NE	NE	3.7	3.2	2.4***	NE

* Relative density not assigned to topsoil or non-engineered fill due to the propensity for settlement.
** Depths rounded to the nearest 0.1 m, and may vary across the site from the test locations. Depths are not corrected for variations in topographic elevation between test locations. DCP blows per depth interval generalised to show general consistency.
*** Possible shallow seepage which may not represent groundwater level.
**** Gravel density inferred from test pit excavations only.
NE = Not Encountered.

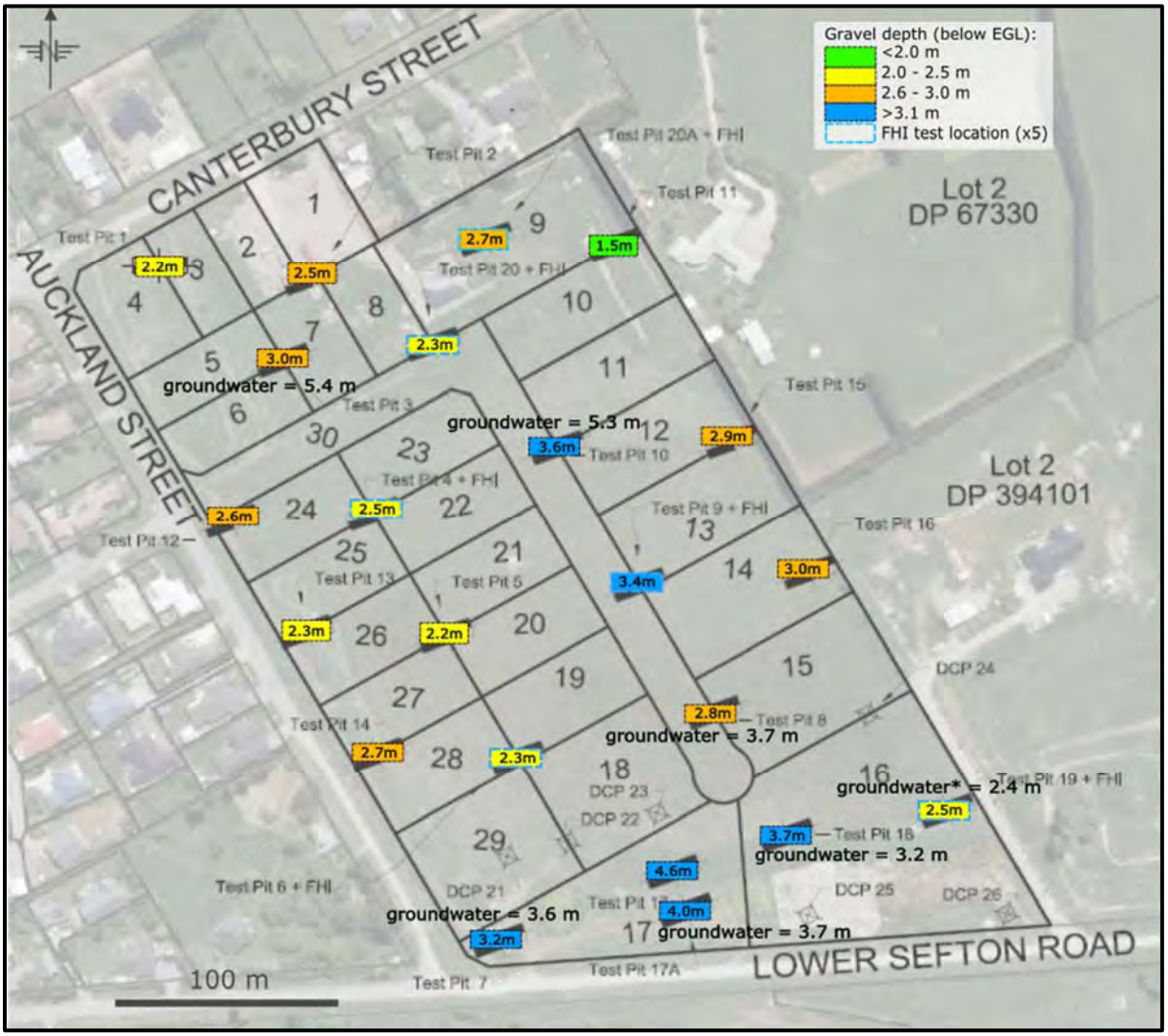

Figure 8: Proposed scheme plan annotated to show the approximate depth to gravel and groundwater (m below EGL) measured in test pit excavations during the site investigation. *Possible seepage encountered at 2.4m depth in TP19.

3.2 Groundwater

As shown in Figure 8, groundwater was encountered in some of the TP excavations at between 2.4 – 5.4 m below EGL, with the median depth being 3.7 m below EGL. Groundwater was encountered at a shallower depth in the south of the site (2.4 – 3.7 m below EGL) compared with measurement in the north (up to 5.4 m below EGL). This is, albeit broadly, consistent with groundwater wells in the area as discussed in Section 2.2. Due to the varied ground level across the site, the depth to water measured below relative ground level broadly reflected changes in topography.

TPs encountered groundwater within the gravel unit. In the south of the site, where the depth to gravel was greater, the initial level of the water strike gradually rose to the lower levels of the overlying silt (and interbedded sand) unit. This is consistent with the observed presence of a gleysol horizon overlying the gravel indicating long-term saturation of the silt.

4.0 INFILTRATION TESTING

Davis Ogilvie conducted falling-head infiltration (FHI) tests at 6 TP locations across the site (TP20a, TP4, TP6, TP9 and TP19 & TP20).

FHI tests were conducted by discharging water in the test pit excavated to down to the gravel unit. Tests were generally repeated 2 to 3 times to ensure full saturation during testing. The field results of all tests are included in Appendix D. Using Horton's empirical equation, FHI parameters derived from the selected field results are summarised in Table 2. These selected results, returned average initial rates of between 1.8 – 3.1 m/hr, and ultimate rates ranged between 0.3 – 0.6 m/hr. It should be noted that given the high infiltration capacity of the gravelly soils, an ultimate plateau rate was not always reached.

The results of TP4, TP19 & TP20 did not show an appreciable drop in water level or did not return sufficient data are not included in Table 2 but the raw data is included in Appendix D.

Table 2: Summarised Horton's Equation Infiltration Parameters for TP6, 9 & 20a

	TP6	TP9	TP20a
Test depth (below EGL)	2.7 m	1.7 m	3.7 m
Initial infiltration rate, f_0 (m/hr)	2.4 – 3.6 (mean 3.0)	1.2 – 2.4 (mean 1.8)	1.9 – 5.2 (mean 3.1)
Ultimate infiltration rate, f_c (m/hr)	<0.1 – 0.6** (mean 0.3)	0.1 –0 .5* (mean 0.3)	0.2 – 1.0** (mean 0.6)
Decay Coefficient, k (/hr)	3 – 5** (mean 4)	1 – 4** (mean 3)	1 – 17** (mean 9)

* Figures stated are averages taken from the three infiltration tests undertaken at each TP location.
** Ultimate infiltration rate often did not reached due to high infiltration capacity of gravel soils.

5.0 GEOTECHNICAL DESIGN RECOMMENDATIONS

5.1 Design Criteria

In accordance with NZS 1170.5 a site soil class of D (deep or soft soils) shall apply to the site, due to the expected significant depth to bedrock.

5.2 Liquefaction Hazard

Currently the underlying liquefaction hazard at the site is unclassified based on regional hazard map, as discussed in Section 2.3. No deep testing or quantitative liquefaction hazard assessments have been undertaken at the site to date. The following classifications apply to the possible damage as a result of both seismically-induced vertical settlement and lateral spreading.

Observations of the soil materials and groundwater profile at the site based on test pit excavations suggest that northern areas of the site (proposed Lots 1 – 15 and 18 – 29) are considered consistent with a 'Very Low' Liquefaction Vulnerability Category (i.e., liquefaction damage is unlikely)[22], as shown in Figure 9. Observations in the north showed groundwater as generally being confined to the dense underlying gravel unit which is overlain by 2.0 – 3.0 m of stiff silt (excluding topsoil thickness). The saturated gravel is assumed to be sufficiently dense and consistent to resist liquefying under seismic conditions.

TPs 7, 17/17a and 18 within ~50 m of the southern boundary (proposed Lots 16 and 17) identified gravel at greater depth overlain by soft and wet silts. The soft soils included a ~1.0 m thick silt and sand gley horizon, approximately 3.0 m below EGL. This material indicates groundwater is present at a shallower depth, and the saturated soils overlying gravel are potentially liquefiable.

Based on observations of liquefaction occurrence in Canterbury during the CES[23], a 'crust' thickness greater than 3.5 – 4.0 m overlying a liquefiable unit was found sufficient to prevent liquefaction-induced damage. Measurements in the south of the site show that there may not be a sufficiently thick non-liquefiable cap available in the south of the site to eliminate the risk of liquefaction damage. However, given the thinness of the potentially liquefiable layer and proximity to dense gravels with a 3.0 m thick cap/crust of unsaturated material above, we consider the two proposed lots in the south to be consistent with a 'Low' Liquefaction Vulnerability Category (i.e., liquefaction damage is unlikely but none to minor ground damage could occur)[22]. This could be confirmed by Cone Penetration Testing (CPT), however at the time of this report, the land immediately adjacent to the southern boundary was not expected to be developed for residential dwellings. It is anticipated that Lot 17 will be used for stormwater disposal and Lot 16 is sufficiently large to enable a suitable building platform to be established through geotechnical testing if required.

[22] Ministry of Business, Innovation and Employment (MBIE). Planning and engineering guidance for potentially liquefaction-prone land. Rev 0.1. Dated September 2017.
[23] Bowen, H. J. & Jacka, M. E. (2013) Liquefaction induced ground damage in the Canterbury earthquakes: predictions vs. reality *in* Proceedings 19th NZGS Geotechnical Symposium. Ed. CY Chin, Queenstown.

Figure 9: Expected liquefaction vulnerability categories at the site based on subsurface observations. Category extents defined by proposed lot boundaries. Categories based on MBIE (2017)[22].

5.3 Soil Static Ultimate Bearing Capacities and Foundation Recommendations

"Good Ground" is defined by NZS 3604:2011 *(Timber-Framed Buildings*) as any soil or rock capable of permanently withstanding an ultimate bearing capacity (UBC) of 300 kPa, but excludes compressible ground, expansive soils and ground that could foreseeably experience movement, including liquefaction-induced ground movement.

Based on the in-situ DCP testing, a static UBC of 300 kPa is achieved at depths ranging from 0.5 – 2.4 m below EGL, as shown on the map in Figure 10. The maximum depth at which “good ground” has been assigned at the site is ≤0.6 m relative to EGL. This is considered a maximum practical depth where standard (NZS 3604:2011) foundation options are considered suitable. In addition, NZS 3604 states that "Specific Engineer Design (SED) foundations are required if filling is in excess of 600 mm”. Where the depth to 300 kPa UBC exceeds a depth of 0.6 m below EGL (i.e., below normal foundation depths), an UBC of 200 kPa is recommended with SED for concrete slab foundations. Table 3 summarises the depth to 300 kPa and 200 kPa UBC encountered at the location of the DCP testing. We note, however, that that the testing was undertaken during winter and the prevailing weather conditions could have increased the moisture content and softened the near-surface soils. Testing during drier seasons may encounter different results.

Due to the presence of soft near-surface soils, any future development at Lots 16 and 17 is expected to require specific engineering design, observation and certification for development. Alternately, these lots may both be utilised as stormwater storage reserves rather than for residential development, as currently proposed for Lot 16.

Site-specific geotechnical investigation at building consent stage will be required to determine the depth to UBC at the location of each dwelling. For a building to comply with NZS 3604:2011, all topsoil, organic material or any other unsuitable material, including non-engineered fill, should be stripped from beneath the building footprint prior to any foundation construction onsite. Recommended foundation options where ‘good ground’ has been achieved include NZS 3604 concrete slab founded on appropriate competent natural soil or engineered fill, or piles founded to a depth where 300 kPa has been achieved for suspended floors.

Should the developer wish to construct gravel pads to be used for construction of house foundation on each lot, testing will be required at the location of the pad to determine the required depth. Any engineered fill placed onsite must be in accordance with NZS 4431:1989.

It should also be noted that although testing revealed relatively consistent subsurface soil conditions, a low density of geotechnical testing has been undertaken (i.e., is not lot-specific). The level of testing is considered suitable for general recommendations to assist with the initial consenting phase of the development, however, following earthworks and prior to building consent, site-specific shallow investigation in accordance with NZS 3604:2011 should be undertaken. Additional testing in Lots 16 and 17 could define areas with higher UBC within these large lots.

Table 3: Summary of bearing capacities encountered at the site			
TP / DCP	**Depth to 300 kPa UBC* (below EGL)**	**'Good Ground' Achieved?** (within 0.6 m below EGL)	**Depth to 200 kPa UBC** (below EGL)**
1	0.6 m	Yes	0.4 m
2	0.7 m	No	0.5 m
3	0.6 m	Yes	0.5 m
4	0.5 m	Yes	0.4 m
5	0.7 m	No	0.5 m
6	0.5 m	Yes	0.4 m
7	1.8 m	No	1.2 m
8	0.5 m	Yes	0.4 m
9	0.5 m	Yes	0.4 m
10	0.6 m	Yes	0.4 m
11	0.9 m	No	0.4 m
12	0.7 m	No	0.6 m
13	0.7 m	No	0.5 m
14	0.5 m	Yes	0.3 m
15	0.6 m	Yes	0.4 m
16	0.7 m	No	0.5 m
17a	2.4 m	No	0.8 m
18	0.5 m	Yes	0.3 m
19	0.6 m	Yes	0.5 m
20	0.6 m	Yes	0.4 m
21***	0.6 m	Yes	0.5 m
22***	0.8 m	No	0.6 m
23***	0.8 m	No	0.6 m
24***	0.5 m	Yes	~0.5 m
25***	1.9 m	No	0.7 m
26***	1.8 m	No	~0.4 m

* 300 kPa UBC based on the definition by NZS 3604 as a minimum of 5 blows/100 mm using the DCP to a depth of twice the foundation width (assumed to be 0.6 m), followed by a minimum of 3 blows/100 mm thereafter.
** 200 kPa UBC based on MBIE Guidance (2012) as a minimum of 2 blows/100 mm.
*** Depth to suitable bearing capacity inferred from DCP only (no test pit excavation confirming appropriate materials).

Figure 10: Map of the proposed development showing the depth 300 kPa (UBC) below EGL encountered across the site.

5.4 Indicative Soil Properties

Estimated soil properties for structural design purposes are provided in Table 4.

Table 4: Estimated Shallow Soil Properties

Soil Description	Unit Weight[24] (γ)	Internal Angle of Friction[25] (ϕ)	Cohesion (c)[24]	Elastic Modulus (E_s)[25]	Modulus of Subgrade Reaction (k_s)[26]
SILT*	16 – 18 kN/m^3	26 – 28°	3 – 5 kPa	8 – 10 MPa	35 – 60 kPa/mm

*Assuming stiff (>3 blows per 100 mm) consistency.

[24] Look, B.G. (2007) Handbook of Geotechnical Investigation and Design Tables, Taylor & Francis Group, London, UK.
[25] Bowles, J.E. (2001) Foundation Analysis and Design, McGraw-Hill International Editions – 5th Edition, Table 2-6 pp108.
[26] Figure 3.1 in NZS 4404:2010

5.5 Civil Infrastructure Recommendations

5.5.1 Preliminary Pavement Design

Based on DCP test of the shallow subgrade soils (silt), and correlations provided in NZS 4404:2010[27], a California Bearing Ratio (CBR) of 4 is recommended for preliminary pavement design.

It must be noted that the silty subgrade soils will be sensitive to moisture variations and all vehicle wheel loads. Excessive moisture or vehicles tracking over the subgrade will have an adverse impact on the subgrade conditions and must be carefully managed during the earthworks phase.

5.5.2 Stormwater Management

It is understood the current proposed stormwater management design is to include discharge to groundwater via soak pits on each developed lot, subject to territorial authority and Building Code the requirements. Overflow from the soak pits are proposed to be diverted to attenuation ponds, potentially located on proposed Lot 17.

Based on the results of the infiltration testing, it is recommended that water is discharged to the underlying gravel unit, and the invert of the soak pits are excavated a minimum of 0.5 m into the gravel unit (noting height of groundwater seasonal maximum) to ensure maximum infiltration capacity. Infiltration rates of soak pits should be individually verified to ensure adequate performance before backfilling.

5.5.3 Wastewater

It is understood the proposed sewer management design is to include secondary treatment with either discharge to sand trenches or to raised dripline irrigation beds. Based on infiltration testing in the near-surface silts (i.e., upper 1.5 m) at TP19, very low short-term infiltration rates were identified. It is recommended that a similarly low rate soil loading rate be selected for sewer design with regards to AS/NZS 1547:2012.

5.5.4 Earthworks

It is understood that no significant earthworks (cut and fill) are proposed for the site. Earthworks are limited to the removal of existing stockpiles on the site, construction of proposed stormwater ponds and road excavations, individual building pads and buried services/infrastructure.

[27] NZS 4404:2010 Land development and subdivision infrastructure.

All engineered filling must be carried out in accordance with the NZS 4431:1989[28].

Important aspects of the fill operation include but are not limited to the following:

- The area on which the fill is to be placed is to be stripped of all vegetation, topsoil, soft, organic or otherwise unsuitable soils. Topsoil onsite is approximately 0.3 – 0.5 m thick. All stripped subgrade areas are to be inspected by a suitably experienced geo-professional prior to placing of any fill.
- The engineer is to be notified of all weak soils, soft or organic material, uncontrolled or historic fill.
- The subgrade surface must be adequately surveyed by the contractor (under the supervision of a Registered Professional Surveyor), and the information provided to Davis Ogilvie.
- The subgrade should be protected from water ponding and from rutting or weaving as a result of vehicle or machine loadings.
- Material to be used as engineered fills must be approved by the Engineer prior to use.
- Target engineered fill Maximum Dry Density (MDD) values (1 per 4,000 m^3 of fill) must be obtained prior to placement of fill and shall be retested in accordance with NZS 4431, or as directed at any stage by the engineer. Fill shall be placed in lifts no thicker than 230 mm (un-compacted) and is to be compacted to 95% of its MDD.
- Nuclear Density (ND) testing shall be carried out on every 230 mm lift of filling at max 20 m spacing, 400 m^2 to confirm sufficient compaction, or unless otherwise specified by the Engineer. The site location and subject lift of ND tests must be appropriately recorded (e.g., GPS surveyed), and is to be provided along with the test results to Davis Ogilvie.
- The Engineer may undertake additional DCP testing on the compacted engineered fill, as to achieve a minimum 5 blows/100mm before the placement of any subsequent lifts of topsoil.
- All filling records are to be provided to the engineer for review and to support the fill certificate and as-built completion report.

[28] NZS 4431:1989 Code of practice for earth fill for residential development.

6.0 SECTION 106 RESOURCE MANAGEMENT ACT (1991) ASSESSMENT

Section 106 of the Resource Management Act (RMA 1991) requires that the site of a subdivision be assed for potential material damage due to a range of natural hazards. The natural hazards, as defined by the RMA, considered relevant to this site aspects are addressed in Table 5.

Table 5: Resource Management Act Considerations

Natural Hazard	Potential Effects on Developed Site
Erosion	Erosion is not considered a significant risk to the subdivision due to its low level of topographic variation and distance of the site to the active channel of the Ashley River (which is separated from the site by a flood bank). All surface water on the site should be managed to minimise potential erosion and suitable landscaping and stormwater management systems are required to ensure overland flows are controlled to prevent erosion and scouring of surface soils.
Falling Debris	Due to the relatively flat topography of the subdivision and surrounding area, it is considered there is no risk of falling debris impacting the site.
Subsidence	Based on the observed soil types and groundwater profiles across the site, damaging effects on the land as a result of seismically-induced liquefaction (both seismically-induced vertical settlement and lateral spreading) are considered 'Very Low' risk across the area of proposed Lots 1 – 15 and 18 – 29 , and 'Low' risk across the area of proposed Lots 16 and 17. A risk of static settlement due to bearing capacity failure exists where tests in the shallow soils indicated low ultimate bearing capacity. This risk can be managed by an appropriate level of geotechnical investigation and foundation design on a lot-specific basis. All earthworks filling undertaken across the site is to be carried out in accordance with NZS 4431:1989 to ensure that any settlements are within the SLS limits specified in Appendix B1 of Clause B1 of the Building Code and in Table C1 of NZS 1170.0.
Slippage	Due to the relatively flat topography of the subdivision site, ground slippage (or slope instability) is not anticipated.
Inundation	The site is presently located in an area classified by WDC as a 'low inundation hazard' for flooding (1:200 year event), and due to the presence of the flood stop bank we do not consider the subdivision to be at any greater risk than the neighbouring properties in Ashley Village. Assuming the continued existence of the flood stop bank we do not consider inundation to be a hazard to the site as long as floor levels meet the minimum requirements required by WDC. The proposed development is to include appropriately-designed infrastructure to manage, contain and discharge stormwater from the proposed development in order to manage the inundation risk. It is recommended that a Registered Professional Surveyor confirm ground levels onsite and ECan and WDC should be contacted at the building consent stage to confirm any minimum floor levels for the site.

6.1 Section 106 Summary

As indicated in Table 5, the southern section of the site is at risk of subsidence from static settlement due to low bearing pressures to significant depth and at a low risk of liquefaction induced settlement. However, it is determined that the site is suitable for subdivision into 28 residential lots under Section 106 of the RMA because the risk of subsidence to Lot 16 can be mitigated or managed to an acceptable level (with Lot 17 vested as a stormwater reserve). This will involve specific engineering design, observation and certification, should any structures be planned for those lots in future. We note that site-specific geotechnical investigation will be required on each lot to determine the depth to suitable bearing and enable appropriate foundation design at building consent stage.

A Statement of Professional Opinion on the Suitability of Land for Building Construction is included in Appendix E. The subdivision into 28 residential lots (plus one road and one stormwater reserve in Lot 17) may proceed subject to the following conditions:

- Site-specific geotechnical investigation at building consent stage will be required to determine the depth to an appropriate bearing capacity at the location of each dwelling;
- Finished floor levels are confirmed during the consenting process by WDC and/or ECan;
- Specific engineering design, observation and certification will be required on proposed Lots 16 to address the reduced bearing capacity and possible low liquefaction risk identified in this area. This also applies to Lot 17 should the use change from stormwater reserve to residential development.

7.0 CONCLUSIONS

A geotechnical investigation was undertaken to investigate the underlying ground conditions, assess natural hazards, and provide recommendations regarding residential foundations and civil infrastructure to support a subdivision consent application for 28 proposed residential lots.

Davis Ogilvie oversaw the excavation of 22 Test Pits and 26 Dynamic Cone Penetrometers. The shallow soil profile generally consisted of a 0.3 – 0.5 m topsoil layer over a unit of soft to hard silt which ranged from 1.1 to 3.7 m thick, then dense silty and sandy gravel. Groundwater was encountered at between 2.4 – 5.4 m below EGL. Observation of the soil and groundwater conditions indicates that vertical settlement as a result of liquefaction is unlikely, and a liquefaction vulnerability risk of ‘very low’ to ‘low’ is considered appropriate.

Based on the in-situ DCP testing, a static UBC of 300 kPa was achieved at depths ranging from 0.5 – 2.4 m below EGL. The maximum depth at which "good ground" has been assigned at the site is ≤0.6 m above which standard (NZS 3604:2011) foundation options are considered suitable. Recommended foundation options where "good ground" has been achieved include NZS 3604 concrete slab founded on appropriate competent natural soil or engineered fill, or piles founded to a depth where 300 kPa has been achieved for suspended floors. Where the depth to 300 kPa UBC exceeds 0.6 m below EGL, an UBC of 200 kPa is recommended with SED for concrete slab foundations.

Flood hazard information from Waimakariri District Council suggests the site has 'no identified inundation' risk' to a 'low risk of inundation'. Finished floor levels are expected to be no less than 400 mm above ground level. It is recommended that a Registered Professional Surveyor is engaged to confirm ground levels onsite.

All earth filling must be carried out in accordance in accordance with NZS 4431:1989, and will require engineering certification prior to residential construction. Road pavement design may adopt a preliminary subgrade CBR value of 4, which will require conformation testing on site during the earthworks phase. Falling Head Infiltration testing in the underlying gravelly soils returned average initial rate between 1.8 – 3.1 m/hr, and ultimate rates ranged between 0.3 – 0.6 m/hr.

The site is considered suitable for residential development under Section 106 of the Resource Management Act (1991) in regards to natural hazards, subject to the following conditions:

- Site-specific geotechnical investigation at building consent stage will be required to determine the depth to an appropriate bearing capacity at the location of each dwelling;
- Finished floor levels are confirmed during the consenting process by Waimakariri District Council and/or Environment Canterbury;
- Specific engineering design, observation and certification will be required on proposed Lots 16 and 17 to address the reduced bearing capacity and possible low liquefaction risk identified in this area.

APPENDIX A:

Site and Test Location Plan (DWG G01A)

The DCP & Test Pits (TP for this Geotechnical Report were carried out between 24/06/2020 & 10/07/2020.

Test locations are approximate (scaled and aligned using aerial imagery).
Aerial image obtained from Canterbury Maps
Boundaries are taken from Quickmap and are indicative only.
Proposed lots taken from DO drawing GM37095 101A dated 09/2020.

0m 50m 100m 150m 200m 250m

Scale 1:2500

A	08/20	Geotechnical Report Diagram	HC
/ issue	/ date	/ reason	/ approved

CAD ref: 37905.200617.Geotechnical Site Plan G01A

DAVIS OGILVIE
ENGINEERS / SURVEYORS / PLANNERS

Davis Ogilvie & Partners Ltd - Ph. 0800 999 333

Geotechnical Site Plan
Auckland Street Subdivision
Lot 1 DP 394101

/ design	/ drawn	/ QA check	/ dwg
AB+HC	KL	HC	G01
/ scale @ A4	/ date	/ file	/ issue
1:2500	08/20	37211	A

APPENDIX B:

Waimakariri District Council 1:200 Year Flood Hazard Map and Email Communications

From: Subdivision Eng <subdivisioneng@wmk.govt.nz>
Sent: Thursday, 30 July 2020 9:23 a.m.
To: Hamish Cattell
Subject: RE: SUBDIVENG 2 Auckland Street, Ashley (Lot 1 DP 394101) - Finished floor level requirements

Hi Hamish

Green = Low risk of inundation
Blue = Medium risk of inundation
Red = High risk of inundation

As a general rule of thumb, we work to 400mm above undisturbed ground in a "clear" area, 600mm above undisturbed ground in a green area, 900mm above undisturbed ground in a blue area, and we don't really like people building in red area.

In reality – once we learn the location of a potential dwelling, we can work out the max flood depth and then, 400mm above max flood depth in Green areas and 500 above max flood depth in blue areas, although Council preference would be to avoid these areas if at all practicable.

If an area is identified as being subject to Ashley Breakout – we ask that the applicant gets a FFL from Ecan in the first instance, and we will work to either their level or Council level whichever is the greater.

Kind regards

Debbie Wilson | **Land Development Officer**
Project Delivery Unit
Phone: 0800 965 468 (0800 WMK GOV)
Mobile: 027 322 2338

From: Hamish Cattell <hamishc@do.nz>
Sent: Thursday, 30 July 2020 9:01 AM
To: Subdivision Eng <subdivisioneng@wmk.govt.nz>
Subject: RE: SUBDIVENG 2 Auckland Street, Ashley (Lot 1 DP 394101) - Finished floor level requirements

Thank you.

Can you please confirm the hazard levels of the map colour contours (green, blue and red).

Thank you.

Hamish

HAMISH CATTELL / Engineering Geologist / hamishc@do.nz /

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03 366 1653 / 0800 999 333 / www.do.nz
Level 1, 24 Moorhouse Ave, Addington / P O Box 589, Christchurch 8140

Offices in Christchurch, Nelson, Greymouth and Timaru

From: Subdivision Eng [mailto:subdivisioneng@wmk.govt.nz]
Sent: Thursday, 30 July 2020 8:25 a.m.
To: Hamish Cattell
Cc: Subdivision Eng
Subject: SUBDIVENG 2 Auckland Street, Ashley (Lot 1 DP 394101) - Finished floor level requirements

Good Morning Hamish

Apologies for the delay in replying.

Please find attached the 1 in 200 year flood hazard mapping for 2 Auckland Street, Ashley.

Council Draft Technical Practice note requires the following as a guide to FFL.

The minimum Finished Floor Level (FFL) for a proposed dwelling site at 2 Auckland Street, Ashley (Lot 1 DP 394101) is to be set no lower than 400mm above undisturbed ground at any point intersecting the building footprint and outside Councils mapped 0.5% AEP (1 in 200 year) Flood Hazard Areas.

Hope this helps

Kind regards

Debbie Wilson | **Land Development Officer**
Project Delivery Unit
Phone: 0800 965 468 (0800 WMK GOV)
Mobile: 027 322 2338

From: Hamish Cattell <hamishc@do.nz>
Sent: Thursday, 30 July 2020 8:04 AM
To: Subdivision Eng <subdivisioneng@wmk.govt.nz>
Subject: FW: 37211 - 2 Auckland Street, Ashley - Finished floor level requirements

Good morning,

Can you please provide me with the latest flood hazard information (and any finished floor level requirements) for 2 Auckland Street, Ashley.

Thank you.
Hamish

HAMISH CATTELL / Engineering Geologist / hamishc@do.nz /

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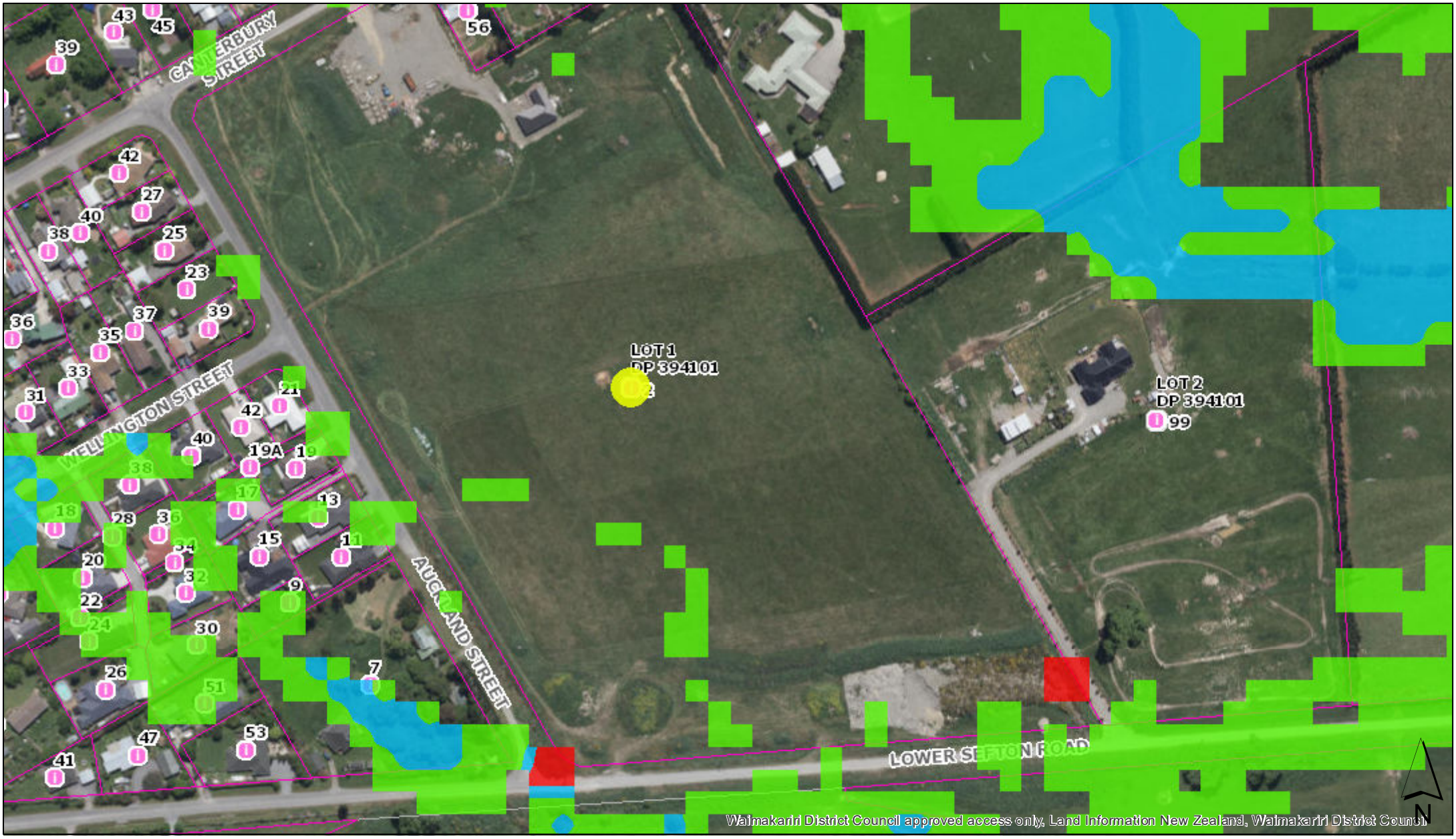


WAIMAKARIRI DISTRICT COUNCIL

2 Auckland Street, Ashley

Date: 30/07/2020

Author: debbiew@WMK

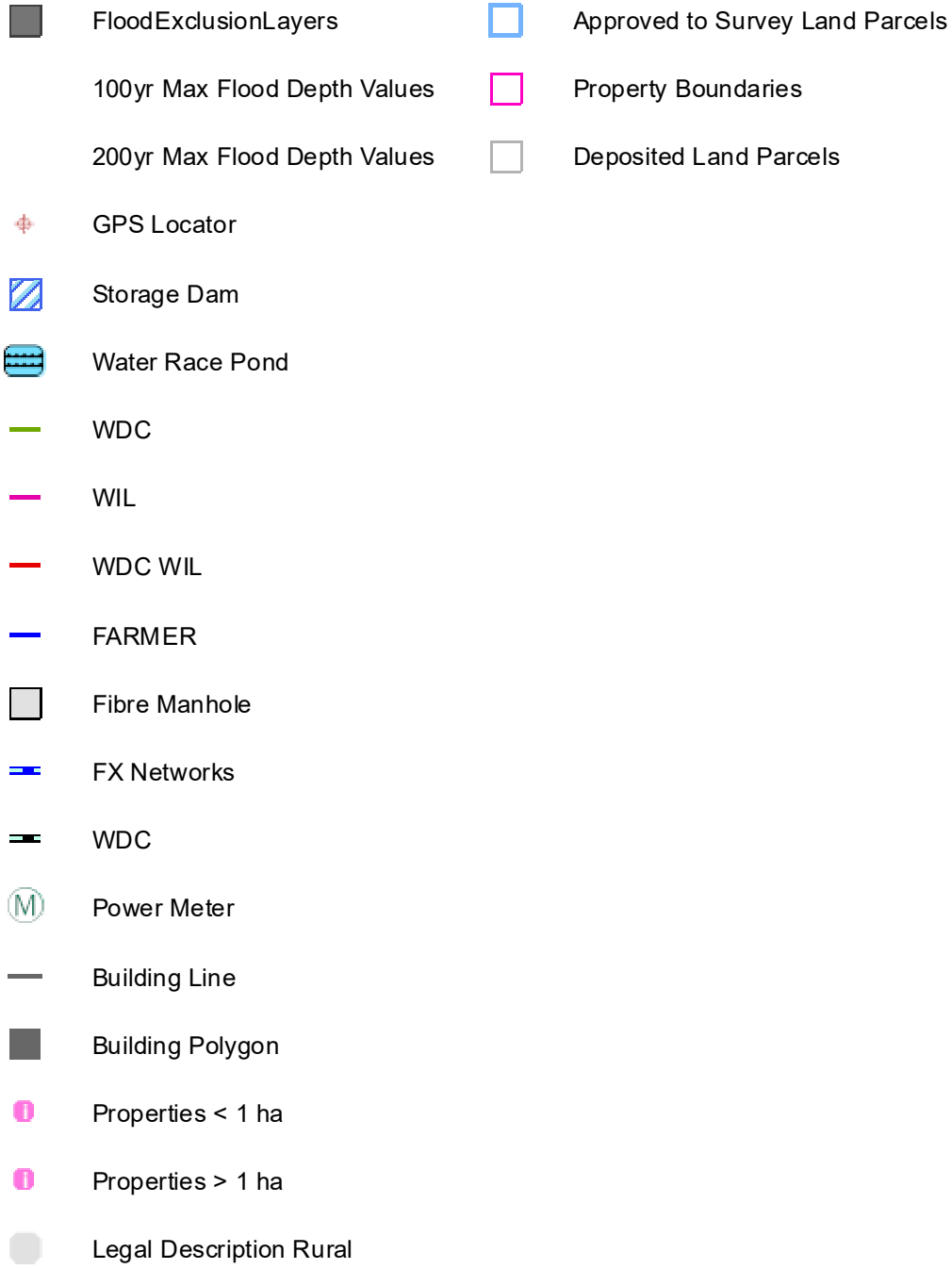
0 25 50 75 100

Meters

Scale @ A4 - 1:2257

Map Created by WAIMAP Utilities at 8:16:45 AM

Legend


FloodExclusionLayers
100yr Max Flood Depth Values
200yr Max Flood Depth Values
GPS Locator
Storage Dam
Water Race Pond
WDC
WIL
WDC WIL
FARMER
Fibre Manhole
FX Networks
WDC
Power Meter
Building Line
Building Polygon
Properties < 1 ha
Properties > 1 ha
Legal Description Rural
Approved to Survey Land Parcels
Property Boundaries
Deposited Land Parcels

APPENDIX C:

Test Pit and Dynamic Cone Penetrometer Logs

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 01

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

Test Pit at DCP 01

DEPTH (m)	STRATA DESCRIPTION (Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005)	USCS	Graphic Log	Water Table	BLOWS / 100 mm — DCP 01 (1 2 3 4 5 6 7 8 9)	
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.40m]	TS	TS	Groundwater Not Encountered		
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [1.80m]	ML				
	0.5m: SV: 66/22					
	0.6m: SV: 102/25					
	0.8m: SV: 196+					
1.0						
	1.3m: Colour change to orangey brown. Soil becomes hard and wet with an increase in sand content.					
1.5					> 11	
					> 13	
					> 14	
					> 17	
					> 16	
					> 19	
2.0					> 21	
					> 26	
2.5	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.60m]	GW				
	Test Pit terminated at 2.80m - Target depth achieved.					
3.0						
3.5						
4.0						
4.5						
5.0						

Logged By:	AB+HC	**Notes:**	Shear vane (SV): peak/remoulded (kPa)
Plotted By:	KL		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 02

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 02

Depth (m)	Strata Description	USCS	Graphic Log
0.0	Sandy GRAVEL; dark grey. Wet, well graded (FILL). [0.20m]	FILL	
0.2	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (BURIED TOPSOIL). [0.30m]	TS	TS
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.00m]	ML	
1.0	1.0m: Becomes hard.		
1.3	1.3m: Colour change to orangey brown. Becomes wet with an increase in sand content.		
2.5	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.30m]	GW	
2.8	Test Pit terminated at 2.80m - Target depth achieved.		

Water Table: Groundwater Not Encountered

BLOWS / 100 mm

DCP 02

Depth (m)	Blows / 100 mm
0.0 – 0.5	11
0.5 – 1.0	13, 12, 14, 15, 14
1.0 – 1.5	16, 17, 21, 24, 30

Logged By:	AB+HC
Plotted By:	KL
Checked By:	HC

Notes:

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº / **37211**
Test Nº / **DCP 03**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 03

DEPTH (m)	Strata Description	USCS	Graphic Log
0.0	SILT with minor gravel and trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.50m]	TS	
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.50m]	ML	
1.0	1.2m: Colour change to orangey brown. Soil becomes hard, wet with an increase in sand content.		
3.0	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [2.40m]	GW	
5.4	Test Pit terminated at 5.40m - Target depth achieved.		

Water Table: 24/06/2020

BLOWS / 100 mm

DCP 03

DEPTH (m)	Blows / 100 mm
0.0	1
0.1	2
0.2	3
0.3	4
0.4	5
0.5	6
0.6	7
0.7	8
0.8	9
0.9	11
1.0	12
1.1	16
1.2	18
1.3	20
1.4	21
1.5	26

Logged By:	AB+HC	**Notes:**
Plotted By:	KL	
Checked By:	HC	

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 04

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 04

SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m] — TS

SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.20m] — ML

0.5m: SV: 107/21
0.6m: SV: 157/39
0.7m: SV: UTP

1.0m: Colour change to orangey brown. Becomes wet with an increase in sand content.

1.3m: Becomes hard.

Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [1.40m] — GW

Test Pit terminated at 3.90m - Target depth achieved.

Groundwater Not Encountered

BLOWS / 100 mm

DCP 04

Depth (m)	Blows / 100 mm
0.5	11
1.0	13
1.5	17
2.0	16
2.5	22
3.0	30

Logged By:	AB+HC
Plotted By:	KL
Checked By:	HC

Notes: Shear vane (SV): peak/remoulded (kPa)
Unable to penetrate with SV (UTP)
IT3 = TP4

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 05

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 05

DEPTH (m)	USCS	Graphic Log	Water Table	BLOWS / 100 mm — DCP 05
0.0	TS		Groundwater Not Encountered	
				SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.35m]
0.5	ML			SILT with minor sand; light grey with patchy orangey brown mottling. Soft to hard, moist, non plastic. Sand is fine. [1.85m]
1.0				1.3m: Colour change to orangey brown. Soil becomes hard and wet with an increase in sand content.
1.5				1.7m: Becomes very stiff.
2.0	GW			Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.90m]
2.5				
3.0				Test Pit terminated at 3.10m - Target depth achieved.
3.5				
4.0				
4.5				
5.0				

DCP 05 blow counts (1 2 3 4 5 6 7 8 9):

Depth (m)	Blows
1.5	11
1.6	14
1.7	17
1.8	19
1.9	22
2.0	24
2.1	26

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building. Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Plotted By:	KL		
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job № / **37211**
Test № / **DCP 06**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 06

DEPTH (m)	USCS	Graphic Log	Water Table	BLOWS / 100 mm
0.0	TS		Groundwater Not Encountered	
				SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.40m]
0.5	ML			SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [1.90m]
				0.6m: Becomes very stiff.
1.0				1.0m: Colour change to orangey brown. Soil becomes wet with an increase in sand content.
1.5				1.5m: Becomes hard.
2.0				
2.5	GW			Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.70m]
3.0				Test Pit terminated at 3.00m - Target depth achieved.
3.5				
4.0				
4.5				
5.0				

DCP 06

Depth (m)	Blows / 100 mm
0.5	11
1.0	11
1.5	15
2.0	18
2.5	22
3.0	24
3.5	24

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.
Plotted By:	KL		Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Checked By:			

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SHALLOW INVESTIGATION RESULTS

Job Nº /37211
Test Nº / DCP 07

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 07

DEPTH (m)	USCS	Graphic Log	Water Table
0.0	TS		
0.5			
1.0			
1.5	ML		
2.0			
2.5			
3.0			
	ML		24/06/2020
3.5			
4.0	GP		
4.5			
5.0			

SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]

Interbedded Sandy SILT and silty fine SAND; orangey brown. soft to hard (to loose to dense), wet. [2.90m]

0.6m: SV: 196+

0.7m: UTP

0.8m: Becomes soft.

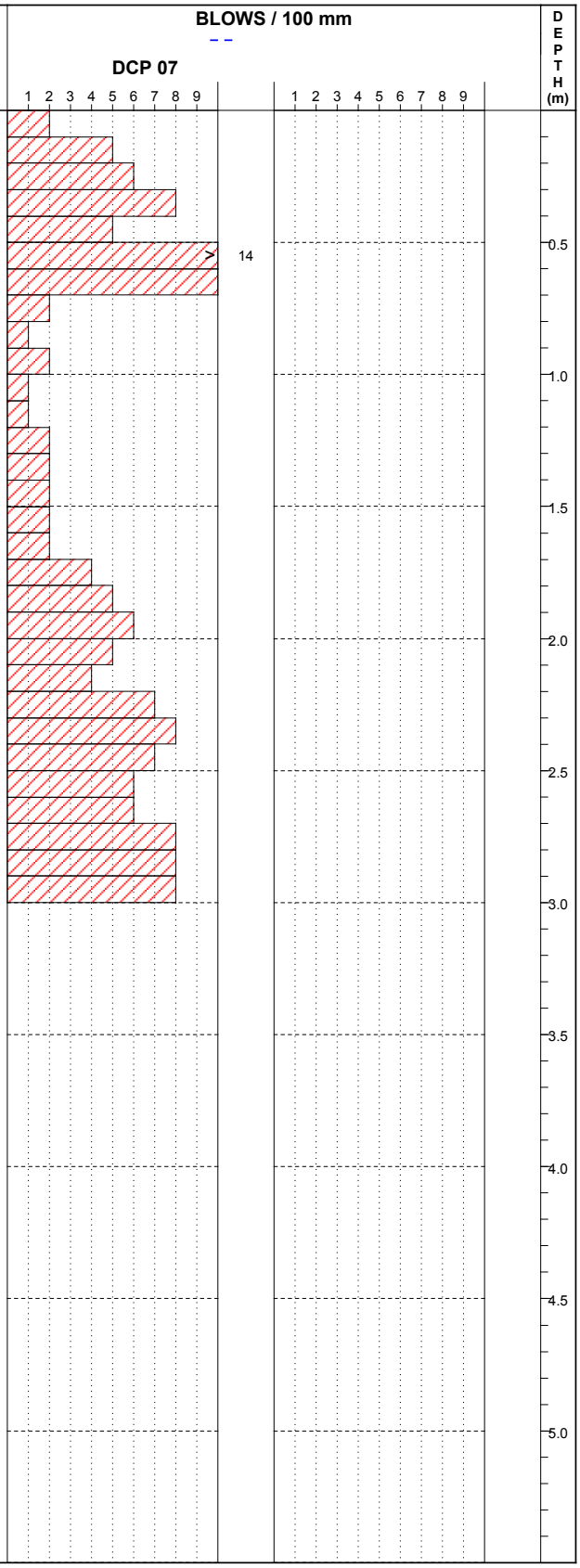
1.7m: Becomes stiff.

2.2m: Becomes very stiff to dense.

SILT with minor sand and trace clay; bluish grey. Very soft, saturated, low plasticity. Interbedded with fine sand beds. Unit has wet 'puggy' appearance and consistency. [0.80m]

Fine to coarse GRAVEL with some sand; grey. Dense, saturated, poorly graded. Sand is fine to coarse. [0.30m]

Test Pit terminated at 4.30m - Target depth achieved.



Logged By:	AB+HC	**Notes:**	Shear vane (SV): peak/remoulded (kPa) Unable to penetrate with SV (UTP)
Plotted By:	KL		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 08

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 08

DEPTH (m)	USCS	Graphic Log	Water Table
0.0	TS		
0.5	ML		
1.0			
1.5			
2.0			
2.5			
3.0	GW		
3.5			24/06/2020
4.0			
4.5			
5.0			

SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]

SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.50m]

0.6m: Becomes very stiff to hard.

0.8m: Colour change to orangey brown. Becomes wet with an increase in sand content.

1.5m: Becomes hard.

Interbedded gravelly fine to coarse SAND with some silt to sandy fine to coarse GRAVEL with some silt; orangey brown with dark stained gravel. Dense, wet. Gravel is subangular greywacke. [1.00m]

Test Pit terminated at 3.80m - Target depth achieved.

BLOWS / 100 mm

DCP 08

DEPTH (m)	1	2	3	4	5	6	7	8	9
0.5									
1.0									
1.5									
2.0									
2.5									
3.0									
3.5									
4.0									
4.5									
5.0									

Depth (m)	Blows / 100 mm
0.5	12
1.0	13
1.5	17
2.0	14
2.5	11
3.0	11
3.5	13
4.0	11
4.5	15
5.0	21
	21
	22

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building. Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Plotted By:	KL		
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 09

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 09

DEPTH (m)	Strata Description	USCS	Graphic Log
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS	
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Soft to hard, moist, non plastic. Sand is fine. [3.10m]	ML	
	0.6m: SV: 134/53 Becomes very stiff.		
	0.8m: SV: UTP		
1.0			
	1.3m: Colour change to orangey brown. Becomes wet with an increase in sand content.		
1.5	1.6m: Becomes hard.		
2.0			
2.5			
3.0			
3.5	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.55m]	GW	
	3.7m: Trace to no silt content below.		
	Test Pit terminated at 3.95m - Target depth achieved.		
4.0			
4.5			
5.0			

Water Table: Groundwater Not Encountered

BLOWS / 100 mm

DCP 09

DEPTH (m)	Blows / 100 mm
0.5	13
	11
1.0	
	11
1.5	11
	14
	22
	27
2.0	26

Logged By:	AB+HC	**Notes:**	Shear vane (SV): peak/remoulded (kPa) Unable to penetrate with SV (UTP)
Plotted By:	KL		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 10

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 10

SILT with trace sand dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.35m] — TS

SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [3.25m] — ML

0.4m - 0.8m: Mottled reddish orange and greyish white.
0.5m: SV: 70/13
0.7m: SV: 154/22
0.8m: Colour change to orangey brown. Soil becomes very stiff and wet with an increase in sand content.
0.9m: SV: UTP
1.4m: Becomes hard.

Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [1.70m] — GW

Test Pit terminated at 5.30m - Target depth achieved.

Water Table: 24/06/2020

BLOWS / 100 mm

DCP 10

Depth (m)	Blows / 100 mm
0.5	13
1.0	12
1.5	11
2.0	15
2.5	19
3.0	24
3.5	22
4.0	21
4.5	27
5.0	30

Logged By:	AB+HC	**Notes:**	Shear vane (SV): peak/remoulded (kPa) Unable to penetrate with SV (UTP)
Plotted By:	KL		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº / **37211**
Test Nº / **DCP 11**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 11

DEPTH (m)	USCS	Graphic Log	Water Table
0.0	TS	TS	Groundwater Not Encountered
0.5	ML		
1.0			
1.5	GM		
2.0			
2.5			
3.0			
3.5			
4.0			
4.5			
5.0			

SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.40m]

SILT with minor sand; light grey with patchy orangey brown mottling. Firm to hard, moist, non plastic. Sand is fine. [1.10m]

0.9m: Becomes very stiff.

1.2m: Becomes hard.

Silty, fine to coarse GRAVEL with some sand and trace cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is medium. Gravel is subangular greywacke. Gap graded. [0.10m]

Test Pit terminated at 1.60m - Target unit encountered.

BLOWS / 100 mm

DCP 11

Depth (m)	Blows / 100 mm
1.5	15
1.6	21
1.7	21

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.
Plotted By:	KL		Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 12

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 12

Depth (m)	Strata Description	USCS	Graphic Log
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS	
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.30m]	ML	
	0.6m: Becomes stiff to very stiff.		
1.0			
	1.3m: Colour change to orangey brown. Becomes wet with an increase in sand content.		
1.5	1.5m: Becomes hard.		
2.0			
2.5	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.70m]	GW	
3.0	Test Pit terminated at 3.30m - Target depth achieved.		
3.5			
4.0			
4.5			
5.0			

Water Table: Groundwater Not Encountered

BLOWS / 100 mm

DCP 12

Depth (m)	Blows / 100 mm
0.0	1
0.1	1
0.2	1
0.3	1
0.4	1
0.5	2
0.6	3
0.7	4
0.8	5
0.9	6
1.0	7
1.1	8
1.2	9
1.3	9
1.4	9
1.5	9
1.6	9
1.7	9
1.8	9
1.9	9
2.0	9
2.1	9
2.2	9
2.3	9
2.4	9
2.5	9
2.6	9
2.7	9
2.8	9
2.9	9
3.0	9
3.1	9
3.2	9
3.3	9

Logged By:	AB+HC
Plotted By:	KL
Checked By:	HC

Notes:

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº /37211
Test Nº / DCP 13

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 13

DEPTH (m)	USCS	Graphic Log	Water Table
SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS		
SILT with minor sand; light grey with patchy orangey brown mottling. Soft to hard, moist, non plastic. Sand is fine. [2.00m]	ML		
0.8m: Colour change to orangey brown. Soil becomes soft to hard and wet with an increase in sand content.			
Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [1.90m]	GW		
Test Pit terminated at 4.20m - Target depth achieved.			25/06/2020

BLOWS / 100 mm

DCP 13

DEPTH (m)	1 2 3 4 5 6 7 8 9
0.5	
1.0	> 13
	> 12
1.5	> 13
	> 21
	> 21
2.0	> 26
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building. Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Plotted By:	KL		
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 14

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

Test Pit at DCP 14

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

DEPTH (m)	STRATA DESCRIPTION	USCS	Graphic Log	Water Table	BLOWS / 100 mm DCP 14
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS		Groundwater Not Encountered	
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Firm to hard, moist, non plastic. Sand is fine. [2.40m] 0.4m: Becomes stiff to very stiff.	ML			13
1.0	0.9m: Colour change to orangey brown. Becomes wet with an increase in sand content.				
1.5	1.5m: Becomes hard.				13, 18, 18, 23, 19, 17, 20, 21, 22
2.0					
2.5	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.40m]	GW			
3.0	Test Pit terminated at 3.10m - Target depth achieved.				
3.5					
4.0					
4.5					
5.0					

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building. Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Plotted By:	KL		
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job Nº /37211
Test Nº / DCP 15

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 15

DEPTH (m)	USCS	Graphic Log	Water Table
0.0	TS		Groundwater Not Encountered
0.5	ML		
1.0			
1.5			
2.0			
2.5			
3.0	GW		
3.5			
4.0			
4.5			
5.0			

SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]

SILT with minor sand; orangey brown. Firm to hard, moist, non plastic. Sand is fine. [2.60m]

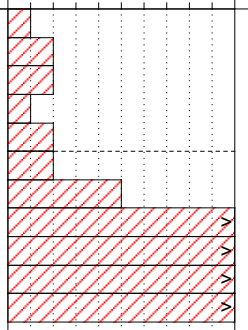
0.7m: Becomes hard.

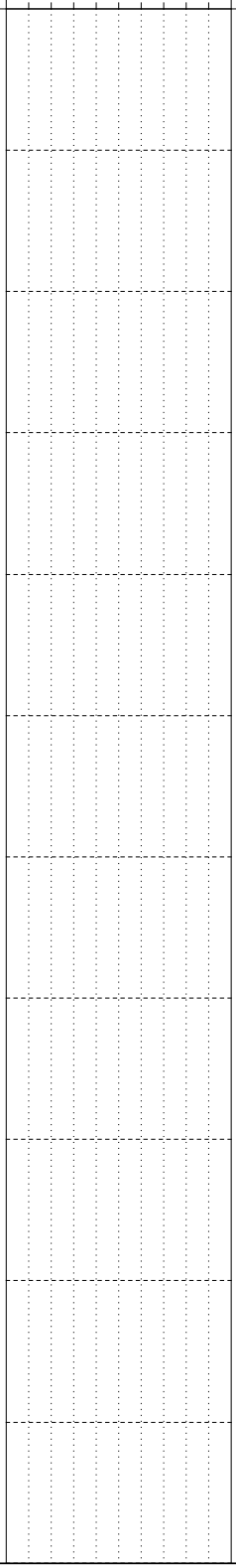
Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.80m]

Test Pit terminated at 3.70m - Target depth achieved.

BLOWS / 100 mm

DCP 15





Logged By:	AB+HC
Plotted By:	KL
Checked By:	HC

Notes: Shear vane (SV): peak/remoulded (kPa)
Unable to penetrate with SV (UTP)

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 16

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 16

DEPTH (m)	USCS	Graphic Log	Water Table
0.0	TS		Groundwater Not Encountered
SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]			
SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.70m]	ML		
1.0m: Colour change to orangey brown. Becomes wet with an increase in sand content.			
Silty, fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, poorly graded (uppermost unit). Sand is fine to coarse. Gravel is subangular greywacke. [0.10m]	GM		
3.10			

Test Pit terminated at 3.10m - Target depth achieved.

BLOWS / 100 mm

DCP 16

DEPTH (m)	1	2	3	4	5	6	7	8	9
0.0									
0.5									
1.0									
1.5									
2.0									
2.5									
3.0									
3.5									
4.0									
4.5									
5.0									

1.0	>	13	
1.1	>	13	
1.5	>	12	
1.6	>	15	
1.7	>	16	
1.8	>	20	
1.9	>	25	
2.0	>	26	

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.
Plotted By:	KL		Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job Nº / 37211
Test Nº / TP 17

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at TP 17

USCS | **Graphic Log** | **Water Table** | **BLOWS / 100 mm** — **TP 17**

SILT with trace sand dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL/FILL). [1.00m]

USCS: TS

Sandy fine to coarse GRAVEL with minor cobbles; grey. Dense, dry, contains rootlets. Gravel is subrounded to subangular greywacke (POSSIBLE FILL/PITRUN) [1.50m]

USCS: SW

2.5m: Deposit of iron precipitate beneath perched water inflow.

25/06/2020

Sandy SILT with trace clay; bluish grey. Very soft, puggy, saturated, low plasticity. Sand is fine. Unit has wet 'puggy' appearance and consistency. [2.10m]

USCS: ML

24/06/2020

Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.05m]

USCS: GW

Test Pit terminated at 4.65m - Target depth achieved.

Logged By:	AB+HC	**Notes:**	No DCP at TP17 due to surfiial unit of gravel (pit run fill?) - see adjacent DCP 17A. IT2 = TP17
Plotted By:	KL		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº /37211
Test Nº / DCP 17A

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 17A

DEPTH (m)	Strata Description	USCS
0.0	SILT with minor sand and gravel; dark brown. Moist, contains rootlets. Gravel is medium to coarse, subrounded greywacke (TOPSOIL/FILL) [0.40m]	TS
0.5	SILT with minor sand; orangey brown. Soft to very stiff, wet. Sand is fine. [2.90m]	ML
	0.8m: Becomes stiff.	
1.0		
1.5		
2.0		
2.5	2.5m: Groundwater seepage encountered.	
3.0	3.0m: Beomes very stiff.	
3.5	Sandy SILT; bluish grey with localised orangey mottling. Very soft*, saturated. Sand is fine. Unit has wet 'puggy' appearance and consistency. [0.70m]	ML
4.0	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.05m]	GW
	Test Pit terminated at 4.05m - Target depth achieved.	
4.5		
5.0		

Graphic Log

Water Table: 25/06/2020, 24/06/2020

BLOWS / 100 mm

DCP 17A

DEPTH (m)	Blows / 100 mm
3.5	14
	19
	19
	30

Logged By:	AB+HC	**Notes:**	IT2a = TP17a
Plotted By:	KL		* Silt was very soft upon excavation, but DCP results indicate dense which may be attributed to high DCP rod friction at depth.
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 18

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 18

DEPTH (m)	Strata Description	USCS	Graphic Log
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS	
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Firm to hard, moist, non plastic. Sand is fine. [3.40m]	ML	
	0.6m: SV: 164/11		
	0.8m: SV: 159/21		
1.0	1.0m: SV: UTP		
	1.3m: Colour change to orangey brown. Soil becomes hard and wet with an increase in sand content.		
1.5			
2.0			
2.5			
3.0	3.0m - 3.4m: Bed of silty GRAVEL; orangey brown.		
3.5			
3.8	Sandy fine to coarse GRAVEL with trace silt and cobbles; orangey brown with dark reddish stained grey gravel. Dense, wet, moderately well graded. Sand is fine to coarse. Gravel is subangular greywacke. [0.20m]	GW	
4.0	Test Pit terminated at 3.90m - Target depth achieved.		
4.5			
5.0			

Water Table: 24/06/2020

BLOWS / 100 mm

DCP 18

DEPTH (m)	1 2 3 4 5 6 7 8 9
0.5	14
1.0	13
1.5	11 12 14 15 23 21 25
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	

Logged By: AB+HC

Plotted By: KL

Checked By: HC

Notes: Shear vane (SV): peak/remoulded (kPa)
Unable to penetrate with SV (UTP)

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 19

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	24/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

DEPTH (m)	STRATA DESCRIPTION Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005 **Test Pit at DCP 19**	USCS	Graphic Log	Water Table	BLOWS / 100 mm DCP 19	DEPTH (m)
0.0	SILT with trace sand; dark greyish brown. Moist, contains rootlets. Sand is fine (TOPSOIL). [0.30m]	TS				0.0
0.5	SILT with minor sand; light grey with patchy orangey brown mottling. Stiff to hard, moist, non plastic. Sand is fine. [2.20m] 0.7m: Colour change to orangey brown. Soil becomes very stiff to hard and wet with an increase in sand content.	ML			14 13 17	0.5
1.0						1.0
1.5	1.5m: Becomes hard.				12 13 17 20 21 24	1.5
2.0				24/06/2020		2.0
2.5	Fine to coarse GRAVEL with some sand; grey. Dense, saturated, poorly graded (fine possibly washed out). Gravel is subangular greywacke. Sand is coarse. [0.50m] 2.8m: Groundwater inflow.	GP		28/07/2020		2.5
3.0	Test Pit terminated at 3.00m - Target depth achieved.					3.0
3.5						3.5
4.0						4.0
4.5						4.5
5.0						5.0

Logged By:	AB+HC	**Notes:**	Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building. Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)
Plotted By:	KL		
Checked By:	HC		

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SHALLOW INVESTIGATION RESULTS

Job № 37211
Test № / DCP 20

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	25/06/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	13T Ex+DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

Test Pit at DCP 20

DEPTH (m)	Strata Description	USCS	Graphic Log
0.0	SILT with some sand; dark grey. Moist, rootlets. Sand is fine. (TOPSOIL) [0.40m]	TS	TS
0.5	SILT with some sand; light orangey brown/grey with orange mottles. Very stiff to hard, moist, trace rootlets. [1.90m] 0.5m: SV: 129/46 0.6m: Becomes stiff. 0.8m: SV: 196+ 0.9m: SV: 168/59 1.3m: Becomes hard.	ML	
2.5	Medium to coarse GRAVEL with some sand and trace cobbles; orangey brown. Dense, moist. Gravel is subangluar to well rounded greywacke, iron staining on outside of gravel/cobbles. Sand is coarse. [0.60m]	GP	
2.90	Test Pit terminated at 2.90m - Target depth achieved.		

Water Table: Groundwater Not Encountered

BLOWS / 100 mm

DCP 20

DEPTH (m)	1	2	3	4	5	6	7	8	9
0.0									
0.5									
1.0									
1.5									
2.0									
2.5									
3.0									
3.5									
4.0									
4.5									
5.0									

DEPTH (m)	Blows / 100 mm
0.5	12
1.0	12
1.5	11
2.0	15
2.5	15
3.0	15
3.5	20
4.0	24
4.5	30
5.0	

Logged By: JLP

Plotted By: KL

Checked By:

Notes: IT1a = TP20

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº 37211
Test Nº TP 20A + HA

Project: 2 Auckland Street, Ashley (Lot 1 DP 394101)
Client: A J Cameron
Test Location: Refer to attached Geotechnical Site Plan (G01A).

Date: 24/06/20
Time: 10:00 a.m.
Excavation Method: DCP

DEPTH (m)	STRATA DESCRIPTION Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005 **Auger at TP 20A**	USCS	Graphic Log	Water Table
0	SILT with some sand; dark grey. Moist, rootlets. Sand is fine. (TOPSOIL) [0.30m]	TS		Groundwater Not Encountered
0.5	SILT with some sand; light orangey brown/grey with orange mottles. Stiff to hard, moist. [1.30m]	ML		
1.5	Silty medium to coarse GRAVEL with some sand and trace cobbles; orangey brown. Dense, dry. [1.10m]	GM		
2.5	Medium to coarse GRAVEL with some sand and trace cobbles; orangey brown. Dense, moist. Gravel is subangluar to well rounded greywacke, iron staining on outside of gravel/cobbles. Sand is coarse. [1.00m]	GP		
3.5	Auger terminated at 3.70m - Target depth achieved.			
5.0				

BLOWS / 100 mm
TP 20A
1 2 3 4 5 6 7 8 9 | 1 2 3 4 5 6 7 8 9

Logged By: JLP
Plotted By: HC
Checked By: HC

Notes: No DCP at TP20A - see nearby DCP 20.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 21

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

No Associated Log

0.5m: Becomes stiff.

0.7m: Becomes very stiff to hard.

1.5m: Becomes hard.

Groundwater Not Encountered

BLOWS / 100 mm

DCP 21

Depth (m)	Blows / 100 mm
0.5	13
1.0	16
1.5	16
2.0	12
2.5	12
3.0	14
3.5	18
4.0	20
4.5	21
5.0	21

Logged By:	AB+HC	**Notes:**	No test pit undertaken at DCP 21.
Plotted By:	HC		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº / **37211**
Test Nº / **DCP 22**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

No Associated Log

0.6m: Becomes stiff to very stiff.

2.0m: Becomes hard.

Groundwater Not Encountered

BLOWS / 100 mm

DCP 22

Depth (m)	Blows / 100 mm
1.0	13
2.0	11
2.0	11
2.0	18
2.0	19
2.0	30

Logged By:	AB+HC	**Notes:**	No test pit undertaken at DCP 22.
Plotted By:	HC		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 23

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

DEPTH (m)	STRATA DESCRIPTION Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005	USCS	Graphic Log	Water Table	BLOWS / 100 mm DCP 23	DEPTH (m)
	No Associated Log			Groundwater Not Encountered	1 2 3 4 5 6 7 8 9	
0.5	0.8m: Becomes stiff to very stiff.					0.5
1.0					> 11	1.0
1.5	1.6m: Becomes hard.				> 12	1.5
					> 12	
					> 12	
					> 17	
2.0					> 17	2.0
					> 30	
2.5						2.5
3.0						3.0
3.5						3.5
4.0						4.0
4.5						4.5
5.0						5.0

Logged By:	AB+HC	**Notes:**	No test pit undertaken at DCP 23.
Plotted By:	HC		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job № /37211
Test № / DCP 24

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

No Associated Log

0.5m: Becomes stiff to hard.

1.4m: Becomes hard.

Groundwater Not Encountered

BLOWS / 100 mm

DCP 24

Depth (m)	Blows / 100 mm
0.5	14
0.6	16
0.7	14
1.5	13
1.6	16
1.7	17
1.8	23
1.9	27
2.0	30

Logged By:	AB+HC	**Notes:**	No test pit undertaken at DCP 24.
Plotted By:	HC		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº / **37211**
Test Nº / **DCP 25**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

No Associated Log

USCS | **Graphic Log** | **Water Table**

Groundwater Not Encountered

BLOWS / 100 mm

DCP 25

1 2 3 4 5 6 7 8 9

0.4m: Becomes soft to firm.

2.0m: Becomes stiff.

3.1m: Becomes very stiff to hard.

Depth (m)	Blows / 100 mm
3.0	11
3.1	11
3.2	12
3.3	11
3.4	12

Logged By: AB+HC

Plotted By: HC

Checked By: HC

Notes: No test pit undertaken at DCP 25.

Fill inferred to ~0.3 m.

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

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SHALLOW INVESTIGATION RESULTS

Job Nº / **37211**
Test Nº / **DCP 26**

Project:	2 Auckland Street, Ashley (Lot 1 DP 394101)	**Date:**	10/07/20
Client:	A J Cameron	**Time:**	10:00 a.m.
Test Location:	Refer to attached Geotechnical Site Plan (G01A).	**Excavation Method:**	DCP

STRATA DESCRIPTION

Strata description in general accordance with Field Description of Soil and Rock. Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes. NZ Geotechnical Society Inc, December 2005

No Associated Log

USCS | Graphic Log | Water Table

Groundwater Not Encountered

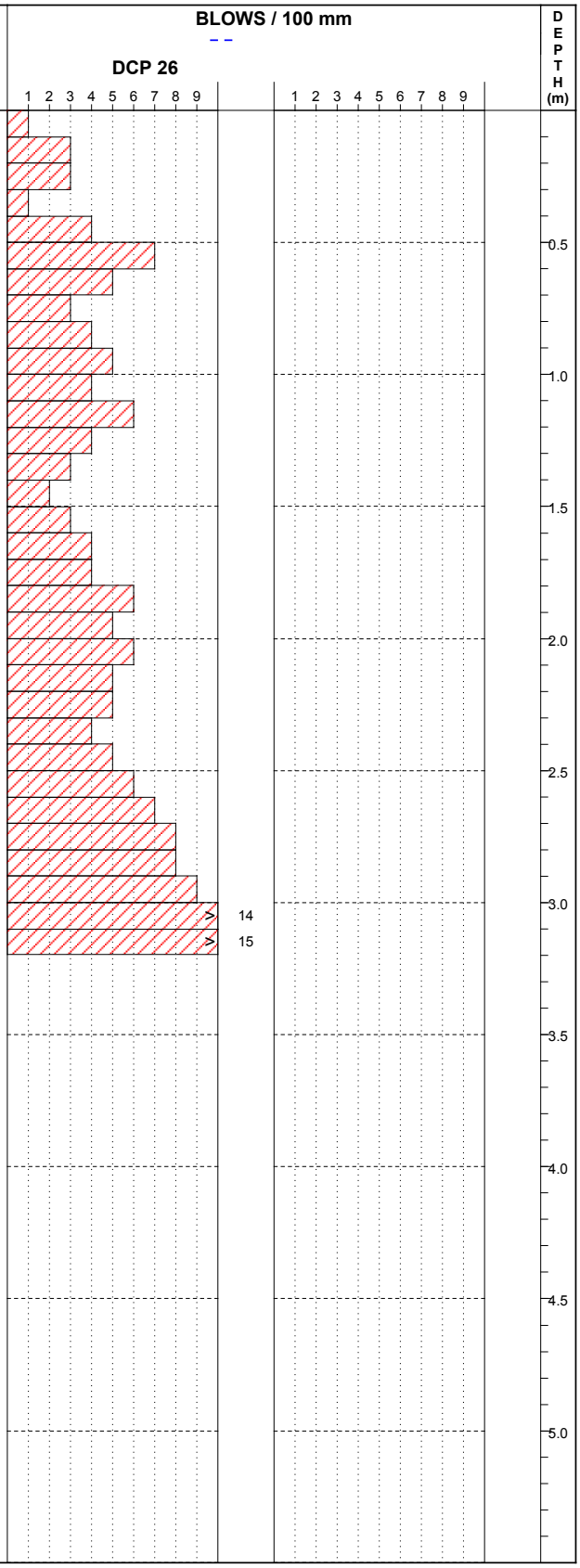
0.7m: Firm.

1.6m: Becomes stiff.

2.5m: DCP rod wet

2.6m: Becomes very stiff.

3.0m: Becomes hard.



Logged By:	AB+HC	**Notes:**	No test pit undertaken at DCP 26. Fill interred to ~0.5 m.
Plotted By:	HC		
Checked By:	HC		

Dynamic Penetrometer Test and logs give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations. This log does not cover slope stability or suitability of the site for building.

Dynamic Cone Penetrometer Test performed in accordance with NZS 4402 Test 6.5.2 (Procedure 1 and 2)

APPENDIX D:

Falling Head Infiltration (FHI) Test Results

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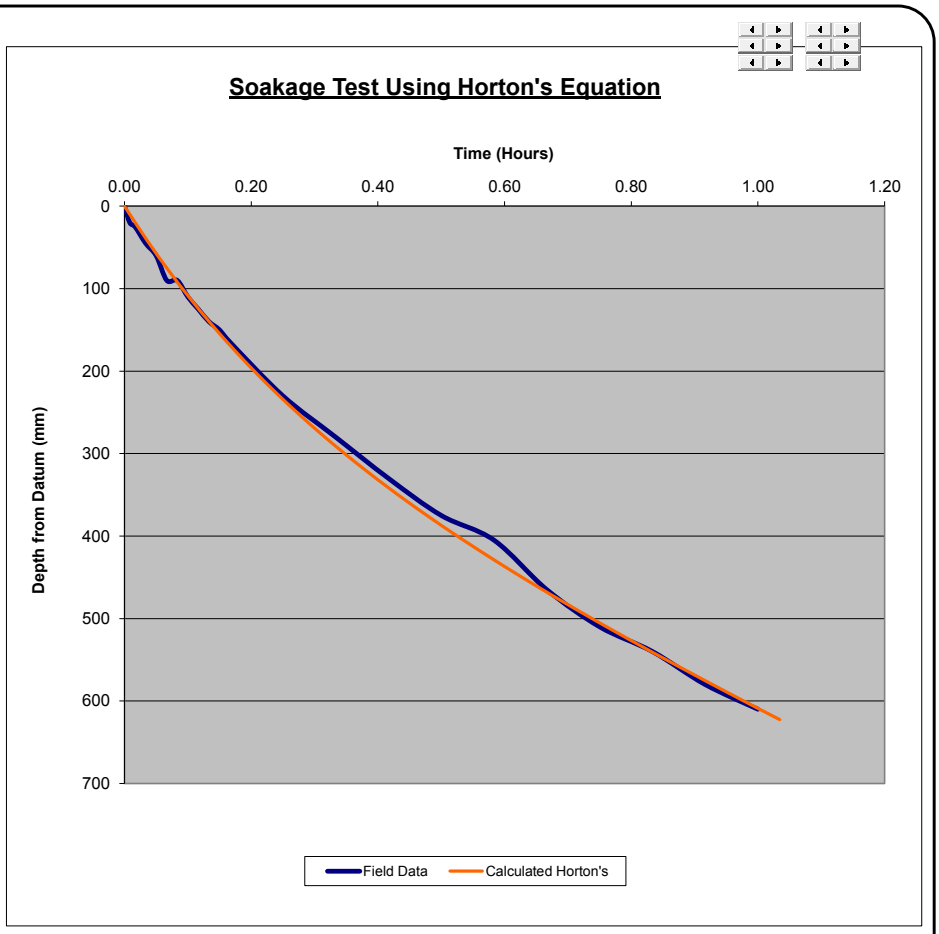
INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	FHI1
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB JLP				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1000 x 2800 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	25
3	2.00	45
4	3.00	60
5	4.00	90
6	5.00	90
7	6.00	110
8	7.00	125
9	8.00	140
10	9.00	150
11	10.00	165
12	15.00	230
13	20.00	280
14	25.00	330
15	30.00	375
16	35.00	405
17	40.00	465
18	45.00	510
19	50.00	540
20	55.00	580
21	60.00	610
22		
23		
24		
25		
26		
27		
28		
29		
30		



Initial Infiltration Rate:	**1214.00**	**mm per hour**
Ultimate Infiltration Rate:	**372.00**	**mm per hour**
Horton's Decay Coefficient:	**3.44**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	FHI-1A-1
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB JLP				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	1100 x 1500 x 3700 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	40
2	1.00	70
3	1.50	130
4		
5		
6		
7		
8		
9		
10		
11		
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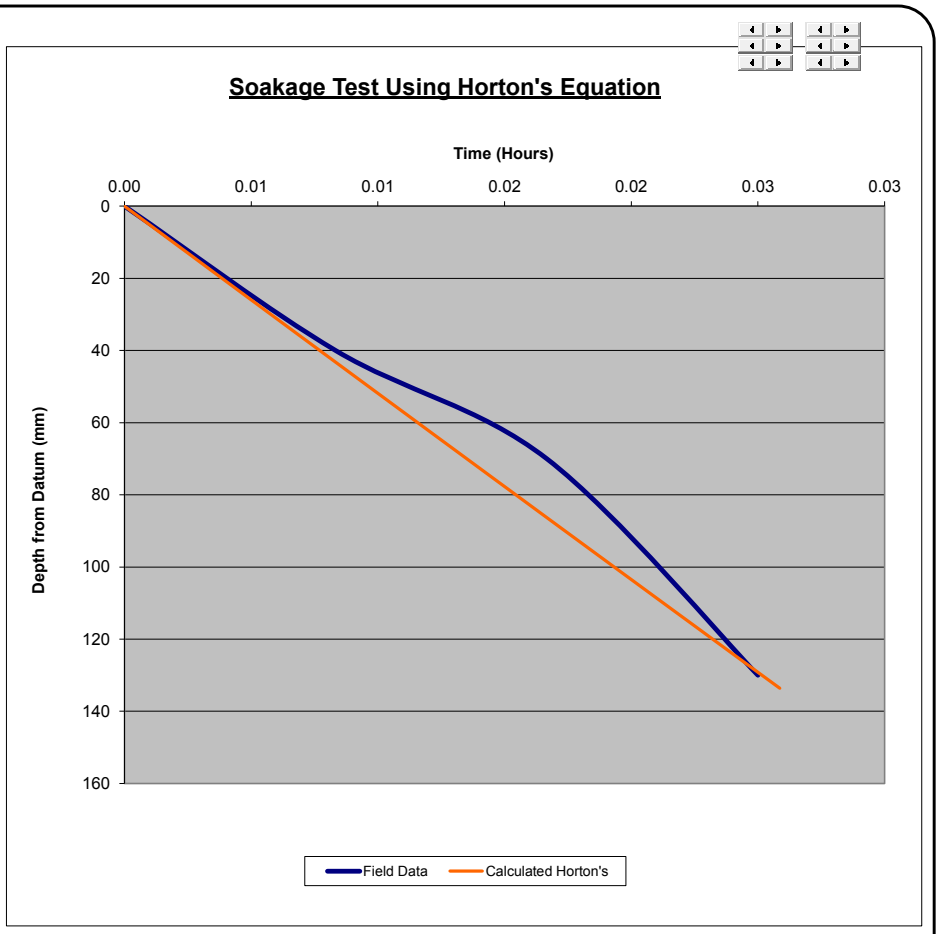

Initial Infiltration Rate: 5200.00 mm per hour

Ultimate Infiltration Rate: 255.00 mm per hour

Horton's Decay Coefficient: 0.53 per hour

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	FHI1A-2
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1000 x 2800 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	25
3	1.50	45
4	2.00	60
5	3.00	90
6	4.00	90
7	5.00	110
8	6.00	125
9	7.00	140
10	8.00	150
11	9.00	165
12		
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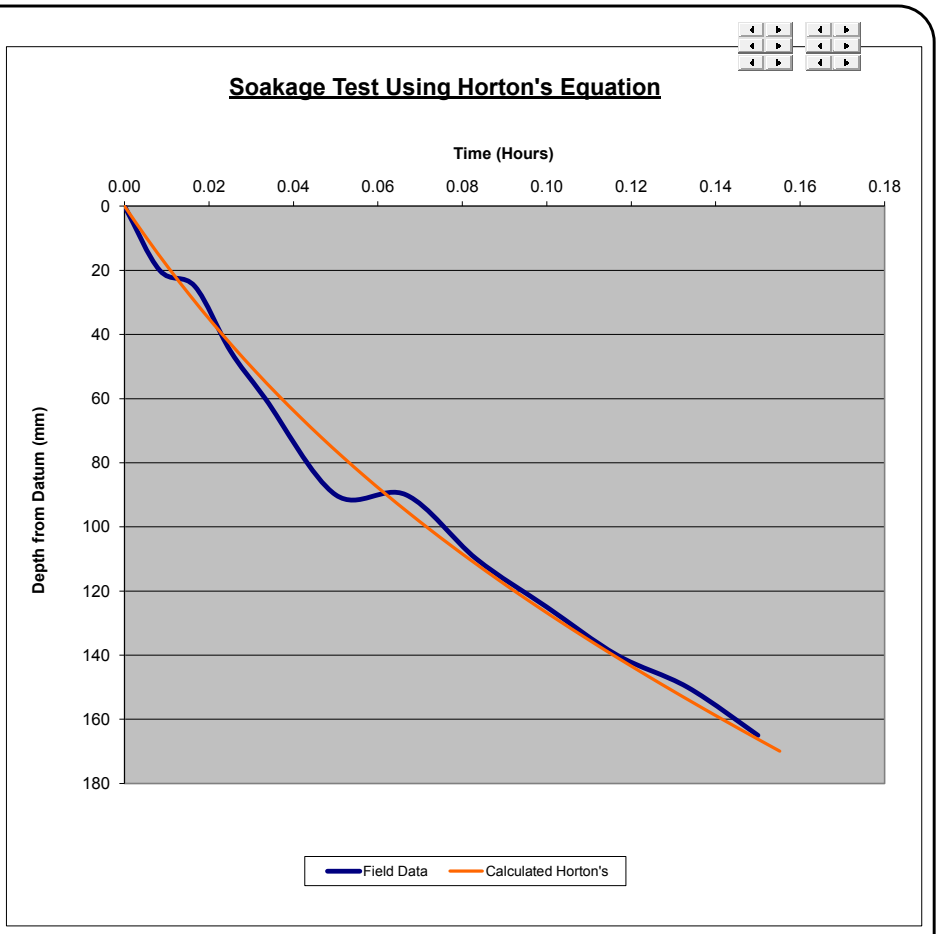

Initial Infiltration Rate:	**1953.00**	**mm per hour**
Ultimate Infiltration Rate:	**616.00**	**mm per hour**
Horton's Decay Coefficient:	**16.62**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	FHI1A-3
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1000 x 2800 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	40
3	2.00	70
4	3.00	110
5	4.00	130
6	5.00	155
7	6.00	180
8	7.00	200
9	8.00	220
10	9.00	240
11	10.00	265
12	12.50	310
13	15.00	360
14		
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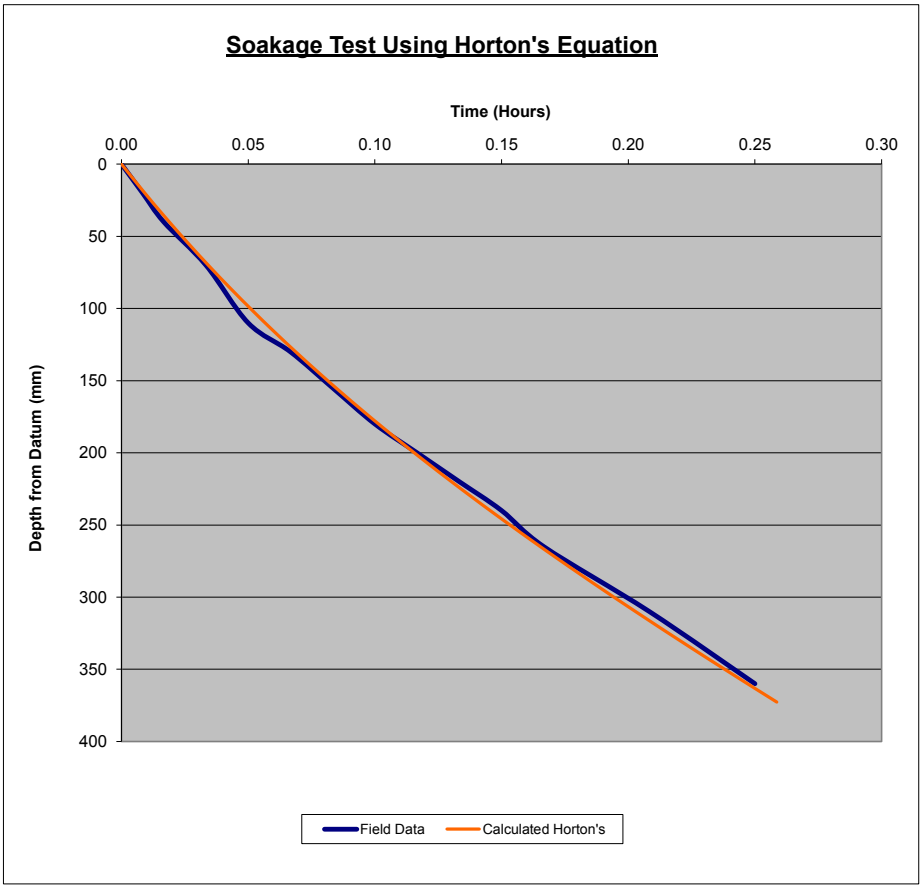

Initial Infiltration Rate: 2232.00 mm per hour

Ultimate Infiltration Rate: 1001.00 mm per hour

Horton's Decay Coefficient: 10.00 per hour

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP4-1
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1000 x 2800 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	70
2	1.00	150
3	2.00	250
4	3.00	310
5	4.00	360
6	5.00	430
7	6.00	470
8	8.00	560
9	10.00	640
10	12.50	740
11	15.00	830
12	20.00	1000
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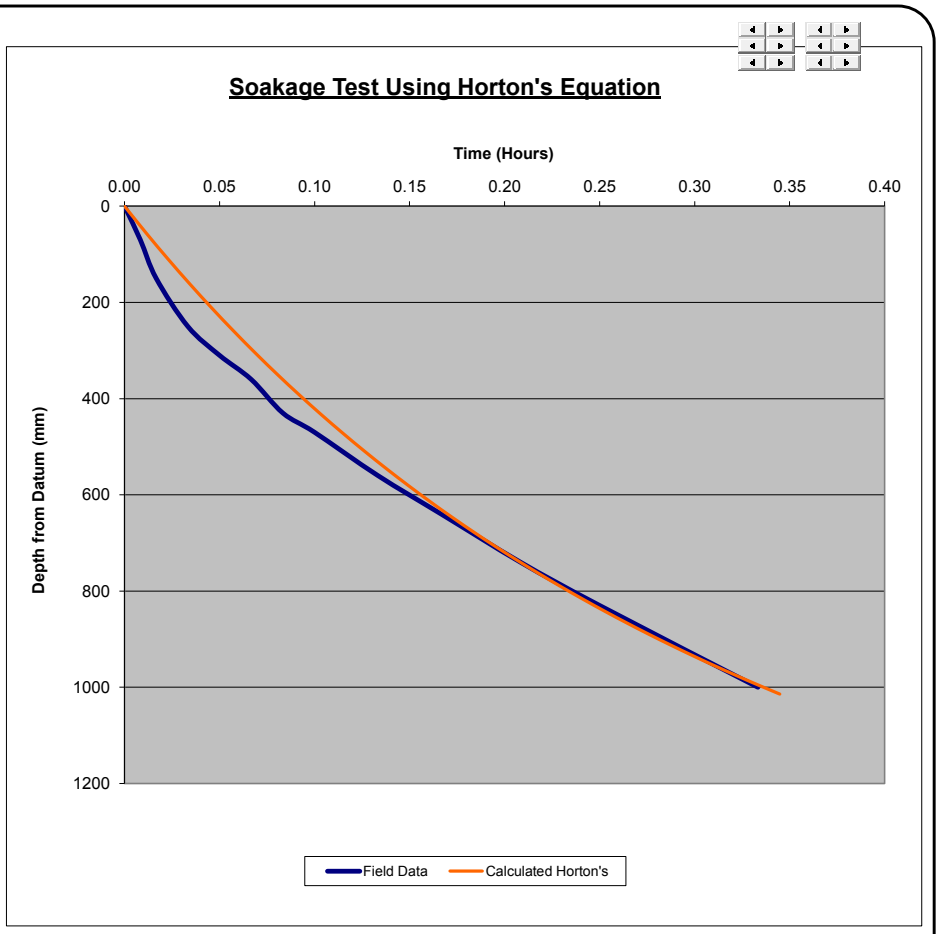

Initial Infiltration Rate:	**5000.00**	**mm per hour**
Ultimate Infiltration Rate:	**500.00**	**mm per hour**
Horton's Decay Coefficient:	**4.00**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	FHI19
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2300 x 1100 x 1600 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	1800
1	33.00	1800
2	110.00	1800
3	184.00	1800
4		
5		
6		
7		
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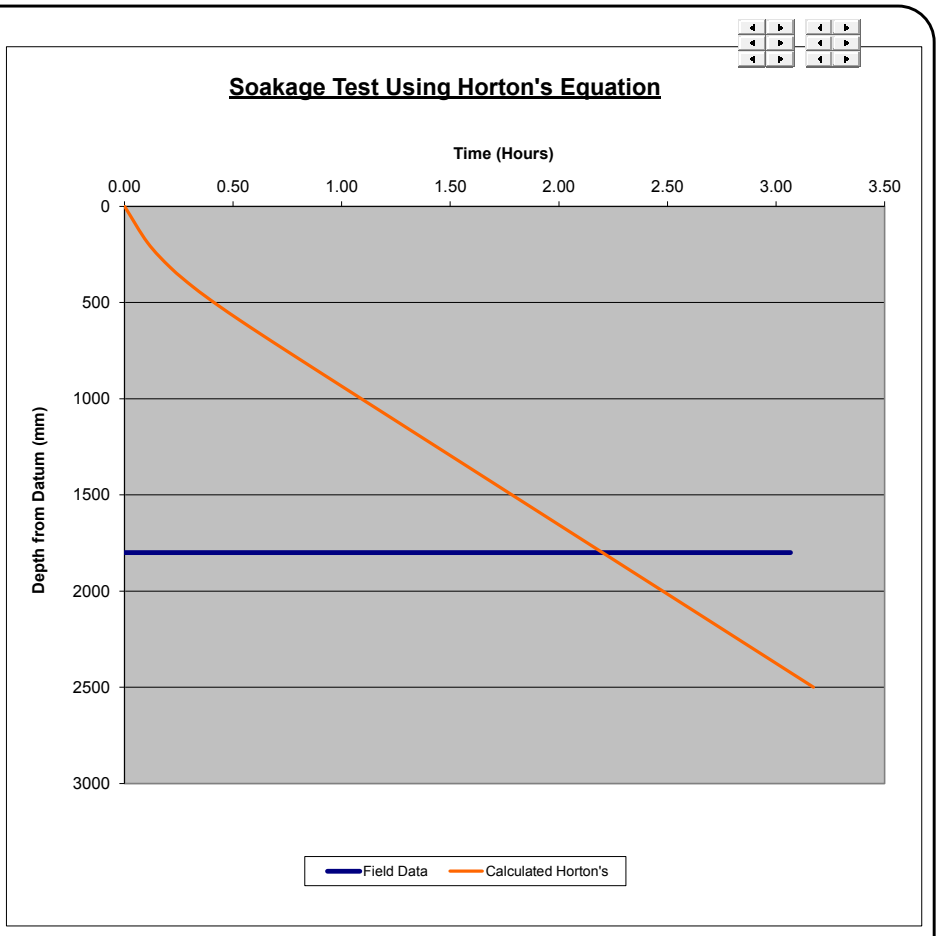

Cannot model 'no change' in field data water level

Initial Infiltration Rate: 2228.00 mm per hour

Ultimate Infiltration Rate: 720.00 mm per hour

Horton's Decay Coefficient: 7.00 per hour

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 9-1
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	3900 x 1100 x 2600 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	50
3	2.00	130
4	3.00	120
5	4.00	110
6	5.00	190
7	6.00	220
8	7.00	240
9	8.00	280
10	9.00	315
11	10.00	344
12	11.00	360
13	12.00	380
14	13.00	410
15	14.00	430
16	15.00	450
17	20.00	550
18	25.00	630
19	30.00	710
20	35.00	750
21	40.00	810
22	45.00	840
23	50.00	910
24	55.00	950
25		
26		
27		
28		
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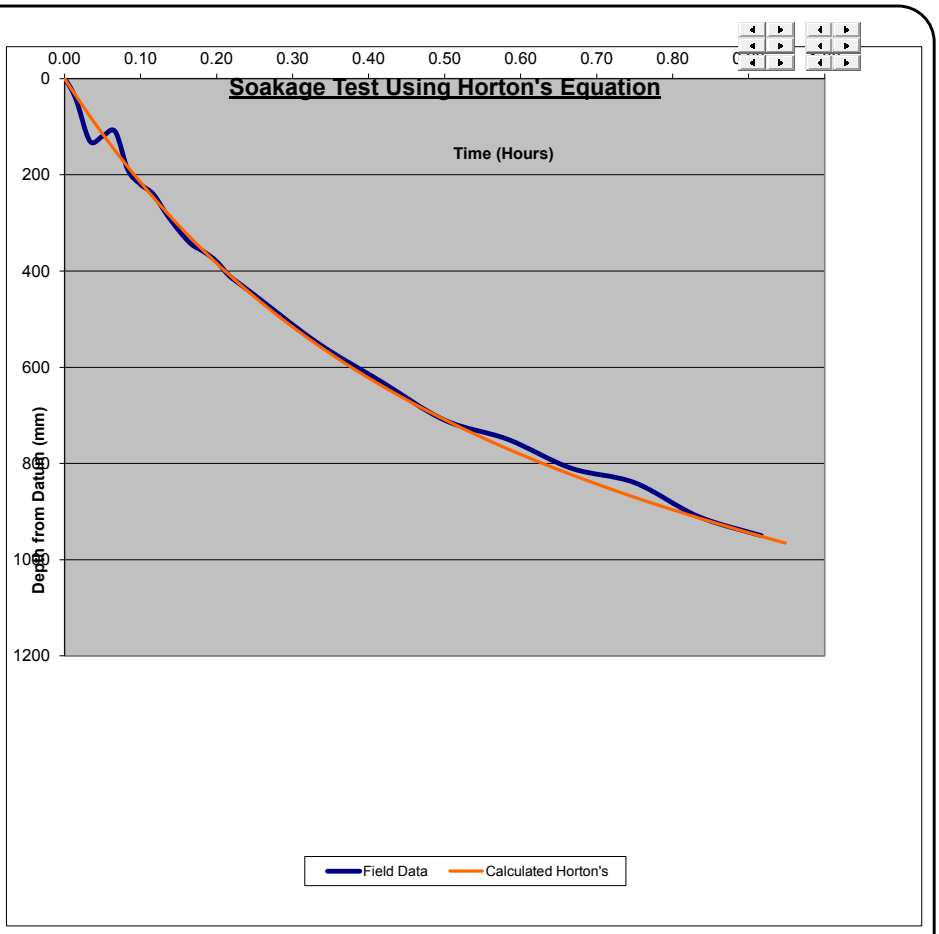

Initial Infiltration Rate:	**2449.00**	**mm per hour**
Ultimate Infiltration Rate:	**310.00**	**mm per hour**
Horton's Decay Coefficient:	**3.00**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 9-2
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	3900 x 1100 x 2600 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	40
3	2.00	60
4	3.00	100
5	4.00	120
6	5.00	130
7	6.00	170
8	7.00	190
9	8.00	215
10	9.00	230
11	10.00	250
12	15.00	340
13	20.00	410
14	25.00	480
15	30.00	540
16	35.00	610
17	40.00	650
18	45.00	710
19	50.00	750
20	55.00	790
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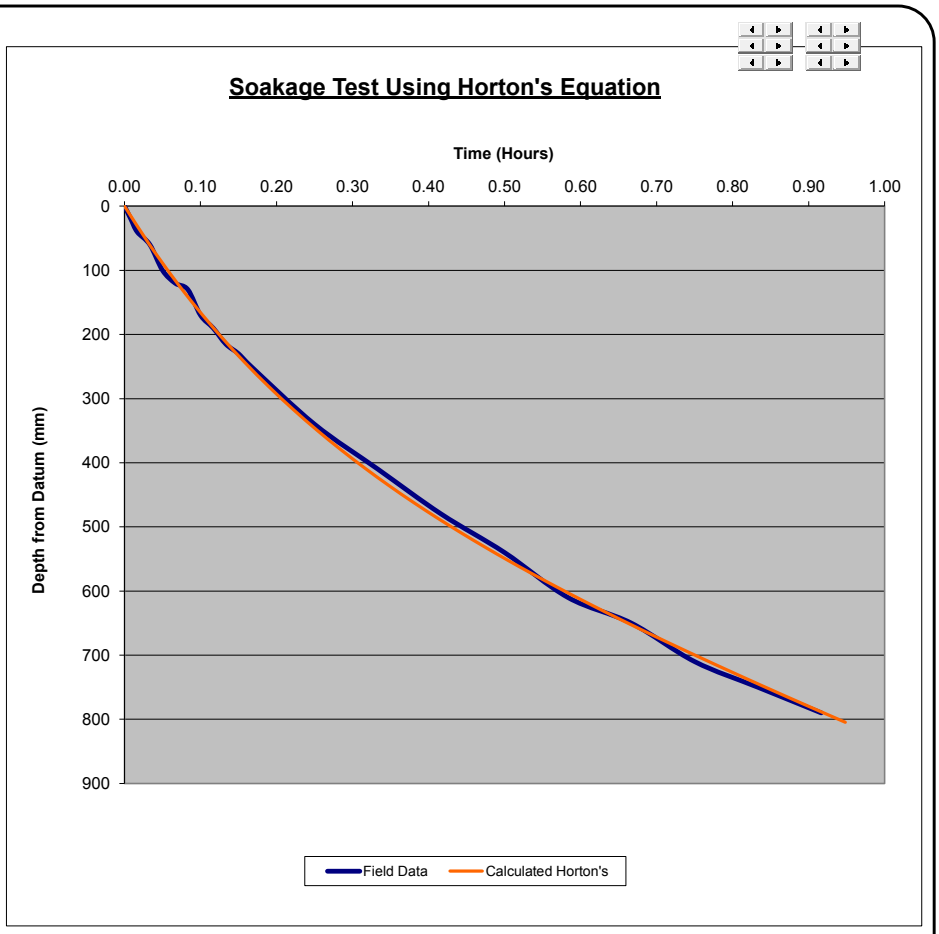

Initial Infiltration Rate:	**1910.00**	**mm per hour**
Ultimate Infiltration Rate:	**480.00**	**mm per hour**
Horton's Decay Coefficient:	**4.00**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 9-3
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	3900 x 1100 x 2600 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	15
2	1.00	25
3	2.00	50
4	3.00	65
5	4.00	80
6	5.00	100
7	6.00	120
8	7.00	140
9	8.00	150
10	9.00	180
11	10.00	190
12	15.00	270
13	20.00	340
14	25.00	390
15	30.00	450
16	35.00	490
17	40.00	540
18	45.00	580
19	50.00	620
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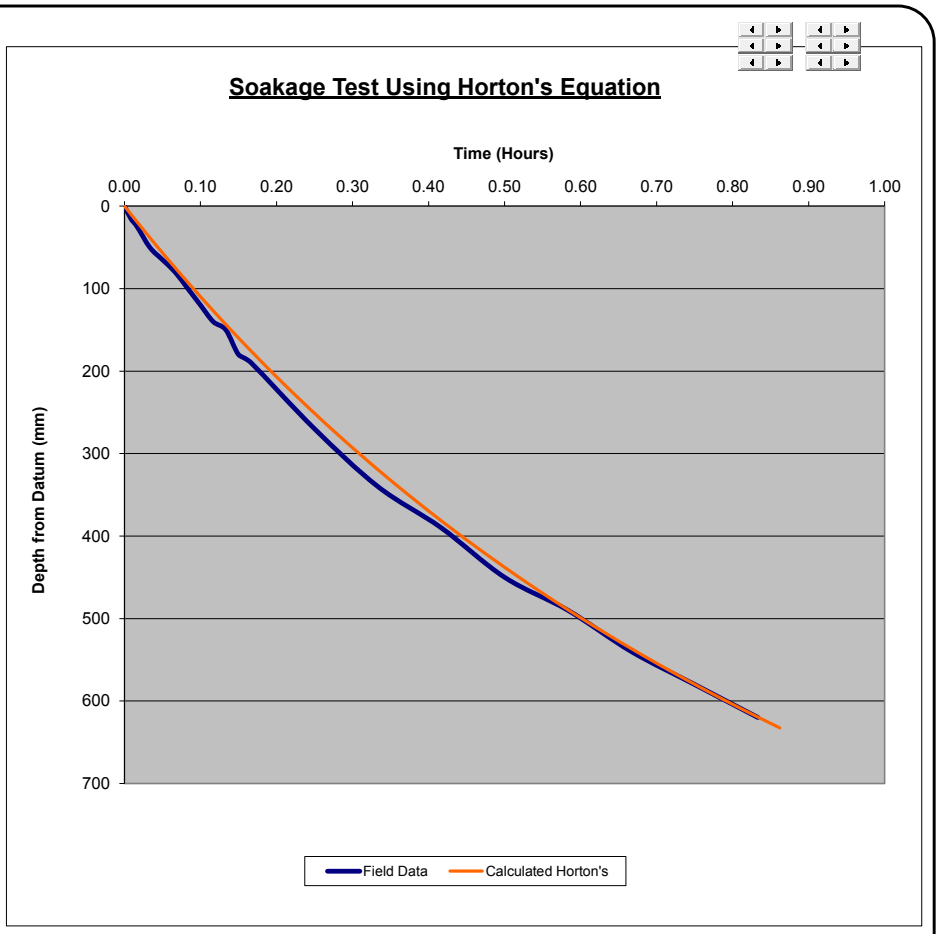

Initial Infiltration Rate:	**1168.00**	**mm per hour**
Ultimate Infiltration Rate:	**161.00**	**mm per hour**
Horton's Decay Coefficient:	**1.46**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 6-1
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1100 x 2700 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	20
2	1.00	50
3	2.00	110
4	3.00	170
5	4.00	220
6	5.00	270
7	6.00	315
8	7.00	355
9	8.00	390
10	9.00	425
11	10.00	455
12	15.00	600
13	20.00	675
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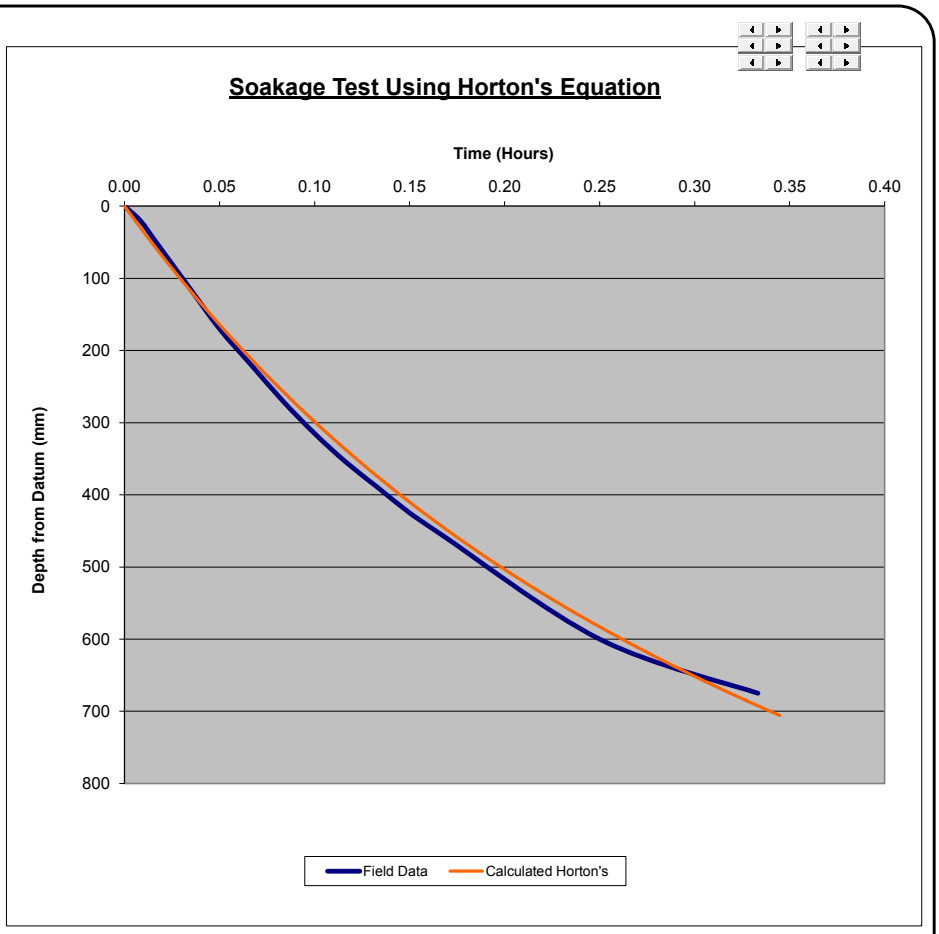

Initial Infiltration Rate:	**3633.00**	**mm per hour**
Ultimate Infiltration Rate:	**613.00**	**mm per hour**
Horton's Decay Coefficient:	**5.03**	**per hour**

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CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 6-2
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1100 x 2700 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	30
2	1.00	55
3	2.00	105
4	3.00	160
5	4.00	190
6	5.00	240
7	6.00	275
8	7.00	310
9	8.00	350
10	9.00	380
11	10.00	410
12	15.00	550
13	20.00	660
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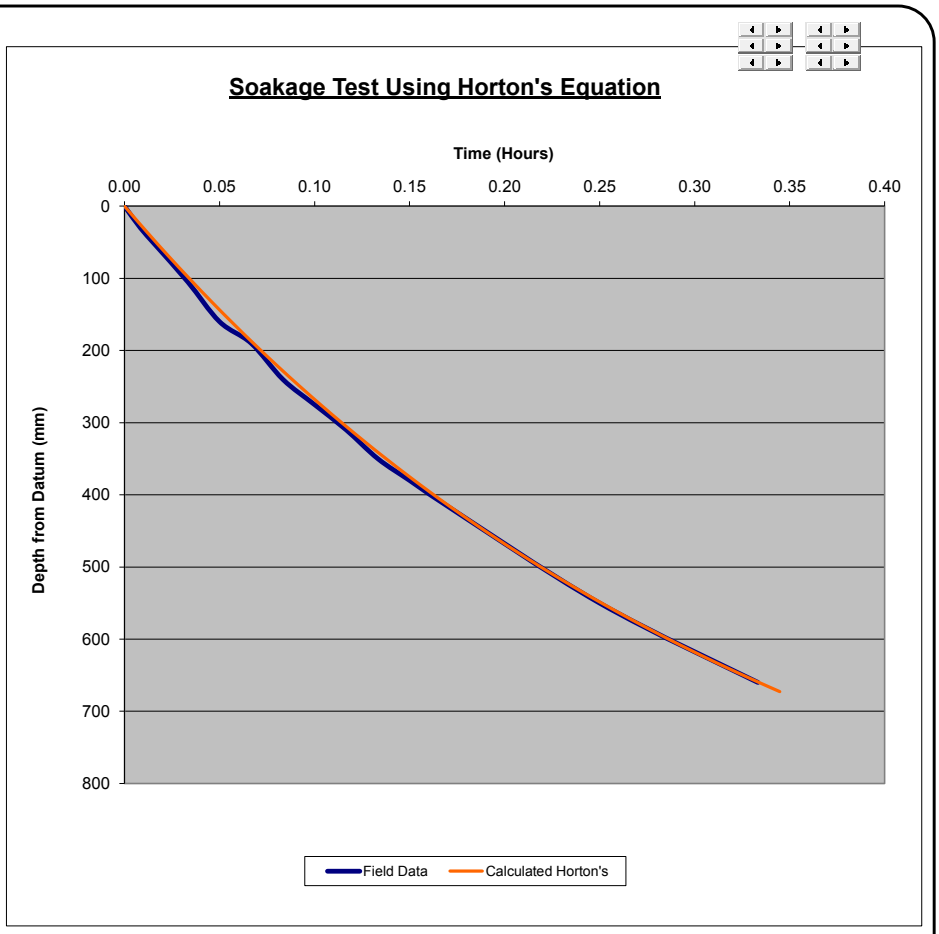

Initial Infiltration Rate:	**3088.00**	**mm per hour**
Ultimate Infiltration Rate:	**71.00**	**mm per hour**
Horton's Decay Coefficient:	**3.00**	**per hour**

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INFILTRATION TEST RESULTS

CONSTRUCTION VERIFICATION

Issued to:	File				
Date:	24 June 2020	Job name:	2 Auckland Street, Ashley	Test Pit:	TP 6-3
Time:		Job no:	37441		
People/equipment/materials on site:	HC AB TR				
Weather/ground conditions:	Wet				
Test/photographs taken:	Falling head infiltration test				
Location Information:					
Pit size:	2500 x 1100 x 2700 (L x W x D)				

Timestep	Time (mins)	Depth from Datum (mm)
0	0.00	0
1	0.50	15
2	1.00	30
3	2.00	70
4	3.00	110
5	4.00	145
6	5.00	175
7	6.00	210
8	7.00	240
9	8.00	265
10	9.00	290
11	10.00	320
12	15.00	440
13	20.00	530
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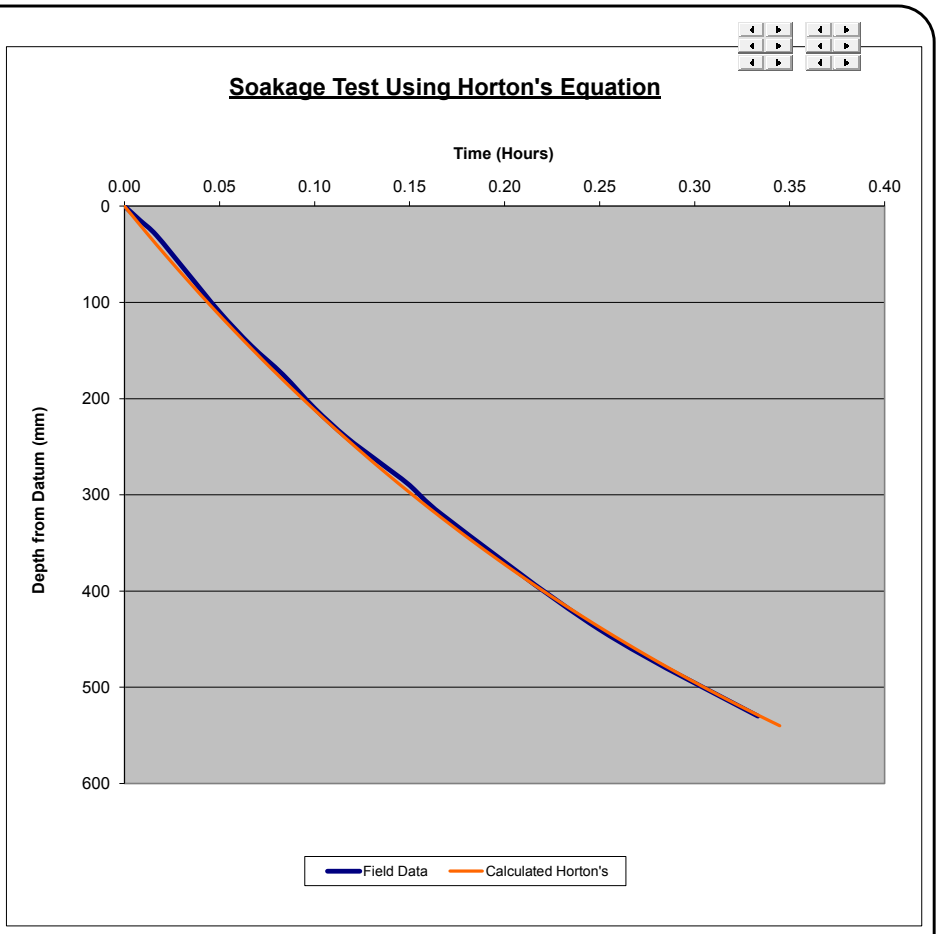


Initial Infiltration Rate:	**2430.00**	**mm per hour**
Ultimate Infiltration Rate:	**138.00**	**mm per hour**
Horton's Decay Coefficient:	**3.00**	**per hour**

STATEMENT OF PROFESSIONAL OPINION ON THE SUITABILITY OF LAND FOR SUBDIVISION

Issued by:	Davis Ogilvie & Partners Ltd *(Geotechnical engineering firm or suitably qualified engineer)*
To:	Alistair Cameron *(Owner/Developer)*
To be supplied to:	Waimakariri District Council *(Territorial authority)*
In respect of:	30 Lot Subdivision (28 Residential Lots) *(Description of proposed infrastructure/land development)*
At:	2 Auckland Street, Ashley - Lot 1 DP 394101 (Title 376526) *(Address)*

I, Joanna Lea Petheram *(Engineering Geologist)* on behalf of Davis Ogilvie and Partners Limited *(Geotechnical Engineering Firm*) hereby confirm:

1. I am a suitably qualified and experienced geotechnical engineer/engineering geologist, employed by Davis Ogilvie and the geotechnical firm named above was retained by the owner/developer as the geotechnical engineer/engineering geologist on the above proposed development.

2. This geotechnical assessment report titled “Geotechnical Report For Subdivision: 2 Auckland Street, Ashley” dated 29 September 2020 has been carried out in accordance with the Ministry of Business, Innovation and Employment (MBIE) *Part D – Guidelines for geotechnical investigation and assessment of subdivisions in the Canterbury region* and the Waimakariri District Council *Engineering Code of Practice* – Part 4: Geotechnical Requirements, and includes:

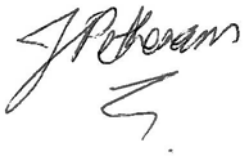
   (i) Site walkover and shallow testing (26 test points) results;
   (ii) Review of data available on the New Zealand Geotechnical Database (NZGD) and previous geotechnical reports;
   (iii) A visual assessment of rockfall and slippage, including potential hazards associated with seismic activity;
   (iv) A visual assessment of the slope stability and discussion on the appropriateness of building sites;
   (v) Recommendations including measures to avoid, remedy or mitigate any potential hazards on the land subject to the application, in accordance with the provisions of Section 106 of the Resource Management Act 1991.

3. In my professional opinion, not to be construed as a guarantee, I consider that Council is justified in granting consent incorporating the following conditions:
   i. Site-specific geotechnical investigation at building consent stage will be required to determine the depth to an appropriate bearing capacity at the location of each dwelling;
   ii. Finished floor levels are confirmed during the consenting process by Waimakariri District Council and/or Environment Canterbury:;
   iii. Specific engineering design, observation and certification will be required on proposed Lots 16 and 17 to address the reduced bearing capacity and possible low liquefaction risk identified in this area.

4. This professional opinion is furnished to the territorial authority and the owner/developer for their purposes alone, on the express condition that it will not be relied upon by any other person and does not remove the necessity for appropriate geotechnical investigation and the normal inspection of foundations and ground conditions at the time of construction of any building.

5. This certificate shall be read in conjunction with the geotechnical report referred to in Clause 2 above, and shall not be copied or reproduced except in conjunction with the full geotechnical completion report.

6. The geotechnical engineering firm issuing this statement holds a current policy of professional indemnity insurance of no less than $ 2,000,000.00 (Minimum amount of insurance shall be commensurate with the current amounts recommended by EngNZ, ACENZ, TNZ, INGENIUM.)



……

(Signature of Engineer)

For and on behalf of Davis Ogilvie & Partners Ltd.

Date: 29 September 2020

Qualifications and experience:

M.Sc. (Hons)

CMEngNZ (PEngGeol) 1010421