Sunfield Developments Limited

GEOTECHNICAL ASSESSMENT REPORT

Sunfield Landholding, Ardmore

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DOCUMENT CONTROL

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Revision	Prepared By	Reviewed & Authorised By
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This report represents the results of the geotechnical investigations and analyses carried out by LDE Limited for and in accordance with instructions received from Sunfield Developments Limited with regard to a consent application for the Sunfield Landholding, Ardmore.

If you have any queries or you require any further clarification on any aspects of this report, please do not hesitate to contact the engineers listed above.

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SYMBOLS:

S_u:	Undrained shear strength (kPa)	**LL**:	Liquid Limit (%)
N-value:	recorded from SPT	**PL**:	Plastic Limit (%)
q_c:	CPT cone resistance (MPa)	**PI**:	Plasticity Index (%)
m_v:	coefficient of volume compressibility (m^2/MN)	**LS:**	Linear Shrinkage (%)
y:	Bulk unit weight (kN/m^3)	**e_0:**	Initial Void Ratio
c':	Effective cohesion (kPa)	**e_f:**	Final Void Ratio
Ø':	Effective friction angle (degrees)	**$\rho_{d,i}$:**	Initial Dry Density (t/m^3)

1 EXECUTIVE SUMMARY

This summary outlines the principal geotechnical issues, design considerations and advice presented as part of our investigation and assessments for the Sunfield Development, Ardmore. Further details are presented in the relevant sections in the main body of the report.

Report Ref.	Geotechnical Consideration	Summary advice/recommendation
6.1 – 6.5	Ground Conditions	The site is underlain by extensive soft to firm organic PEAT soils and soft CLAY deposits generally in the western part of the site with variable depths of inorganic / organic stained crust up to 2.2m thick, although generally less than 1m thick. Isolated PEAT soils are also located along the eastern boundary adjacent to Ardmore Airport. The eastern part of the study area is generally defined by silty CLAY and clayey SILT deposits underlain by East Coast Bays Formation (ECBF) bedrock at depths of between 3.7m and 19.4m. For the purposes of site classification, the above soil groups (types) are referred to collectively as **Zone 1 (peats)** and **Zone 2 (inorganic clays)** respectively throughout this report – refer Figure 2.1.
6.6	Groundwater	Groundwater levels were recorded in piezometers on 30 April 2021, 30 July 2021, 27 October 2021, 17 January 2022, and 9 February 2023 at depths of between 0.20m and 7.17m below existing ground levels, although most locations recorded groundwater depths between 1.0m and 3m. This is considered to be generally representative of a year-round seasonal groundwater regime, with the February 2023 groundwater readings being undertaken during a historic high rainfall period in Auckland, however these show no significant deviations from the established trends.
6.7, 8.7	Percolation	Falling head percolation testing has determined that minimum percolation rates of between 0.0743 L/m2/min in Zone 2 soils and 0.01 L/m2/min in Zone 1 soils. It is paramount to minimise widespread consolidation settlements post-development that groundwater levels are maintained in Zone 1 soils through recharge of stormwater runoff via soakage pits and/or swales.
7.2	Slope Stability	Slope stability of the proposed 1(v) in 4(h) stormwater channel has been analysed and is considered satisfactory. Precedence has also been set by the recently constructed Takanini Stormwater Conveyance Channel, which is a larger system. Similarly, natural or proposed slopes elsewhere on the site will not exceed 1(v) in 4(h) and computer slope stability analysis is not usually warranted in this case.

Report Ref.	Geotechnical Consideration	Summary advice/recommendation
7.3.1, 8.1	Consolidation Settlements	Ground improvements to address consolidation settlements in Zone 1 soils will generally comprise ground improvements involving undercutting beneath building footprints and reinstatement with compacted hardfill or sand and/or preloading. Precedence has typically been set in the Takanini / Ardmore for these types of ground improvements in many significant subdivisions just to the west of Cosgrave Road.
7.3.2	Drawdown Settlements	Drawdown settlements are likely limited to the proposed stormwater channel which will incise below the surface of the surrounding (prevailing) topography. This should be addressed at Engineering Plan Approval (EPA) stage.
7.4	Liquefaction	Most Zone 1 soils have been determined to be susceptible to liquefaction, especially where limited or no stiff crust is present. This is due to cyclic softening of the soft cohesive materials rather than dramatic 'sand boils' or lateral spreading. Ground improvements to address liquefaction can be addressed by the same ground improvements required for consolidation settlement (i.e. pre-loading and raft foundation design for buildings). Liquefaction induced total settlements should be considered in the subdivision design levels with regard to overland flow paths and floodplains, in order to maintain 'free board' following such an event. However, consolidation settlements from imposed earthworks and building loads is by far the greatest geotechnical engineering issue for consideration here.
8.1	Foundations	Foundations within Zone 1 areas for NZS3604 one to two storey light weight timber frame construction, heavier two storey, terraced (i.e. conjoined dwellings) or three storey dwellings will likely require some degree of ground improvement and stiffened raft foundations as outlined in Section 7.3, in conjunction with preloading. Buildings exceeding these loadings / storeys will likely be subject to piled foundations. Subject to further investigations, foundations in Zone 2 should be suitable for standard NZS 3604-type (i.e. lightweight) construction up to three storeys utilising strip and pad footings designed in accordance with AS 2870 and related documents. For commercial / industrial buildings within Zone 1, the foundation solution will be commensurate on end use and as such will require site specific investigations and foundation design. Examples of specific buildings and ground improvement / foundation solutions are presented in Section 8.1.1. For commercial / industrial within Zone 2 more conventional shallow foundations solutions are possible dependent on end-use, however,

Report Ref.	Geotechnical Consideration	Summary advice/recommendation
8.1 (cont.)	Foundations (cont.)	these types of buildings will generally require site specific investigation and foundation design. A summary table of preloading and/or localised ground improvement requirements and specific foundation design criteria is presented in Table 6.2 (Appendix 6.1).
8.2	Expansive Soils	Likely MBIE and/ or AS2870:2011 expansive site class classification for the finished subdivision is likely to fall within Classes M to H. Further assessments involving laboratory shrink-swell testing in accordance with MBIE guidelines should be completed at subdivision stage, provided undisturbed samples can be successfully obtained and tested in the peats (our understanding is that this is virtually impossible in type S1a geology).
8.3	Non-engineered Fills	An area of non-engineered fill has been identified in the south-eastern portion of the site. This material will need to be undercut and reinstated or ground improvement completed within proposed dwelling, infrastructure or roading areas subject to future master planning. There may be other areas of non-engineered fill and further comprehensive geotechnical site investigations prior to construction should minimise the risk of unforeseen areas of non-engineered fills in this regard.
8.4	Earthworks and Civil Works	Within Zone 1 areas, ground improvements will be required to mitigate settlements resulting from the proposed earthworks and building loads, which may include undercut and replacement, preloading and/or lag-periods following earthworks to allow settlements to attenuate. Earthworks in these areas require the use of track-rolled peat materials which are not covered by normal subdivisional compaction specifications. Within Zone 2, the cut materials should be suitable for re-use in other Zone 2 areas as certified clay fills which will need to be compacted to standard subdivisional compaction specifications. However, some degree of conditioning will likely be required to achieve suitable moisture contents for maximum compaction. Within the flatter Zone 2 areas (Stratum S2a), saturated and/or pumiceous soils can often be sensitive to disturbance (via pumping and weaving under earthwork plant). If/where this is encountered, undercutting and replacement of the affected soils will likely by necessary.

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8.5	Pipes and Buried Services in Peat Soils	Public service lines excavated in Zone 1 peat soils face a high risk of settlement of the pipes and redundancy should be built into the service design, such as oversizing pipeline internal diameters, careful consideration in selection of trench backfill materials, seepage cut off collars at regular intervals to prevent the pipe bedding media acting as a groundwater drawdown drain, increased bedding thicknesses, etc. Service lines will also need to be designed to withstand long-term corrosion and specialist advice will need to sought in this regard.
8.6	Roading	Within Zone 1 areas, road subgrades will require subgrade improvement due to the peats / weak crustal deposits. Precedence has been set in the Takanini / Ardmore area for 500mm to 900mm undercuts reinstated with 'black sand' laid upon geotextile cloth, whereupon targeted beam deflection values have then been achievable. Within Zone 2 areas, likely minimum CBR's of between 2% and 4% should be available for pavement design purposes, and a more conventional approach to pavement construction should be available.

2 SCOPE OF REPORT

LDE Limited (previously trading as Lander Geotechnical Consultants Limited) have been engaged by Sunfield Developments Limited to prepare a Preliminary Geotechnical Assessment Report (PGAR) in support of a specified development project (referred to herein as “the development proposal”).

We understand the application seeks to develop approximately 244 hectares for urban purposes. The development proposal area consists of numbers 80, 85 & 92 Hamlin Road, 55, 55A, 101, 103, 119, 119A, 121A, 123, 131 & 143 Cosgrave Road, 508 Old Wairoa Road, and 279 Airfield Road. The study area is as outlined on the Maven Associates Limited drawings (Appendix 1).

Our work has entailed:

- A review of published geology maps, aerial photograph interpretation and observations of prevailing site geomorphology.
- A review of relevant geotechnical reports relating to the site as well as recent developments in the Takanini / Ardmore area (refer Section 3 below).
- A review of 15 No. Cone Penetrometer Tests (CPTs) undertaken by Initia within 279 Airfield Road in August 2022.
- A field investigation including:
    - The drilling of a series of hand auger boreholes (41 No.) to characterise near surface foundation and groundwater conditions to depths of up to 5m (bgl).
    - The drilling of a series of rotary cored machine boreholes (15 No.) to prove soil conditions beyond the reach of hand augers, to depths up to approximately 30m (bgl), and the installation of a piezometer within each machine borehole for the purposes of groundwater monitoring. Five groundwater monitoring rounds have been completed to date, with the first four rounds completed in April 2021, July 2021, October 2021, and January 2022 encompassing a full seasonal year of readings across the site, and the fifth round completed in February 2023 within 279 Airfield Road following the completion of further drilling at this property in December 2022.
    - The excavation of a series of trial pits (8 No.) to characterise near surface ground conditions and groundwater levels within the proximity of proposed stormwater channel or possible stormwater pond areas to depths of up to 3.2m (bgl).
    - The execution of 22 No. Cone Penetrometer Tests (CPTs) and 7 No. Dilatometer Tests (DMTs) to characterise the soils at depth.
    - The measurement of percolation (soakage) tests (2 No.) in accordance with TR 2013/040, Appendix A, Annexure C, Worksheet W1 – Falling Head Percolation Test
- Laboratory testing to characterise plasticity, particle size, pH (acidity) and compressibility characteristics of the various soil types.
- An assessment of slope stability risk within proposed permanent stormwater channel areas as per the recommendations of the Auckland Council Code of Practice (ACCoP), Chapter 2, 24 September 2013.
- An assessment of the settlement from the proposed earthworks and hypothetical foundation loadings to determine the magnitude of total and differential settlements.

- An aassessment of liquefaction risk in accordance with the latest guidance regarding liquefaction assessments, specifically MBIE "Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects"1, and MBIE/NZGS Module 3: "Identification, assessment and mitigation of liquefaction hazards"[2].
- The preparation of a preliminary geotechnical assessment report summarising our findings.

Further analysis for an Engineering Plan Approval (EPA) application will need to be undertaken in due course, once earthworks plans are finalised and subdivision scheme plans have been progressed, and the data herein may be introduced into such report(s). It should be noted that potential flooding hazards are considered by others for this application (i.e. not LDE).

3 RELATED REPORTS

In preparing this report we have reviewed the following reports prepared by LDE Limited and Lander Geotechnical Consultants Limited (now trading as LDE Limited):

- *Winton Study Area in Ardmore – Desktop Geotechnical Appraisal*. Reference J01627, dated 7 December 2020.
- *Sunfields Development – Trial Preload Design and Settlement Monitoring*. Reference J01627, dated 17 November 2021.

We have also reviewed the following reports from GHD Consultants Limited relating to recent stormwater conveyance channel developments in the Takanini / Ardmore area, largely as a resource for soil parameter selection in local soft clays / peats to assist with our analyses:

- *Takanini Stormwater Conveyance Channel – Geotechnical Investigation Report;* Technical Report C. Reference 51/32174, dated December 2015.
- *Takanini Stormwater Conveyance Channel – Geotechnical and Ground Settlements Effects Report; Technical Report E.* Reference 51/32174, dated April 2016.

Based on our review of these reports, the following geotechnical constraints were identified which are also considered relevant to the development proposals at the Cosgrave Road development:

- Slope instability of the 1(v) in 4(h) stormwater channel.
- Soil liquefaction and associated surface settlement deformations due to cyclic softening of the soft cohesive materials. Lateral spreading is a lesser concern due to the flat nature of the site.
- Consolidation of the ground due to the proposed bulk fill and foreseeable end use building loads.

[1] Earthquake Commission (EQC), Ministry of Business Innovation & Employment (MBIE) and Ministry for the Environment (MfE). "Planning and engineering guidance for potentially liquefaction-prone land: Resource Management Act and Building Act aspects" Rev. 0.1, Issue Date September 2017.
[2] New Zealand Geotechnical Society (NZGS) and Ministry of Business Innovation & Employment (MBIE) guidelines for Earthquake Geotechnical Practice in New Zealand. "Module 3: Identification, assessment and mitigation of liquefaction hazards" Rev. 1, Issue Date November 2021.

- Consolidation of the ground due to groundwater potential drawdown within areas of cut (i.e. specifically where stormwater conveyance channels are proposed).

4 SITE DESCRIPTION, GEOLOGICAL SETTING AND GEOMORPHOLOGY

4.1 Site Description

The site is bound by Cosgrave, Old Wairoa and Airfield Roads as well as similar rural residential properties. Hamlin Road runs through the central-northern portion of the study area. The majority of the site is in pasture. Several overland flow paths are shown to run through the site on Auckland Councils GIS database, however this will be confirmed by site specific survey by other members of the project team. Generally, overland flows are draining eastwards towards individual stormwater catchments or to local gullies / creeks in the south-eastern portions of the study area.

Site gradients across the study area are shown on Maven Associates Limited drawing C-200 (Appendix 1) and are generally less than 1(v) in 10(h), however, gradients up to around 1(v) in 4(h) are present on isolated slopes within the south-eastern portion of the study area. There were no obvious signs of active or relict instability across the study area.

A gas transmission line is present within the Cosgrave Road landholding and the location of this is indicated on the attached Auckland Council GIS service plan (refer Appendix 2).

Significant urban residential development is presently underway immediately adjacent to the north-west and west of the study area (i.e. residential subdivisions along Cosgrave and Grove Roads and the Addison Development). To the north-east is Ardmore Airport which contains several large buildings / hangers.

Our interpretation of available historic photographs on Auckland Council's online GIS database, Google Earth images and historic images from Retrolens.nz generally found only minor land modification on the study area over the period 1940 to 2017, however, an area of localised earthworks is identified on or prior to 1959 within the south-western portion of 508 Old Wairoa Road. The next available aerial photograph in 2001 shows the area to be grassed and in the same condition as of the time of preparing this report. This area is discussed in further detail in Section 6.2. Historic aerial photographs dated 1959 and 2001 are inset below.

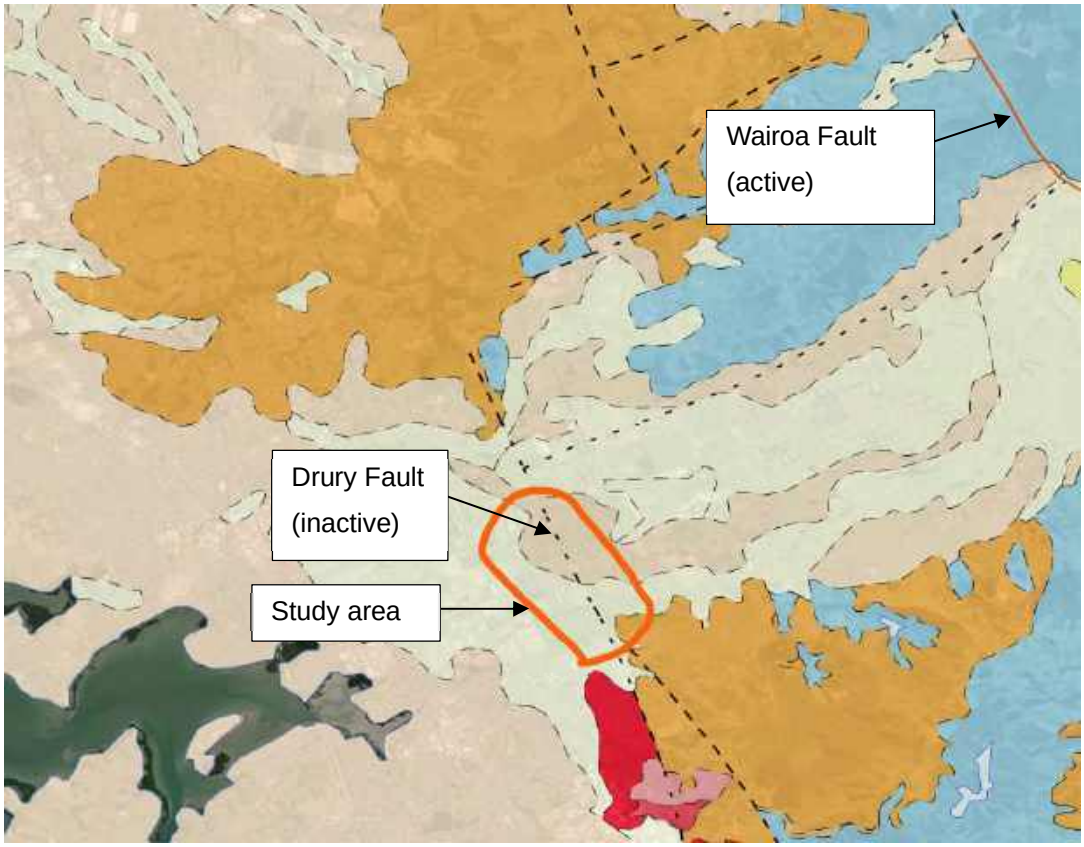
Inset A. Left: Photograph dated 1959, retrieved from Auckland Council GIS database. Area of earthworks circled in blue. Right: Photograph dated 2001.

4.2 Geologic Setting

The GNS digital geological QMaps indicate the site is underlain by three geological units, from north to south as follows:

- Tauranga Group (indicated in light green shading, comprises undifferentiated Holocene river deposits) comprising sand, silt mud and clay with local gravel and peat beds.
- Puketoka Formation (indicated in tan shading, comprises late Pliocene to Middle Pleistocene pumiceous river deposits) comprising pumiceous mud, sand and gravel with muddy peat and lignite, rhyolite pumice including non-welded ignimbrite, tephra and alluvial deposits.
- East Coast Bays Formation (indicated in orange shading, comprises early Miocene turbidite deposits) comprising alternating sandstone and mudstone with variable volcanic content and interbedded volcanic grits.

Beyond the site to the south are deposits (Basalt and Ash / Tuff soils) of the South Auckland Volcanic Field (i.e. pink and red shadings on Inset B). The inactive Drury Fault runs through the site in a north-south fashion. Additionally, the Wairoa Fault (reportedly active, but last event unknown) is located approximately 10km to the east of the study area beneath the Hunua ranges. The position of these geological units and faults are summarised in Inset B below, and also in more detail in Figures 2.11 and 2.12 (Appendix 2).



Inset B: Published Geology (Institute of Geological and Nuclear Sciences. QMap geology. KMZ file. Available from https://services.arcgisonline.co.nz).

5 FIELDWORK PROGRAMME

Our fieldwork was undertaken in April 2021 and December 2022, and included the drilling of 41 No. hand auger boreholes (HA), 15 No. machine boreholes (MH), 8 No. trial pits (TP), 2 No. falling head percolation tests, 22 No. cone penetrometer tests (CPTs), and 7 No. dilatometer tests (DMT's). In addition, 15 CPTs undertaken by Initia within 279 Airfield Road have been supplied to us to supplement the tests undertaken under our supervision. Test positions are detailed on our site investigation plan (Figure 2.1; Appendix 2).

A piezometer standpipe was installed in each machine borehole and the site was re-visited approximately one week, three months, six months, and nine months following the completion of April 2022 drilling, as well as approximately two months following the completion of December 2022 drilling, to measure groundwater levels across the site over a full seasonal year. The standing groundwater levels are presented on Figure 2.2 (Appendix 2) and are also collated in Appendix 3.1.

Full records of all in-situ soil tests and groundwater monitoring, together with detailed descriptions and depths of strata encountered in the investigation locations are included in Appendices 3.2 to 3.7, and existing geotechnical data sourced from the New Zealand Geotechnical Database (NZGD) is presented in Appendix 3.8. Laboratory results selected from relevant MH's are included in Appendix 4.

A geotechnical model has been developed based on the available geotechnical information and is presented in Table 3.1 (Appendix 3). Additionally, eleven geotechnical cross sections through the site have been presented on Figures 2.3 to 2.10 (Appendix 2) detailing the thicknesses and depths of the materials across the site, together with measured groundwater levels and proposed earthworks levels (where known). General descriptions of the materials encountered across the study area are given in Section 6 below.

6 SUMMARY OF GROUND CONDITIONS

The site has been delineated into two specific assessment geotechnical zones based on the soil properties (natural soil types) defined as follows:

- Zone 1: includes all areas containing Undifferentiated Holocene deposits (Stratum S1a and S1b and underlying Stratum S2b to S2d) and generally comprises normally consolidated fibrous peats with variable thicknesses of inorganic or organic-stained crust material.

- Zone 2: includes all areas containing near-surface Puketoka Formation or East Coast Bays Formation deposits (Stratum S2a and S3a to S3c) and generally comprises inorganic, stiff to hard, over consolidated soils with Waitemata Group bedrock generally being found at depths of 12m or less.

6.1 Topsoil

Topsoil was encountered in most test locations and was between 100mm and 550mm thick, averaging 250mm.

6.2 Filling

No filling was detected at our borehole locations, however, during site works in July an area of uncertified filling comprising of intermixed topsoil, construction debris and rubbish materials was identified in the south-eastern portion of the study area during topsoil stripping operations for a proposed site office associated with this project. The full depth and extent of these materials are currently being determined by Focus Environmental at the time of preparing this report, however, the eastern extent of the materials identified by LDE Limited was located in approximately the same position as the earthworks operations observed in the 1959 aerial photograph presented in Section 4.1 of this report. The presence of similar rubbish pits should never be discounted elsewhere in farm environments, and further comprehensive geotechnical site investigations prior to construction should service to maximise the potential to discover these (if any).

6.3 Undifferentiated Holocene Alluvium (Zone 1 – 'Peat')

6.3.1 Crust Materials (Stratum S1a)

These materials comprise inorganic and organic stained silty CLAY and clayey SILT of firm to hard shear strength, although generally stiff. The inferred locations of these materials are indicated on Figure 2.1 which are generally

located in the western part of the study area and the materials to depths of between 0.4m and 2.2m from existing ground levels.

6.3.2 Peat (Stratum S1b)

These materials comprise black and brown fibrous PEAT, with some variable beds of amorphous PEAT, CLAY, dilatant pumiceous SILT. These organic materials were very soft to very stiff, although generally firm. It should be noted that in some instances the measured undrained shear strength can be influenced by decomposing organic inclusions (i.e. tree roots or stumps) or skin friction on account of the boreholes collapsing due to the soft nature of the materials.

These materials were encountered beneath stratum S1a materials, however, Figure 2.1 shows the locations where materials were encountered without any surficial crust present, including isolated pockets along the eastern site boundary adjacent to Ardmore Airport. Where encountered, peat materials were typically recorded to depths of 18m to 20m from existing ground levels.

6.4 Puketoka Formation (both Zone 1 'Peat' and Zone 2 'inorganic clays')

6.4.1 Upper Over-consolidated Clays and Silts (Stratum S2a; Zone 2)

These materials comprise inorganic or organic stained silty CLAY and clayey SILT, with some variable beds of organic silty CLAY or organic clayey SILT. The materials were generally stiff to hard, and their locations on site are shown in Figure 2.1 to be in the central northern portions of the study area, generally extended to depths of between 6m to 12m below existing ground levels.

It should be noted that in HA06, HA38, HA39 and MH07, organic soils were present at depths between 0.0m and 2.0m. The presence of such localised organic deposits is not uncommon and has been identified in the nearby Park Estate and Auranga Residential Subdivisions in Drury which also contain similar Puketoka Formation soils.

6.4.2 Normally Consolidated Clays (Stratum S2b; Zone 1)

These materials comprise inorganic and organic CLAY with some variable beds of dilatant pumiceous SILT, and fibrous and amorphous PEATs. The materials are located beneath Stratum S2b materials typically to depths of between 18m and 27m, although in MH10 the materials extended beyond the reach of the 30m borehole depth. These soils are identified as being very soft to stiff, although generally soft to firm.

6.4.3 Loose Sands and Dilatant Silts (Stratum S2c; Zone 1)

These materials comprise very dense dilatant pumiceous SILTs and soft to firm clayey SAND and silty SAND deposits, and are generally located beneath stratum S2b materials (i.e. typically beyond 2m depth), commonly pinching out between the S2b and S2d materials, although in several instances similar materials were encountered

above the S2b materials. These materials are 3m thick on average across all test locations, although an approximately 7m thick layer was encountered in MH14.

6.4.4 Lower Over-consolidated Clays and Silts (Stratum S2d; Zone 1)

These materials comprise inorganic and organic stained CLAY and silty CLAY with variable beds of fibrous PEAT and SAND. The materials are located beneath stratum S2b or S2c materials and are typically firm to stiff, with shear strengths generally increasing with depth. The materials extended beyond the 30m target depth of the relevant investigation locations.

6.5 East Coast Bays Formation (Zone 2 – 'inorganic clays')

6.5.1 Residual and Transitional Soils (Stratum S3a and S3b)

These materials comprise very stiff to hard inorganic silty CLAY and clayey SILT and are located in the south-eastern portion of the study area which is typically defined by having higher elevations and/or steeper slope gradients (up to 1(v) and 4(h) as mentioned in Section 4.1). Weathered residual soils were recorded to depths of between 3.7m and 4.3m overlying a distinct transitional layer (i.e. transition to bedrock), comprising dark grey, inorganic silty CLAY, clayey SILT and fine SAND deposits with some beds of highly to completely weathered interbedded SILTSTONE and SANDSTONE which become more common with depth.

6.5.2 Bedrock (Stratum S3c)

Bedrock materials were encountered beneath stratum S2a and S3b materials in the northern portions of the study area. The bedrock materials comprise extremely weak to moderately strong, slightly to completely weathered SILTSTONE and SANDSTONE.

6.6 Groundwater

Groundwater was encountered in most hand auger boreholes and trial pits across the site, with groundwater levels being encountered during drilling / excavation at depths of between 0.6m and 3.5m below existing ground level.

As discussed in Section 5, a standpipe piezometer was installed in each machine borehole and groundwater monitoring rounds were undertaken on 30 April 2021, 30 July 2021, 27 October 2021, 17 January 2022, and 9 February 2023 to determine the standing groundwater levels across the site once the groundwater levels had equilibrated following drilling, which is considered to be an accurate representation of the standing groundwater table.

Groundwater levels in the standpipes were measured at depths of between 0.20m and 7.17m below current ground level, however, most locations recorded groundwater depths within the upper 1.0m to 3m below ground level. This is considered to be generally representative of a year-round seasonal groundwater regime, with the February 2023

groundwater readings being undertaken during a historic high rainfall period in Auckland. Full records of groundwater are presented in Table 3.2 (Appendix 3.1).

6.7 Percolation Test Results

Two percolation tests (P01 and P02) were undertaken in the locations indicated on appended Figure 2.1. Tests were undertaken in accordance with TR 2013/040, Appendix A, Annexure C, Worksheet W1 – Falling Head Percolation Test (i.e. autumn conditions). Percolation rates are as indicated on the table below:

Table 1: Percolation Test Summary

Test	Minimum Percolation Rate	Test Depth	Soil Materials Summary	Pre-Soak Conditions
P01	0.0743 L/m^2/min	2.0m	Clayey SILT (low plasticity) / silty CLAY (high plasticity), very stiff, moist	7 Days
P02	0.01 L/m^2/min	2.0m	Fibrous / amorphous PEAT, soft to firm, moist to wet, low to medium plasticity	48 Hrs

6.8 Laboratory Test Results

Laboratory testing was undertaken to determine Atterberg Index properties, particles size distributions, one-dimensional consolidation properties and pH to characterise the subsoils at various locations and depths across the study area.

All results are IANZ (International Accreditation New Zealand) endorsed and these have been summarised in Table 4.1 (Appendix 4). Full laboratory results are included in Appendices 4.2 to 4.5 and are discussed in the following sections of this report.

7 PERCEIVED GEOTECHNICAL HAZARDS

7.1 General

It is apparent based on this preliminary work that with appropriate engineering there should be no insurmountable geotechnical hazards that would prevent future residential intensification. Precedence with residential development upon the alluvial 'Peat' geology setting has been set elsewhere in the Takanini / Ardmore region (i.e. the substantial residential subdivisions along Cosgrave and Grove Roads, Walters Road, Porchester Road and the Addison Development) and it is anticipated that a public reticulation network for stormwater and sewerage will be available for future large-scale subdivision development.

As discussed in Section 3 of this report, the following geotechnical hazards have been identified pertaining to urbanisation of the Sunfield landholding:

- Slope instability of the 1(v) in 4(h) stormwater channel.
- Soil liquefaction and lateral spreading.
- Consolidation of the ground due to the proposed bulk fill and building loads.
- Consolidation of the ground due to groundwater drawdown within areas of cut (i.e. the proposed stormwater channel).

The site-specific geotechnical assessment criteria and assumptions made for the hazard assessments and analyses in the following sections are described in Section 7.1.1 below.

7.1.1 Seismic Site Subsoil Class

The seismic site subsoil class for the study area has been determined in accordance with NZS 1170:5:2004. The assessed site classes for the study have been determined to be Class E (very soft soil sites) in Zone 1 and Class C (shallow soil sites) in Zone 2. For the hazard analyses presented in the following sections, Site Class C has been adopted site-wide as this provides a higher PGA and is therefore the most conservative approach. Further specific seismic testing (e.g. sCPT) during subsequent (more comprehensive investigations) may help classify this further, particularly for the structural design of any infrastructure or buildings.

7.2 Slope Stability

The prevailing topography within Zone 2 soils currently has gradients no steeper than 1(v) in 4(h) with no obvious geomorphic signs of slope instability with the exception of localised over steepened gully flanks within the (S3 type) geology, where shallows seated slips and soil creep are generally observed as is expected.

The proposed earthworks scheme proposes to modify the existing site gradients to reduce slope gradients even further. Slope stability is not considered to be a primary geotechnical constraint within the Zone 2 areas of site because typical prevailing slopes (or proposed grades) do no exceed 1(v) in 4(h). Nevertheless, the proximity of buildings to sloping gully flanks that are left in place should be assessed as part of the future EPA application(s) once the earthworks and subdivision proposals have progressed.

The soils within Zone 1 are considered to be potentially susceptible to slope stability at moderate to flat gradients due to their inherent weak nature, with the primary area of concern being the proposed 1(v) in 4(h) flanks forming the proposed stormwater conveyance which is to be incised entirely within ‘crustal’ materials or peat soils (i.e. S1 type). The Takanini / Ardmore area has recently seen the construction of the Takanini Stormwater Conveyance Channel which has also been formed at 1(v) in 4(h) gradient which is engineer designed, and to the best of our knowledge has not experienced any slope instability issues.

We have completed an analysis of the proposed 1(v) in 4(h) stormwater channel as shown on the Maven Associates Limited drawings (Appendix 1). The GHD reports[3,4] have been used to form the basis of our approach to slope stability assessments given that the current proposal involves a similar slope gradients and ground conditions to the Takanini Stormwater Conveyance Channel, although the channel in the landholding is nowhere as big as the GHD designed ones. A full description of our slope stability analyses together with detailed summary tables and full output results are presented in Appendix 5 of this report.

Based on our assessments slope stability assessments, assessed slip surfaces beneath the proposed permanent stormwater channel batters meets the minimum factor of safety criteria prescribed in the Auckland Council Code of Practice and are therefore satisfactory. Nevertheless, the proposed channels are subject to detailed design and it is recommended that further geotechnical assessments are completed once the final channel locations and geometries have been confirmed.

Specific slope stability assessments for lateral spread as outlined in MBIE Module 3[5] under earthquake loading are discussed in Section 7.4.2 below and in Appendix 5.

7.3 Compressible Soils

7.3.1 Consolidation Settlements

To assess the settlement caused by anticipated future building loads (one, two and three storey), a settlement analysis was completed using the CPT and DMT traces across the study area. A full description of how the building loads are derived, our settlement analysis together with detailed summary table and full output results are presented in Appendix 6 of this report.

Based on the results of the settlement assessment, total settlement beneath building loads are summarised for one, two and three-storey buildings, respectively, as follows:

Zone 1:

- Up to 183mm, 234mm and 286mm (using the DMT data).
- Up to 212mm, 317m and 423mm (using the CPT data)

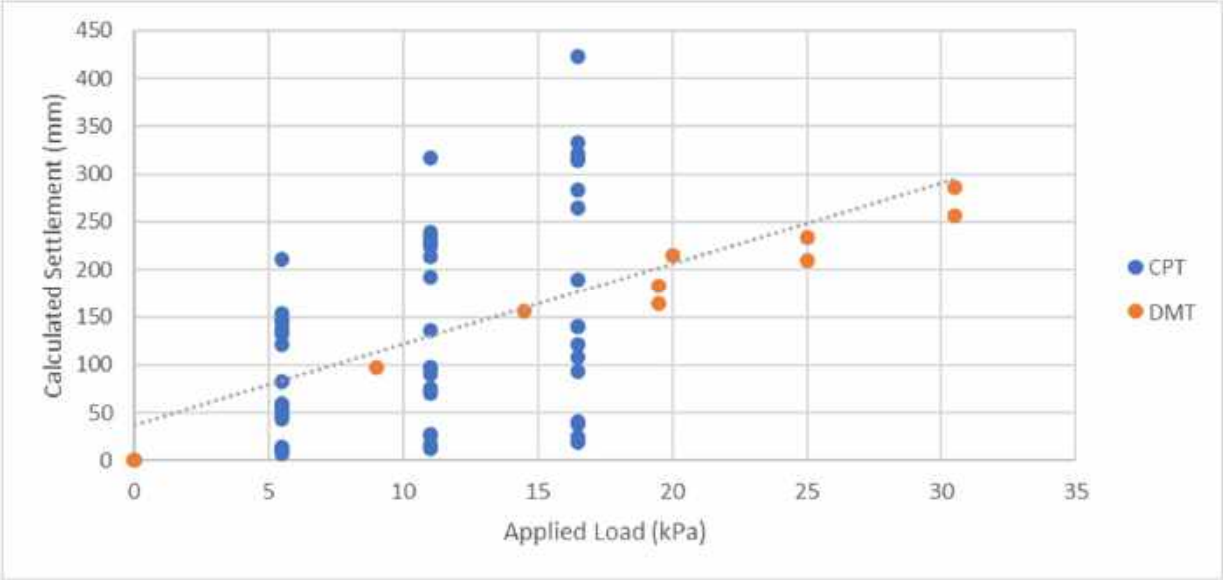
Zone 2:

- Up to 9mm, 18mm and 27mm (using the DMT data).

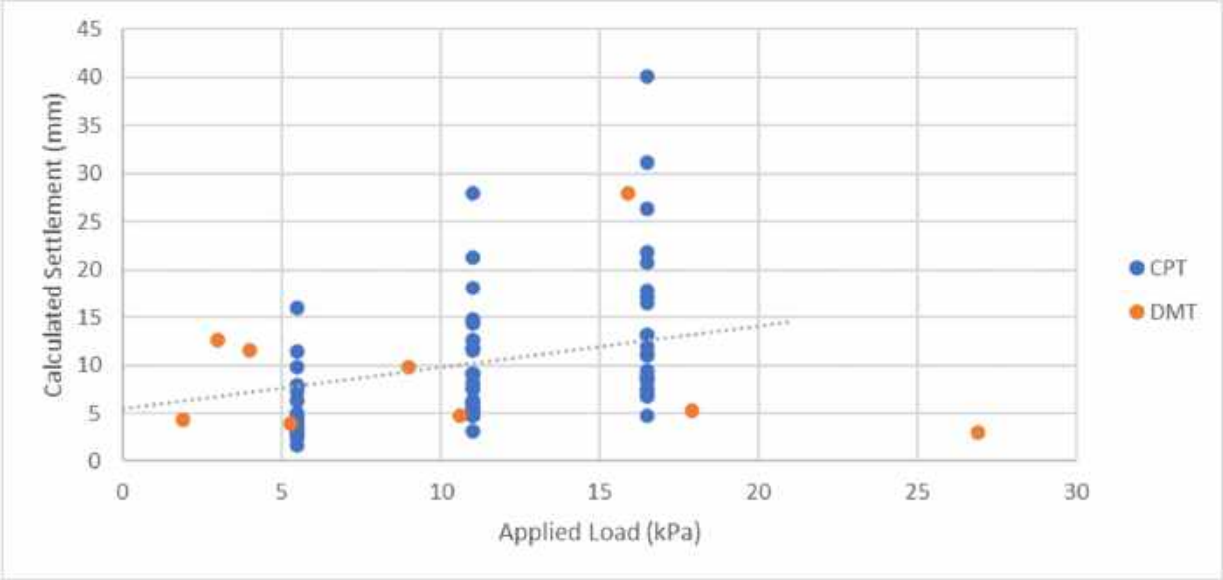
[3] Takanini Stormwater Conveyance Channel – Geotechnical Investigation Report; Technical Report C. Reference 51/32174, dated December 2015.
[4] Takanini Stormwater Conveyance Channel – Geotechnical and Ground Settlements Effects Report; Technical Report E. Reference 51/32174, dated April 2016.
[5] New Zealand Geotechnical Society (NZGS) and Ministry of Business Innovation & Employment (MBIE) guidelines for Earthquake Geotechnical Practice in New Zealand. "Module 3: Identification, assessment and mitigation of liquefaction hazards" Rev. 0, Issue Date May 2016.

- Up to 16mm, 28mm and 41mm (using the CPT data).

The insets below show a summary of the expected settlements calculated for both Zones. It should be noted that there is a reasonable disparity between CPT and DMT settlement estimations. DMT methods are widely regarded as a more accurate in-situ test for estimating settlements due to the direct measurement of the soil constraint modulus (M). Notwithstanding, trial preloading as alluded to later in this section will help assess actual response of the ground to surcharge application, as opposed to reliance on widely varying theoretical estimations.



Inset C: Applied Load vs Calculated Settlement for all Zone 1 assessments.



Inset D: Applied Load vs Calculated Settlement for all Zone 2 assessments**.**

Based on these preliminary analyses, the settlements are assessed to generally be acceptable for NZS3604-type buildings up to three-storeys constructed in Zone 2 areas, however, within Zone 1, all assessed tests were found to be in excess of this requirement as is expected in 'Peat'.

Precedence has been set to construction on similar ground conditions in nearby subdivisions and consolidation settlement is typically addressed by ground improvement (generally undercutting by around 500mm and replacing with compacted hardfill or sand beneath building platforms to act as a raft) and preloading to induce the settlements to be imposed by future building loads.

A preload design should be completed commensurate with EPA application, and this will need to consider the final earthworks proposal, building typologies and uniformly distributed loads (UDLs) as well as the preferred preload material type, and trial preloads are recommended in this regard.

LDE Limited has been retained by Sunfield Developments Limited to provide geotechnical services for several preload trials to get a head start and quantify anticipated consolidation settlements and timeframes that can be expected under a preloading regime for the various building typologies and densities anticipated. At the time of preparation of this report, the preload design has been completed (refer Section 3), however, preload trials have not yet commenced.

The assessment for settlement beneath buildings greater than three storeys in Zone 2 has not been completed as part of this assessment, however, it is foreseeable that such construction would likely require piled foundations to support dwellings due to wind or seismic loading requirements. Such assessments should be addressed in further investigations if required.

7.3.2 Drawdown Settlements

Drawdown induced settlements occur where the soils experience dewatering to a groundwater level lower than that of the average seasonal variability. Groundwater drawdown is calculated as the difference between the proposed earthworks cut level and the season low in the groundwater levels (i.e. if the cut level extends below the seasonal low in the groundwater level then groundwater drawdown will occur). In Zone 1 soils, drawdown will create an increase in effective stress and induce settlement.

Our groundwater monitoring indicates seasonal fluctuations in the order of 1-2m between summer and winter. Over this zone of fluctuation the soils would tend to be pre-consolidated due to the effective stresses imposed. Over most areas of the site, cuts of around 1m or less are proposed and there is only minor groundwater drawdown risk, however, the primary concern for any such drawdown settlements is in the area of the proposed stormwater channel excavations. This is a matter for detailed design and should be assessed at EPA application stage.

Based on the existing groundwater data and earthworks proposals the following preliminary assessments of groundwater drawdown have been made for the proposed stormwater channel using the data presented in Figure 2.2 and Table 3.2:

Table 2: Preliminary Groundwater Drawdown Assessment

Location	Cut Depth	Lowest Measured Groundwater Level (m)	Groundwater Drawdown (m)
Stormwater Channel	1m to 2.5m	1.57m to 3.37m*	Up to 0.43m*

* We recommend further commentary be included during a future EPA application to address this risk, including the lateral extent affected by any drawdown. However, drawdown should only be assessed against the lowest recorded readings, which is generally the summer case.

7.4 Liquefaction and Lateral Spread Potential

7.4.1 Computer Liquefaction Analysis

Due to the variable nature of soils encountered across the study area (i.e. normally consolidated fibrous peat and clay deposits, pumiceous silty and sandy materials, over consolidated cohesive materials), a computer liquefaction assessment has been completed using the CPT data across the study area. A full description of our computer liquefaction analyses together with detailed summary tables and full output results are presented in Appendix 7.

No vertical settlements were calculated under SLS seismic conditions, however, under ULS seismic conditions, theoretical vertical settlements of up to 105mm (i.e. due to cyclic softening) were calculated, however, this does not take into account non-liquefiable crust thickness overlying the liquefiable layers, nor does it account for the Liquefaction Severity Number (LSN) for each analysis or the geological age of the soils. These criteria are outlined in Section 7.4.3 to 7.4.6 below and assessed vertical settlements following these assessments are presented in Section 7.4.7.

Lateral spreads are not considered to be a geotechnical concern as the site is generally flat and non-liquefiable crust layers across the site are generally thick enough to mitigate this as an issue (as there is no free face present for lateral spreading to develop). Additionally, lateral spread was not determined to be an issue in the proposed stormwater channel due to the Newmark Rigid-Block slope stability analysis (discussed in Section 7.2 and in Appendix 5).

In the following sections of this report we outline the relevant geotechnical criteria from relevant geotechnical publications for classifying soils as being prone to liquefaction and how they relate to the assessed results and the subsoils identified at the Cosgrave Road landholding.

7.4.2 Computer Lateral Spread Analysis

MBIE Module 3 indicates that lateral spread can develop where a factor of safety against liquefaction of less than 1.0 and a free face are present in combination (i.e. the proposed stormwater channel).

The Newmark Rigid-Block lateral spread assessment outlined in Appendix 5 indicate that no lateral spread occurs.

7.4.3 Geological Age

MBIE Module 3 advises aging of soils generally improves their resistance against liquefaction, and that liquefaction almost exclusively occurs in geologically young Holocene sediments, constructed fills and soils that have liquefied previously, and that in rare instances liquefaction of saturated sandy soils has been recorded in late Pleistocene soils (>11,000 years).

The soils within Zone 1 are of Holocene age and are therefore considered susceptible from a geological age perspective to the liquefaction calculated in our computer analyses.

The soils within Zone 2 are aged between Late Pliocene to Middle Pleistocene (11,000 years to 23 Ma). Soils of Late Pliocene age (Stratum S2a) comprise over consolidated cohesive materials and therefore considered to be less susceptible to liquefaction due to their age.

7.4.4 Soil Fabric

MBIE Module 3 states that 'sand-like' soils (sands, non-plastic silts and gravels) are most commonly susceptible to liquefaction and 'clay-like' soils (clays and clayey silts) are not susceptible to liquefaction, although the latter are soils of Holocene age may be susceptible to cyclic softening (as is the case at Cosgrave Road). The distinction between 'clay-like' and 'sand-like' soils are determined by the fine content of the soil, where 'clay-like' behaviour is defined as where greater than 30% of the dry mass can pass through a 0.075mm sieve (i.e. D_{30} <0.075mm (or 75µm)).

Additionally, MBIE Module 3 presents the following classification system for classifying liquefaction susceptibility in terms of the plasticity index of the soil for soils having a D_{30} <0.075mm:

Table 3. Liquefaction Susceptibility Criteria.

Plasticity Index Value	Susceptibility
PI <7	Susceptible to liquefaction ('sand-like' soils)
7 ≤ PI ≥ 12	Potentially susceptible to liquefaction; (possibly 'sand-like' soils)
PI ≥ 12	Not susceptible to liquefaction; ('clay-like' soils)

Preliminary laboratory testing has been completed for various soil types across the site to characterise their characteristics and behaviour. Plasticity index and particle size distribution testing indicate that materials described as 'organic silty CLAY' or 'pumiceous silty CLAY' comprise D_{30} of 1.4µm or less and have a PI of 40% or more ('clay-like'), and materials described as 'silty SAND' or 'pumiceous SILT' comprise D_{30} of 19.7µm or less and have a were unable to be tested for PI (i.e. PI can be assumed to be 0 and therefore 'sand-like').

This indicates that the soils described as CLAY (generally in Zone 2 or lower Zone 1) are not susceptible to liquefaction, however, the Zone 1 soils described as SILT, pumiceous SILT and SAND are susceptible to liquefaction

based on cohesion and plasticity index classification. However, these near surface non-cohesive deposits are thinly bedded, and peat is more prevalent.

Although not tested (on account of the difficulty of obtaining a sample suitable for testing), the fibrous PEATs which make up the majority of the near surface subsoils within Zone 1 generally have high moisture contents and a porous-fibrous structure and inherently can be classified as susceptible to cyclic softening (i.e. they can be treated as SILT or SAND in this sense).

7.4.5 Liquefaction Severity Number

MBIE Module 3 Table 5.1 indicates expected performance levels for liquefied deposits based on the Liquefaction Severity Number (LSN). The potential for ground surface damage as a result of the computer liquefaction settlements has therefore been evaluated using LSNs for each CPT assessed. As shown in Table 7.4 in Appendix 7, the CPT-based LSN values for ULS ground shaking are typically less than 10 with the remaining values in excess of 10 but still less than 15. This indicates insignificant to mild effects as a result of liquefaction as per MBIE Module 3 Table 5.1 (refer Inset E right).

Table 5.1: General performance levels for liquefied deposits

	EFFECTS FROM EXCESS PORE WATER PRESSURE AND LIQUEFACTION	CHARACTERISTICS OF LIQUEFACTION AND ITS CONSEQUENCES	CHARACTERISTIC F_L, LPI, LSN
L0	Insignificant	No significant excess pore water pressures (no liquefaction).	$F_L > 1.4$ LPI=0 LSN <10
L1	Mild	Limited excess pore water pressures; negligible deformation of the ground and small settlements.	$F_L > 1.2$ LPI = 0 LSN = 5 – 15
L2	Moderate	Liquefaction occurs in layers of limited thickness (small proportion of the deposit, say 10 percent or less) and lateral extent; ground deformation results in relatively small differential settlements.	$F_L = 1.0$ LPI < 5 LSN 10 – 25
L3	High	Liquefaction occurs in significant portion of the deposit (say 30 percent to 50 percent) resulting in transient lateral displacements, moderate-to-large differential movements, and settlement of the ground in the order of 100 mm to 200 mm.	$F_L < 1.0$ LPI = 5 – 15 LSN = 15 – 35
L4	Severe	Complete liquefaction develops in most of the deposit resulting in large lateral displacements of the ground, excessive differential settlements and total settlement of over 200 mm.	$F_L << 1.0$ LPI > 15 LSN > 30
L5	Very severe	Liquefaction resulting in lateral spreading (flow), large permanent lateral ground displacements and/or significant ground distortion (lateral strains/stretch, vertical offsets and angular distortion).	

Inset E: General performance levels for liquefied deposits.

The average LSN for the Zone 1 soils for the ULS case is approximately 2.4, while the average LSN for the Zone 2 soils is approximately 9.2. This indicates insignificant to mild liquefaction effects generally prevail under ULS shaking across both of these zones, resulting in limited excess pore water pressures, negligible deformation of the ground and small settlements only.

7.4.6 Surface Manifestation Criteria

MBIE Module 3 provides guidance around consideration of crust thickness. A non-liquefiable crust thickness of 3m is generally deemed thick enough to suppress surface manifestation of deep liquefaction occurrence for earthquakes with a PGA of 0.2g or less.

Research completed by Bowen & Jacka (2013)[6] has compared this theory to the damage recorded during the 2010 and 2011 Canterbury earthquake sequence which also found that where the crust thickness of 3m or more is present (for a PGA of 0.2g), liquefaction was considered unlikely to occur as the crust thickness was considered too thick for the underlying liquefied soils to 'break through', for example in the case of sand boils. The research also suggests

[6] Bowen, H. & Jacka, M. (2013) "Liquefaction induced ground damage in the Canterbury earthquakes: predictions vs reality" Proc. 19th NZGS Geotechnical Symposium.

that the thickness of the underlying liquefied layer is a less important factor except in instances where a liquefied layer of between 0.5m and 2.0m were present within the upper 3m. The results of our computer liquefaction analysis have considered the thickness of non-liquefiable crust layers, and these demonstrate that the non-liquefiable crust thickness was between 1.3m and 6.3m under ULS seismic conditions, with the resulting ULS settlements up to 105mm (refer Table 7.4). A significant number of CPTs in Zone 1 (11 out of 19) have non-liquefiable crusts less than 3m thick, while out of the Zone 2 CPTs, only 7 out of 20 have non-liquefiable crusts less than 3m thick. Based on this, the Zone 1 soils could have more surface manifestation of liquefaction during a ULS earthquake, while the Zone 2 soils are generally not expected to show surface manifestation based on crust thickness criteria.

Based on our assessment of geological ages, soil cohesiveness, and surface manifestation criteria, the Zone 1 soils are possibly susceptible to liquefaction only under ULS shaking with calculated settlements of up to 105mm, while the Zone 2 soils are considered to be less susceptible to liquefaction.

7.4.7 Development on Liquefaction-Prone Soils (Zone 1)

The results of this liquefaction analysis (based on a post-construction earthworks scenario) indicate that soils which have been identified as susceptible to liquefaction / cyclic softening (i.e. Zone 1 soils with no sufficient non-liquefiable crust) and assessed to possibly undergo liquefaction-induced settlement under ULS conditions could be between approximately 5mm and 130mm. These figures are only preliminary and future assessments should be completed as part of an EPA application(s).

Due to the potential for liquefaction-induced settlements, the subdivision will need to be designed with this in mind, with a regard to overland flow path, floodplain levels and maintaining free-board for building platforms, etc.

Additionally, MBIE Module 5[7] outlines several methods of ground improvement that can be used in soils which are assessed to be susceptible to liquefaction. Of the methods of ground improvement, the following methods are considered to be the most applicable to the proposed development based on precedence set in the area (see section 8.1.1 also) at nearby subdivisions and as these methods will also address the consolidation settlements as discussed in Section 7.3.1:

- Replacement: involves the undercutting of the upper liquefaction prone soils and reinstating with a non-liquefiable material. This is commonly a compacted GAP65 hardfill material which acts as an additional raft beneath the future building and also improves the available bearing capacity available for future buildings. In peat soils this may be problematic for construction due to the high groundwater table, and for consolidation settlements due net increases in stress (e.g. from hardfill reinstatement).

- Densification: involves the rearrangement of soil particles into a tighter / denser configuration. This can be achieved in part via preloading, which is also required to remove building induced settlement as discussed in Section 7.3.1.

[7] New Zealand Geotechnical Society (NZGS) and Ministry of Business Innovation & Employment (MBIE) guidelines for Earthquake Geotechnical Practice in New Zealand. “Module 5: Ground improvement of soils prone to liquefaction” Issue Date June 2017.

7.5 Proximity to Faults

Based on a review of the GNS digital geological QMaps, it is apparent that there are several identified faults in proximity to the study area. The Drury Fault runs through the study area and is classified by GNS as inactive. The likely return period of the Drury Fault is considered to be in the order of several thousand years or more8. The nearest defined active fault is the Wairoa North Fault which is located approximately 10km to the east of the study area (refer Fig 2.12).

Due to the distance of the site to the nearest active fault being 10km and the existence of other Urban and Future Urban developments in similar or closer proximity to the Drury Fault (i.e. residential subdivisions along Cosgrave and Grove Roads and the Addison Development), we consider that the fault should not be considered a high impact geotechnical issue to this development.

7.6 Expansive Soils

A phenomenon common to the plastic soils found throughout this region is their expansive nature and tendency to shrink and swell, particularly with seasonal fluctuations of near surface water contents. Geotechnical engineering solutions to expansive soils are discussed in Section 8.2 below.

7.7 Flood

The Auckland Council Geomaps database indicates that flood plains within the study area are generally confined to the identified overland flow path areas and we understand these will be assessed by other specialist reports accompanying the application.

7.8 Regional Hazards

7.8.1 Earthquake

As stated above, the Cosgrave Road landholding is located 10km from the nearest active fault (the Wairoa North Fault). Notwithstanding, all future foundations for structures should be seismically designed in accordance with the relevant New Zealand Standards and guidelines.

7.8.2 Tsunami

The landholding is located approximately 2.5km from the nearest Tsunami shore exclusion zone and evacuation zones as per Auckland Councils Geomaps database, which are adjacent to the Pahurehure Inlet. Tsunami should be dismissed as a likely hazard.

[8] Williams et al. 2006. “Active Faulting in the Auckland Region, Earthquake and Urban Development,” New Zealand Geotechnical Society, IPENZ, Proceedings or Technical Groups Vol.31.

7.8.3 Volcanic

The landholding is located relatively close to the South Auckland Volcanic Field, which is considered to be extinct, and is around 9km from the nearest Auckland Volcanic Field Volcanoes (Matakarua, Manurewa and Ash Hill mountains in Wiri). Leonard and Roberts (2017)[9] highlights the difficulty in forecasting future eruption timelines and locality in the Auckland Volcanic Field and argues that given the population and extent of economic and urban development in Auckland, avoidance of this hazard is not feasible, but rather risk should be mitigated through contingency and emergency planning at a regional level.

8 GEOTECHNICAL ENGINEERING CONSIDERATIONS

8.1 Foundations for Buildings

8.1.1 Zone 1

Based on the results of our field investigation and subsequent settlement analyses, soils in this area of the site comprise generally fibrous peats (Stratum S1b) with varying degrees of stiffer crustal thicknesses (Stratum S1a) generally through the central and western portions of the study area. Crust thicknesses of up to 2.2m are present, although are generally less than 1m thick. However, there is the potential for 'crust thicknesses' to increase by up to 1m in some areas due to the proposed bulk filling works.

Within S1a areas, one and two storey light weight standalone residential dwellings will generally require undercutting beneath the building footprints by 500mm and replacement with compacted hardfill or approved sand, in conjunction with a geotextile cloth to separate the backfill from underlying soft subgrades. Localised preloading may be required; however, this should be assessed during future site-specific investigations.

Within S1b areas, one and two storey light weight standalone dwellings will require ground improvement as required for S1a areas plus a wider preload. Preload details should be confirmed commensurate with specific building proposals at EPA stage.

For both S1a and S1b areas, heavier two storey, or terraced (i.e. conjoined residential dwellings), or three storey on natural ground will require the undercutting plus a higher degree of preloading. Preloads can be in place for anywhere between 6 and 18 months based on precedence. Preload trials are recommended to observe actual response of the soils to surcharges loadings (LDE Limited have been retained to provide geotechnical inputs into such trials, with preload design completed at the time of preparation of this report – refer Section 3).

Alternatively such buildings could be piled or some other deep ground improvement option implemented to mitigate settlement and bearing capacity concerns.

[9] Leonard, G. A. & Roberts, R. C. Volcanic Hazard from the Auckland Volcanic Field. Proceedings 20th NZGS Geotechnical Symposium. 2017.

For commercial / industrial buildings within Zone 1, the foundation solution will be commensurate on end use and as such will require site specific investigations and foundation design. There is precedence of large buildings having commercial / industrial end-use in Takanini peats, and solutions such as piling, soft pile rafts, ground improvement and preloading etc. have been utilised.

All building types constructed on peat soils will require stiffened pod-raft type foundation solutions to spread building loads evenly in order to minimise the potential for differential settlements.

Other floor slab systems may be appropriate provided that they are the subject of specific site investigation and foundation design by an appropriately experienced Chartered Professional Engineer. Roofing systems should preferably be light weight and the exterior cladding should preferably be flexible or at least contain adequate control joints as specified by the Architect/ Engineer.

Private services entry points into houses with require flexible connections and driveways will need a transition slab into the floor slab to minimise cracking / distress between these elements.

A summary table of preloading and/or localised ground improvement requirements and specific foundation design criteria is presented in **Appendix 6.1.** A summary of specific buildings and ground improvement / foundations solutions adapted for commercial / industrial buildings is presented in Table 4 below.

Table 4. Commercial / Industrial Ground Improvement and Foundation Solution Case Studies (for Zone 1 areas).

Location / Building	Building Working Load	Ground Improvement	Foundation Solution
Sikh Temple, 70 Takanini School Road	20kPa	N/A	8m deep piled foundations (to relatively shallow ECBF bedrock)
Gymnasium and Multi-Sports Centre, Bruce Pulman Park, Walters Road	Unconfirmed, typically 'lightweight'	Stage 1 (single storey) - 1400mm high preloading, average settlement of 142mm recorded Stage 2 (two-storey) - 1700mm high preloading, average settlement of 500mm recorded	foundation pads and floor slab thickenings
Mitre 10 Centre, 238 Great South Road	10kPa	500mm thick hardfill raft	Timber driven piles (for column loads) Strip footings (for external tilt slab walls)

8.1.2 Zone 2

Where inorganic natural ground is present, bearing capacity is expected to be in accordance with the limitations imposed by NZS 3604 where 300kPa geotechnical ultimate bearing capacity should be adopted. However, as is evident from our borehole findings, some areas contain pockets of weaker ground and/or lenses of organics.

Softer ground or lenses of organics can pose constraints to NZS 3604 building foundations and residential end use, necessitating remediation during earthworks construction (e.g. undercutting and reinstatement with stronger soils), and/ or specifically designed foundation solutions (i.e. 'raft' foundations). LDE's experience in the delivery of hundreds of lots in the nearby area on Puketoka Formation soils (i.e. the Auranga Residential Subdivision in Drury) indicates that typically only a small number of lots are affected by soft ground or organic soils, but in due course more intensive physical site investigation associated with a subdivision scheme will substantiate this risk.

For commercial / industrial within Zone 2 more conventional shallow foundations solutions are possible dependent on end-use, however, these types of buildings will generally require site specific investigation and foundation design.

8.2 Expansive Soils

A phenomenon common to the plastic soils found throughout this region is their expansive nature and tendency to shrink and swell, particularly with seasonal fluctuations of near surface water contents. Expansive soils are outside the provisions of NZS 3604 (according to its definition of "good ground") and therefore foundations on such soils require specific design to establish appropriate embedment depths and/ or concrete reinforcement configurations.

Based on the preliminary laboratory testing undertaken and our knowledge of the soils encountered within this area of Auckland, the assessed expansive site class for this site is as follows when assessed in accordance with AS2870:2011 guidelines is as follows:

- Class M (moderate)* to Class H2 (high)*
- Characteristic ground movement of 40mm and 75mm, respectively*

**Note: This AS2870:2011 assessment is based on the scaling factor of the site being adjusted to a 1/500yr event to meet the recommendations of MBIE.*

It is foreseeable that foundation design in Zone 2 may be carried out in accordance with AS2870:2011 provided they are designed to the recommendations above on expansive site class and characteristic ground movement or alternatively an engineer approved design solution may be adopted.

Within Zone 1 areas, consolidation settlement of the underlying peat soils and the need to charge groundwater will govern here, not expansivity.

This will be addressed in greater detail as part of an EPA approval report and will need to consider proposed earthworks.

8.3 Non-engineered Fills

As described in Section 6.2, some pre-existing filling is present within the landholding and is likely associated with an old rubbish pit.

Where deemed economic to do so, pre-existing filling will need to be undercut and reinstated with engineer certified filling to mitigate the risk of differential settlement and bearing capacity issues associated with non-engineered filling.

If there are any fill depths which are considered too deep for undercutting and reinstatement to be a viable option, specific foundation design will be required to mitigate the aforementioned risks, with a view to pile foundation solutions or ground improvement. This is a matter to be re-addressed as part of an EPA application report.

8.4 Earthworks and Civil Works

8.4.1 Zone 1

The risk of ground settlement in this area requires that careful mitigation measures be implemented to ensure that any settlements that do occur are within acceptable limits. Surficial soils within Zone 1 are relatively sensitive to disturbance and any earthworks and construction operations should be undertaken with care.

Based on the results of our settlement analyses, a large portion of Zone 1 could be subject to significant consolidation settlements which will be in excess of Building Code limits for differential settlements. It is our view that development in these areas should be subject to ground improvements comprising of the undercutting and replacement of weaker soils immediately beneath the foundations or the preloading of the building platforms following post-construction earthworks. Additionally, in some areas, a lag-period could be implemented where construction is able to commence without additional ground improvement following, say 1-year, to allow fills to settle under their own self-weight. Such assessments should be made at EPA application stage when further detail is available regarding the proposed development schemes.

Control of post-construction settlement is usually reduced through appropriate engineering design, such as preloading if required, identification and removal of buried tree stumps/ logs from beneath building platforms and service line corridors, and settlement monitoring of fills. Stump detection involves probing to 2m depth in a grid fashion (say 3m centres) using a special attachment on a digger, and excavation of any obstructions encountered and replacement with peat or black sand.

With regard to bulk filling, normal subdivisional compaction specifications do not apply to these organic materials if they are used as fill. The materials are best bladed out to a uniform thickness and screened using a root rake to remove as much large matter as possible. The materials are then track rolled and allowed to drain and harden over time. Light re-compaction once moisture contents have reduced during favourable site conditions is prudent. This methodology has been widely used in other nearby developments on peat soils over the past 10 years or so (e.g. Addison).

8.4.2 Zone 2

Based on our previous experience in the area we expect that the natural soils on site should generally be suitable as borrow materials. Moisture contents in laboratory samples tested were generally higher than the plastic limits, indicating that they will likely require conditioning prior to placement as engineer certified filling. However, these samples were collected in winter and more favourable conditions could possibly be observed during summer conditions.

Puketoka Formation soils, particularly pumiceous soils (which are common in Puketoka Formation), can be sensitive to disturbance during earthworks and trafficking with pumping and weaving occurring under heavy machinery trafficking (i.e. the subgrade may lose strength and become difficult for primary earthworks machinery to traverse). If sensitive and/ or pumiceous soils are uncovered near to proposed levels on site, appropriate earthworks methodologies and programming should be implemented to avoid disturbing these materials. This can include keeping machinery trafficking to designated haul roads and maintaining levels at 200mm-300mm above final level until topsoil or basecourse can be placed. Where these soils are disturbed, undercutting and reinstatement of the disturbed soil mass with engineered filling will likely be necessary.

Sensitivity to disturbance can also cause the degradation of roading subgrades once exposed. This can be avoided by careful construction sequencing or mitigated by subgrade improvement such as undercutting and replacement or lime stabilisation etc.

It is likely such areas will be determined in greater detail as part of further investigations commensurate with subsequent EPA application(s).

8.5 Pipes and Buried Services

The laying of deep pipelines in ground with a high groundwater table can be extremely difficult and is best undertaken by a Constructor with a proven track record in this regard (i.e. laying pipes in peat).

If flat grades are proposed then the risk of settlement dipping the lines increases, and redundancy should be incorporated into the design, such as oversizing pipeline internal diameters, careful consideration in selection of trench backfill materials, seepage cut off collars at regular intervals to prevent the pipe bedding media acting as a groundwater drawdown drain, etc.

Increased bedding thickness and undercut to provide a uniform support to the pipelines will also be necessary. It is important to note that despite design and construction best efforts, differential settlement on flat service lines always poses a risk and cannot be completely mitigated in this terrain. It will be important to ensure settlement in bulk fill areas has attenuated to acceptable level prior to the laying of minimal grade service lines and roading kerbs, etc. This is an important construction sequencing issue.

Deep trench fills (e.g. greater than 3m) if hard filled may induce settlements that dip lines, so lightweight fills (e.g. PolyRock) or Puni sand with 3% cement (i.e. to immobilise it) may be warranted.

It is also important that services pipes are designed to withstand long-term corrosion. We anticipate that specialist advice will need to be sought for assessments in accordance with AS4058:2007 Appendix E, Table E1 (or current standard) as to concrete pipe resistance to the corrosive nature of the soils (refer Appendix 8 for site specific pH results). Further chemical testing and analyses of the organic soils/groundwater may be required for this (e.g. pH, total alkalinity (mg/L), Baumann-Gully acidity (mL/kg), chloride and sulphate (mg/kg)).

8.6 Roading

Roading subgrades within Zone 1 peaty soils will be extremely soft but precedence has been set in the area. Subgrade improvement undercuts typically comprise of ranges from 500mm to 700mm. The undercuts are typically reinstated with black sand (e.g. sourced from Woodhill or Waiuku), with a geotextile cloth placed to separate the sand from the underlying subgrade. The roading materials themselves may involve settlement of the underlying subgrade and requirement for additional depths of roading aggregate may be experienced as a 'top up' to achieve design levels. Our experience with Benkelman Beam deflection testing in the local area (e.g. on 700mm thick sand improvements) indicates deflections of close to 1mm are normally achievable, which seems to improve in time as the pavement 'sets up'. The deflection target criteria are normally 1mm for main through roads and 1.5mm for lesser roads.

Within Zone 2 soils, likely minimum CBRs of between 2% and 4% will likely be available for pavement design purposes.

8.7 Stormwater Management

LDE Limited (previously Lander Geotechnical Consultants Limited) have performed falling head stormwater percolation testing in two locations shown on our site plan (Figure 2.1) in accordance with the method described in the Auckland Council stormwater design manual TR2013-040.

Minimum percolation rates ranged from 0.01 L/m^2/min (within fibrous PEAT soils) to 0.0743 L/m^2/min. Based on these results and comparison to Table 4 of TR2013-040 we consider that in-situ percolation at Cosgrave Road will be likely be poor within identified CLAY deposits (i.e. Stratum S2a and S3a).

Within Zone 1 it is vital that existing groundwater levels within the Zone 1 peaty soils are maintained through recharge of stormwater runoff via soakage pits and/ or swales to minimise the potential for widespread drawdown and associated consolidation settlements. Within Zone 2 stormwater should be disposed of via specifically designed soakage pits or alternatively into the stormwater reticulation network.

9 Conclusions

Overall, the landholding is considered suitable for urban intensification as has been done on other topographically large land holdings to the west in similar geologies, and we therefore support the development proposal.

Further site investigation, and/ or design analyses will be required as part of the EPA application process in due course, commensurate with earthworks plans.

10 LIMITATIONS

This report has been prepared solely for the use of our client, Sunfield Developments Limited, its professional advisers in relation to the specific development proposal brief described herein. No liability is accepted in respect of its use for any other purpose or by any other person or entity. All future owners of this property should seek professional geotechnical advice to satisfy themselves as to its ongoing suitability for their intended use.

The opinions, recommendations and comments given in this report result from the application of normal methods of site investigation. As factual evidence has been obtained solely from boreholes which by their nature only provide information about a relatively small volume of subsoils, there may be special conditions pertaining to this site which have not been disclosed by the investigation and which have not been considered in the report.

APPENDIX 1

CLIENT SUPPLIED DRAWINGS

Sunfield Masterplanned Community

Masterplan - 25.11.2024

Sunfield Masterplanned Community

Masterplan - 25.11.24

Notes

1. BEARING AND COORDINATE DATUM IS NZGD2000 MOUNT EDEN CIRCUIT 2000 LEVELS ARE IN TERMS OF LANDS AND SURVEY DATUM (MSL) AUCKLAND 1946.
2. ORIGIN OF SURVEY CE 34 (AEE6) 783303.09mN,417353.67mE, RL 24.746m
3. CHECK ORIGIN OF SURVEY SM 5813 (C6AM) (SO 58209) 781995.74mN, 418450.50mE, RL 34.51m

Legend

- EX BDY
- PROP BDY
- EX MAJOR CONTOUR
- EX MINOR CONTOUR
- PR MAJOR CONTOUR
- PR MINOR CONTOUR

Rev	Description	By	Date
C	FOR INFORMATION	CE	12/2023

	By	Date
Survey	BY	MM/YYYY
Design	CE	12/2023
Drawn	CE	12/2023
Checked	WM	12/2023

Maven Associates
09 571 0050
info@maven.co.nz
www.maven.co.nz
5 Owens Road, Epsom
Auckland 1023

Project

SUNFIELD DEVELOPMENT ARDMORE FOR WINTON PROPERTY LTD

Title

PROPOSED BULK EARTHWORKS LEVELS

Project no.	215001		
Scale	1:9000 @A3		
Cad file	C200-EARTHWORKS SITEWIDE 1.DWG		
Drawing no.	C200	Rev	C

DATE 12/23 FILEPATH P:\MAVEN\PROJECTS\215001\SUNFIELD\DWG\C200 EARTHWORKS SITEWIDE 1.DWG

EARTH WORKS (SURFACE EXISTING COMPARISON WITH SURFACE PROPOSED BULK EARTHWORKS)
CUT/FILL VOLUMES ARE APPROXIMATE

CUT VOLUME	830,000 m³
FILL VOLUME	830,000 m³
CUT TO FILL BALANCE	0,00 m³

NOTE: NO ALLOWANCE FOR SERVICES TRENCHES, VOLUMES ARE UNFACTORED AND IN SITU

Notes
1. BEARING AND COORDINATE DATUM IS NZGD2000 MOUNT EDEN CIRCUIT 2000 LEVELS ARE IN TERMS OF LANDS AND SURVEY DATUM (MSL) AUCKLAND 1946.
2. ORIGIN OF SURVEY CE 34 (AEE6) 783303.09mN,417353.67mE, RL 24.746m
3. CHECK ORIGIN OF SURVEY SM 5813 (C6AM) (SO 58209) 781995.74mN, 418450.50mE, RL 34.51m

LEGEND
- EX BDY
- PROP BDY
- PROP EXTENT WORK

Cut/Fill Table

Number #	Minimum Elevation	Maximum Elevation	Color
1	-6.277	-1.000	
2	-1.000	-0.500	
3	-0.500	0.000	
4	0.000	0.500	
5	0.500	1.000	
6	1.000	1.500	
7	1.500	2.000	
8	2.000	2.968	

Rev	Description	By	Date
C	FOR INFORMATION	CE	12/2023

	By	Date
Survey	BY	MM/YYYY
Design	CE	12/2023
Drawn	CE	12/2023
Checked	WM	12/2023

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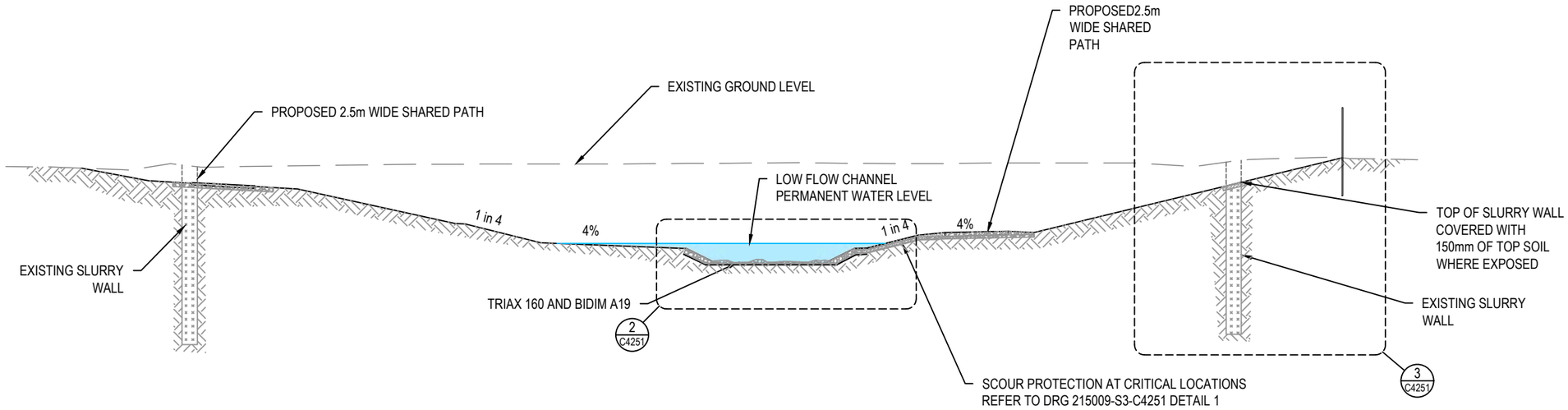
Auckland 1023

Project
SUNFIELD DEVELOPMENT ARDMORE FOR WINTON PROPERTY LTD

Title
PROPOSED BULK EARTHWORKS CUT TO FILL PLAN

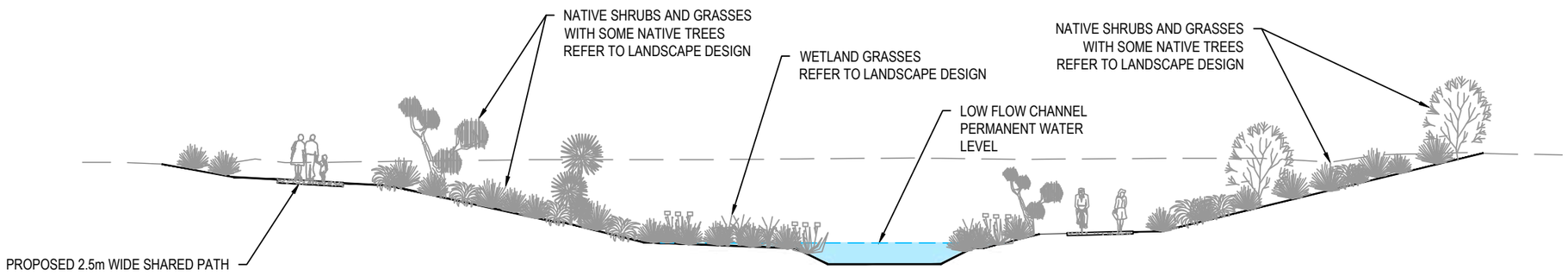
Project no.	215001
Scale	1:9000 @A3
Cad file	C200-EARTHWORKS SITEWIDE 1.DWG
Drawing no.	C201 Rev C

DATE 12/23 FILEPATH: P:\MAVEN\PROJECTS\21500\SUNFIELD\DWG\C200-EARTHWORKS SITEWIDE 1.DWG



CHANNEL TYPICAL SECTION (WITH SLURRY WALL)

SCALE 1:200 (A3)



CHANNEL TYPICAL SECTION (WITHOUT SLURRY WALL)

SCALE 1:200 (A3)

RESOURCE CONSENT

NOTES:

1. REFER TO DRG 215009-S3-C4000 FOR STANDARD CHANNEL NOTES.

Rev	Description	By	Date
A	RC	BL	02/02/24

	By	Date
Survey		
Design	HA	27/10/2023
Drawn	BL	27/10/2023
Checked	KRW	17/11/2023

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Auckland 1023

Project

AWAKERI WETLAND
STAGE 3
PAPAKURA
FOR
WINTON LAND LTD

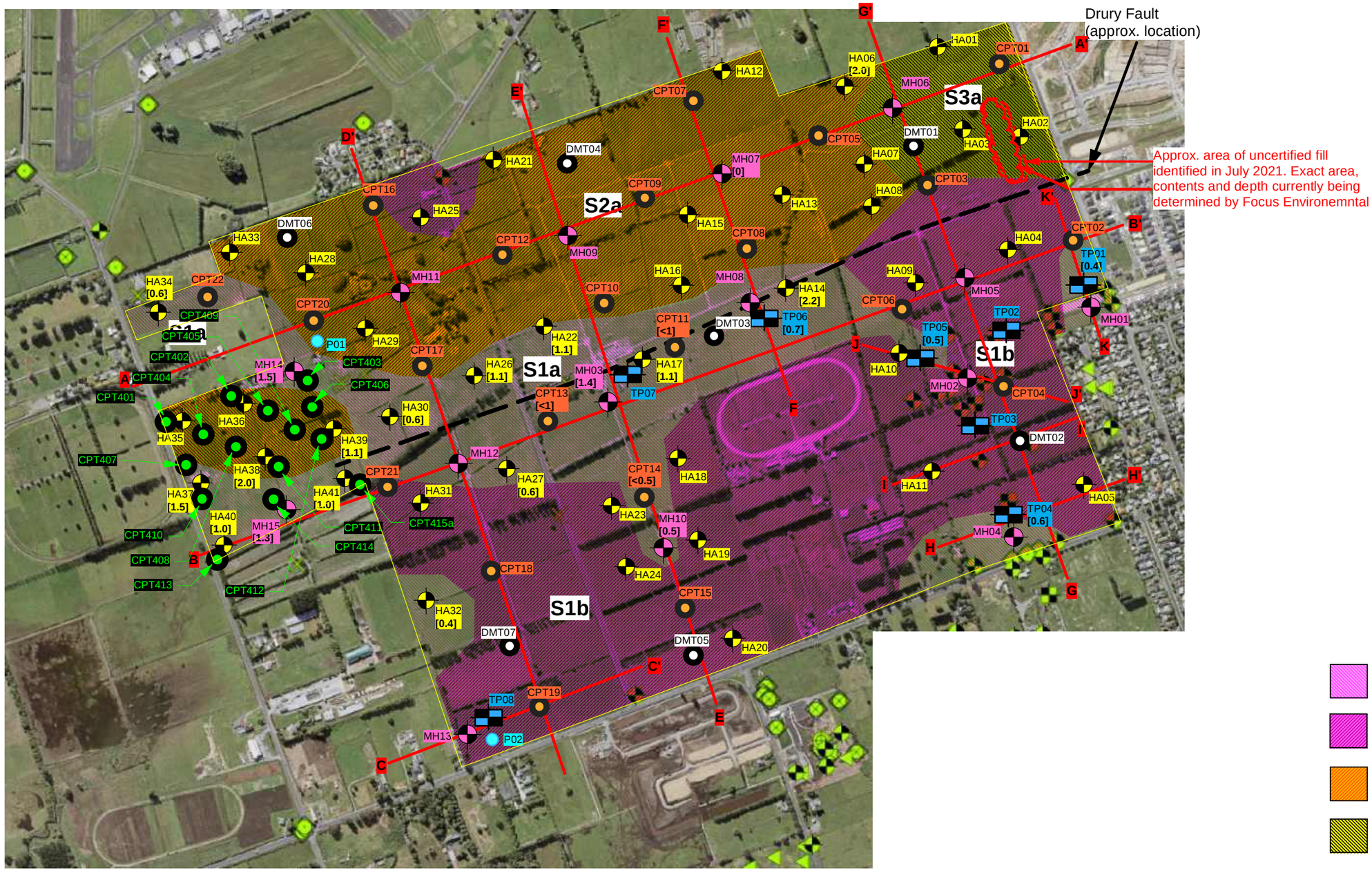
Title

PROPOSED CHANNEL TYPICAL SECTIONS

Project no.	215009
Scale	1:200 @ A3
Cad file	215009-S3-C4250-CHANNEL DETAILS.DWG
Drawing no.	215009-S3-C4250 Rev A

APPENDIX 2

LANDER GEOTECHNICAL CONSULTANTS LIMITED AND LDE LIMITED DRAWINGS



Legend and/or Notes:

- Trial Pit (TP) [Lander 2021]
- Machine Borehole (MH) [Lander 2021]
- Cone Penetration Test (CPT) [Lander 2021]
- Dilatometer Test (DMT) [Lander 2021]
- Hand Auger Borehole (HA) [Lander 2021]
- Falling Head Percolation Test [Lander 2021]
- Cone Penetration Test (CPT) [Initia 2022]
- Study Area
- Geotechnical Cross Section Alignment

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al).*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*

THICKNESS OF INORGANIC CRUST INDICATED IN [BRACKETS] IN METRES. ALL TESTS IN S1b MATERIALS HAVE 0m CRUST THICKNESS.

Green circles and crosses are various existing tests from NZGS database

SOURCE: NZGS Database, existing tests as green circles or crosses

revision	description	drawn	approved	date

0 200.0 400.0 600.0
Horizontal Scale (metres)
0 200.0 400.0 600.0
Vertical Scale (metres)

drawn	KM
approved	SGL
date	28.11.23
scale	1:10,000
original size	A3

LDE LAND DEVELOPMENT & ENGINEERING

client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **STUDY AREA GEOLOGY PLAN**

project no: **J01627** figure no: **2.1**

Template revision: 1:1000 (10/12/14)

Legend and/or Notes:

SOURCE: NZGS Database, existing tests as green circles or crosses

Green circles and crosses are various existing tests from NZGS database

MEASURED GROUNDWATER LEVELS WITHIN STANDPIPES ON MONITORING DATES INDICATED IN [BRACKETS]

revision	description	drawn	approved	date

0 200.0 400.0 600.0
Horizontal Scale (metres)
0 200.0 400.0 600.0
Vertical Scale (metres)

drawn	KM
approved	SGL
date	28.11.23
scale	1:10,000
original size	A3

LDE LAND DEVELOPMENT & ENGINEERING

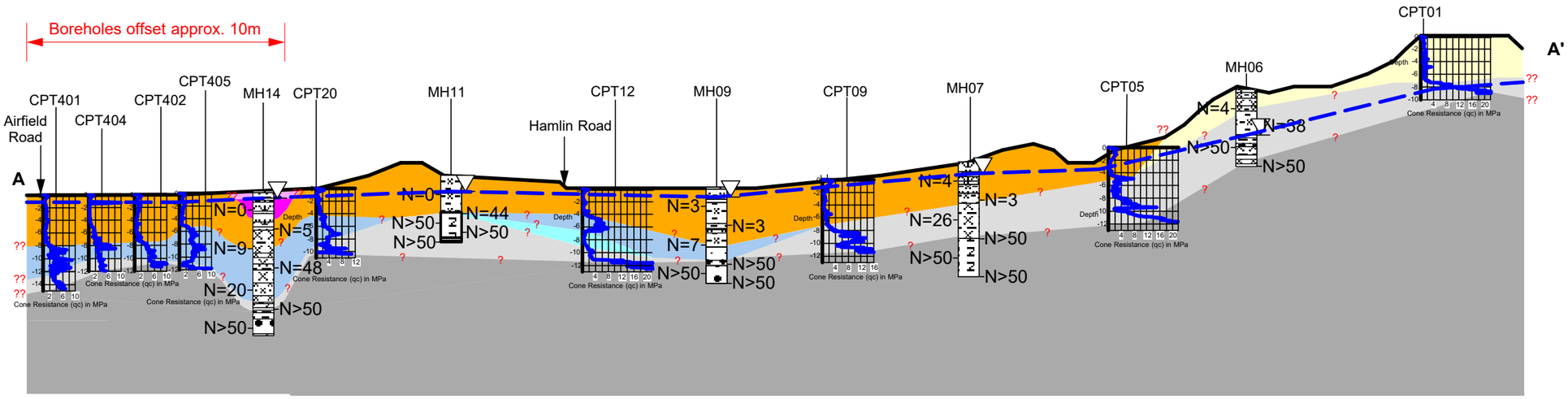
client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **SEASONAL STANDPIPE GROUNDWATER LEVELS**

project no: **J01627** figure no: **2.2**

Template revision: 1:1000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**

revision	description	drawn	approved	date

0 120.0 240.0 360.0 480.0
Horizontal Scale (metres)
0 12.0 24.0 36.0 48.0
Vertical Scale (metres)

drawn	**JM**
approved	*SGL*
date	**13.02.23**
scale	**1:8000**
original size	**A3**

LDE LAND DEVELOPMENT & ENGINEERING

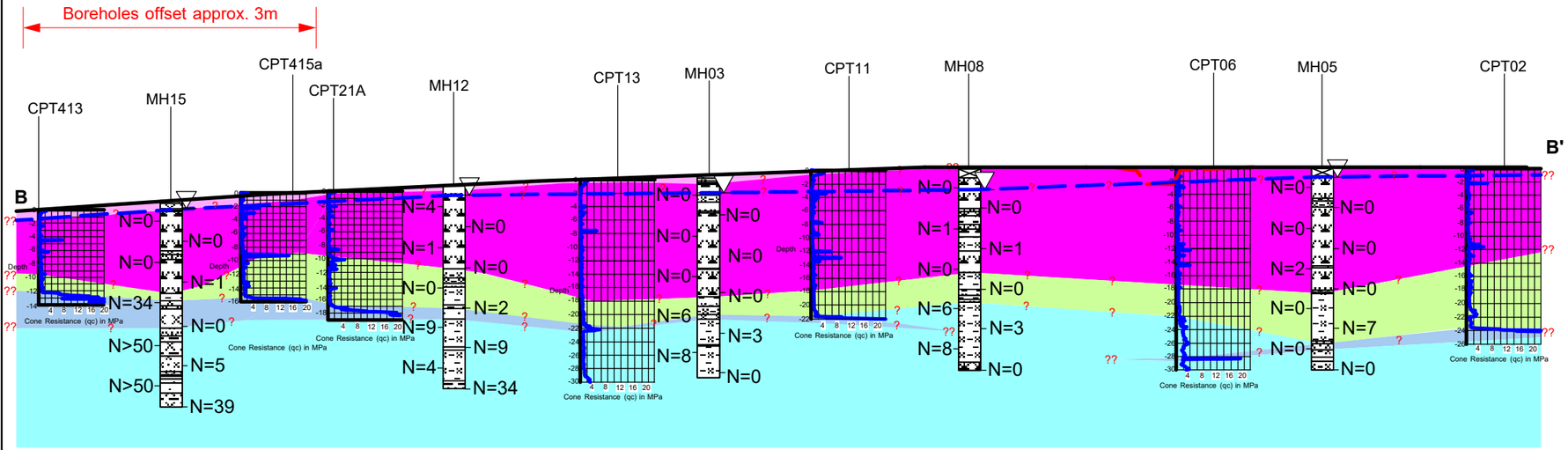
client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **CROSS SECTION AA'**

project no: **J01627** figure no: **2.3**

Template revision: 1:2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**

revision	description	drawn	approved	date

0 120.0 240.0 360.0 480.0
Horizontal Scale (metres)
0 12.0 24.0 36.0 48.0
Vertical Scale (metres)

drawn	**JM**
approved	**SGL**
date	**13.02.23**
scale	**1:8000**
original size	**A3**

LDE LAND DEVELOPMENT & ENGINEERING

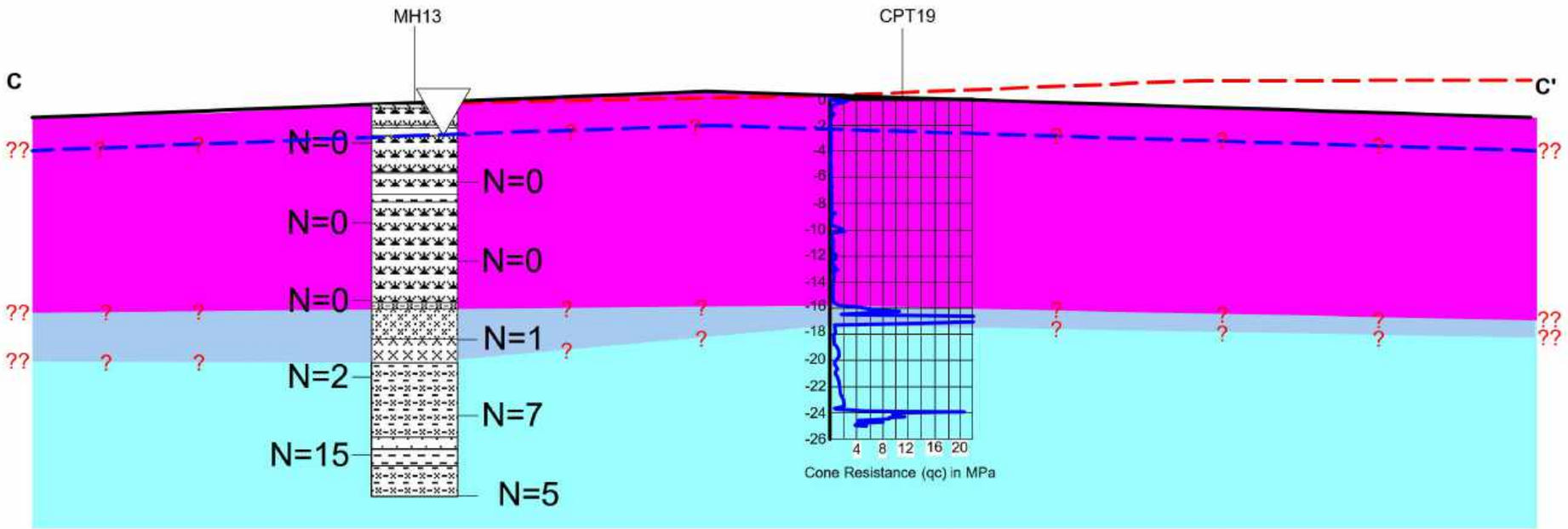
client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **CROSS SECTION BB'**

project no: **J01627** figure no: **2.4**

Template revision: 1:2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**

revision	description	drawn	approved	date

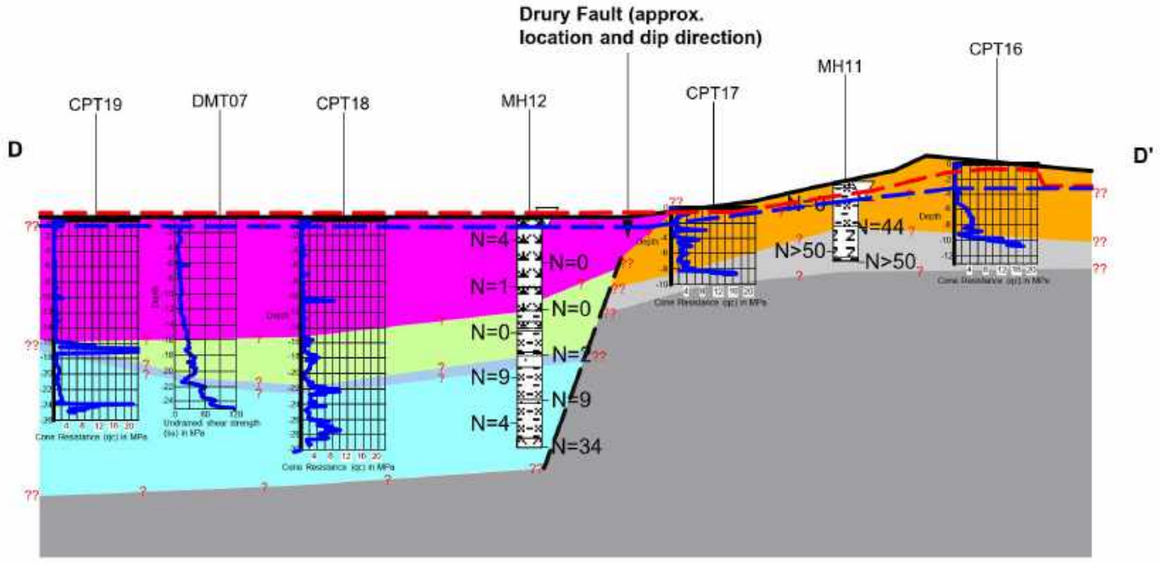
0 30.0 60.0 90.0 120.0
Horizontal Scale (metres)
0 6.0 12.0 18.0 24.0
Vertical Scale (metres)

drawn	PL
approved	SGL
date	03.06.21
scale	1:8000
original size	A3

LANDER geotechnical

client: **SUNFIELD DEVELOPMENTS LIMITED**
project: **SUNFIELDS, ARDMORE**
title: **CROSS SECTION CC'**
project no: **J01627** figure no: **2.5**

Template revision: 1.2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**

revision	description	drawn	approved	date

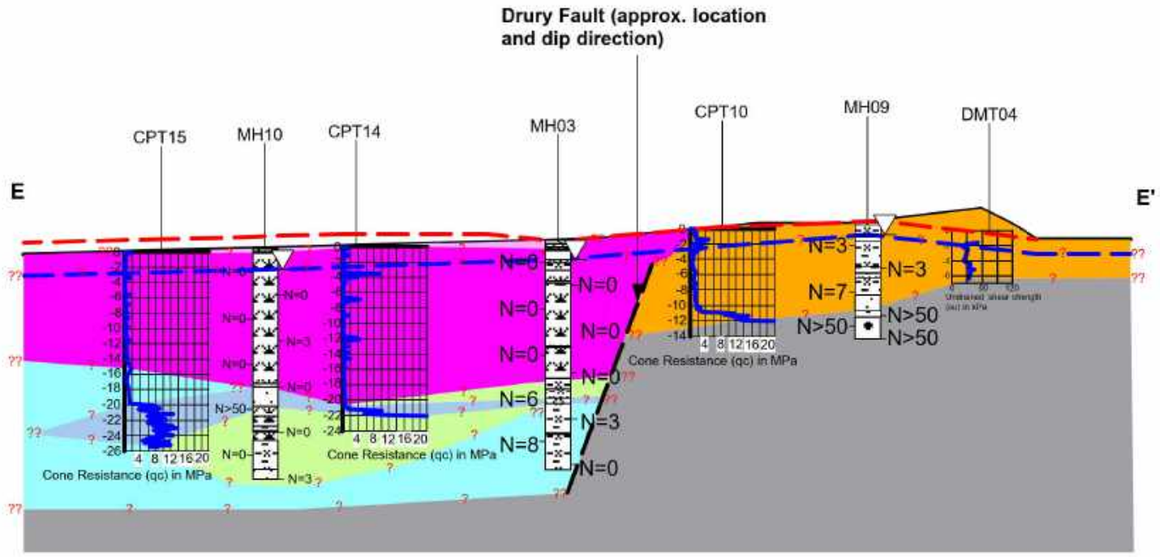
0 120.0 240.0 360.0 480.0
Horizontal Scale (metres)
0 12.0 24.0 36.0 48.0
Vertical Scale (metres)

drawn	PL
approved	SGL
date	03.06.21
scale	1:8000
original size	A3

LANDER geotechnical

client: **SUNFIELD DEVELOPMENTS LIMITED**
project: **SUNFIELDS, ARDMORE**
title: **CROSS SECTION DD'**
project no: **J01627** figure no: **2.6**

Template revision: 1:2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**

revision	description	drawn	approved	date

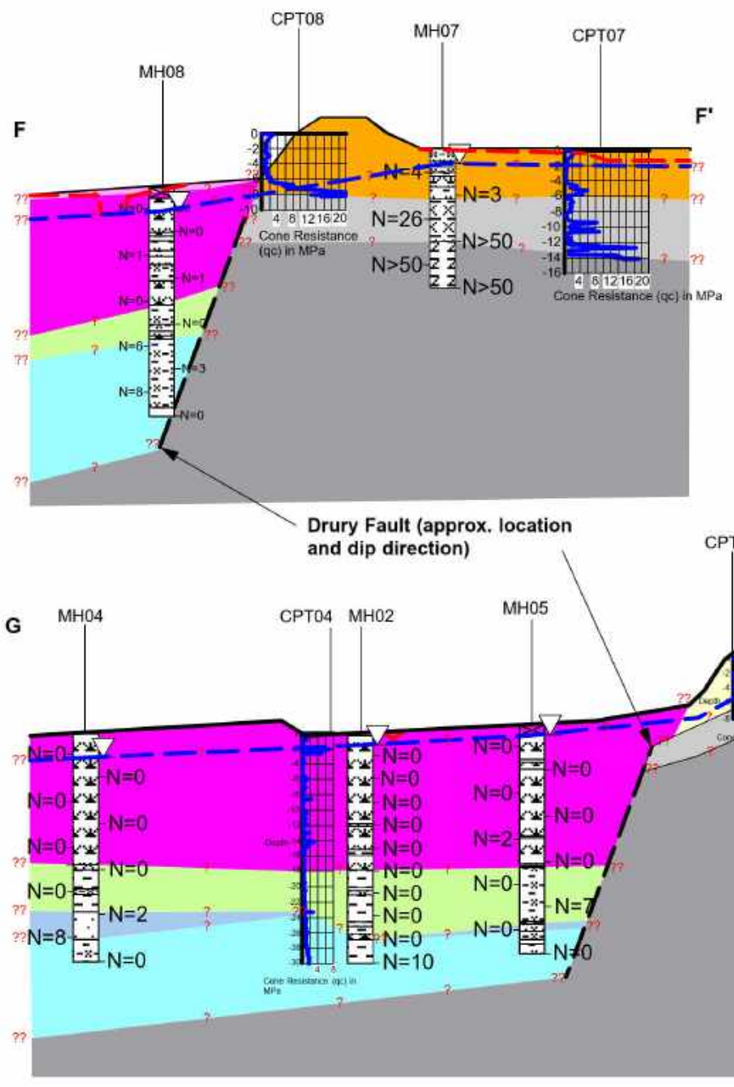
0 120.0 240.0 360.0 480.0
Horizontal Scale (metres)
0 12.0 24.0 36.0 48.0
Vertical Scale (metres)

drawn	PL
approved	SGL
date	04.06.21
scale	1:8000
original size	A3

LANDER geotechnical

client: **SUNFIELD DEVELOPMENTS LIMITED**
project: **SUNFIELDS, ARDMORE**
title: **CROSS SECTION EE'**
project no: **J01627** figure no: **2.7**

Template revision: 1:2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**

revision	description	drawn	approved	date

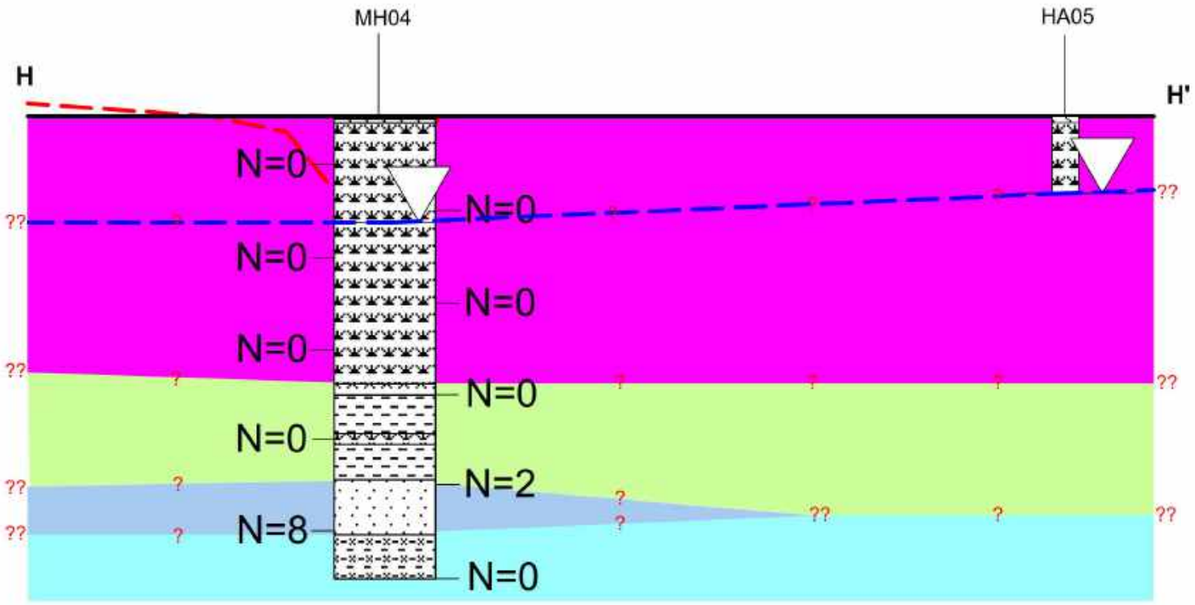
0 120.0 240.0 360.0 480.0
Horizontal Scale (metres)
0 12.0 24.0 36.0 48.0
Vertical Scale (metres)

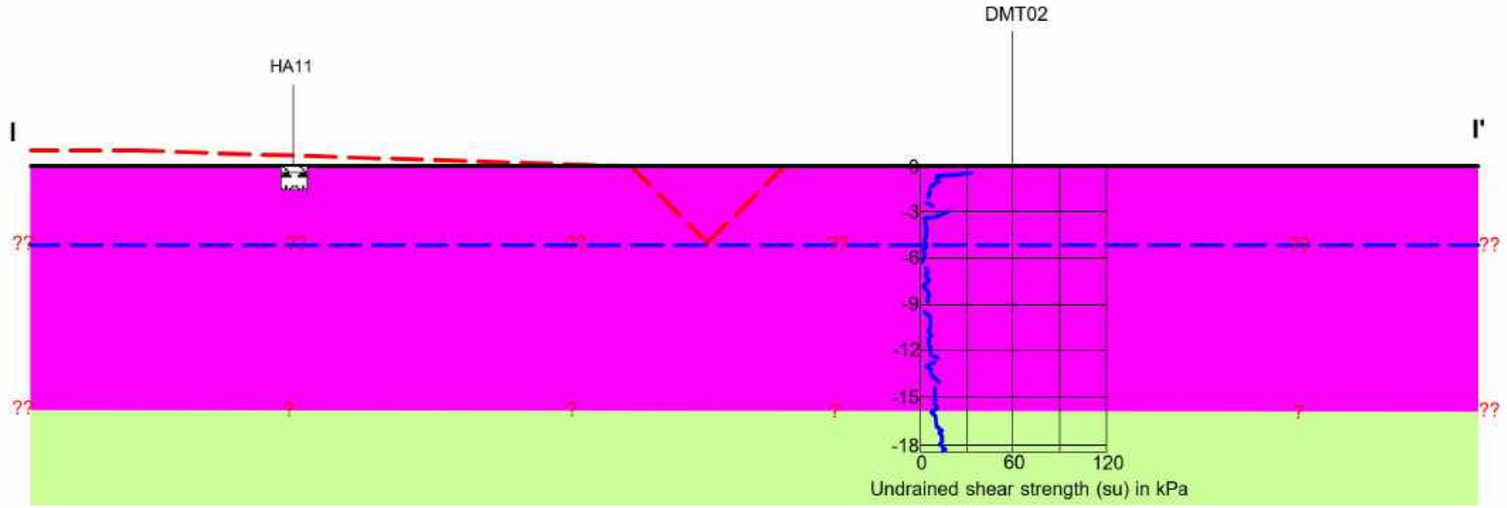
drawn	PL
approved	SGL
date	04.06.21
scale	1:8000
original size	A3

LANDER geotechnical

client: **SUNFIELD DEVELOPMENTS LIMITED**
project: **SUNFIELDS, ARDMORE**
title: **CROSS SECTION FF' & GG'**
project no: **J01627** figure no: **2.8**

Template revision: 1:2000 (10/12/14)





Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
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- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**

revision	description	drawn	approved	date

0 30.0 60.0 90.0 120.0
Horizontal Scale (metres)
0 6.0 12.0 18.0 24.0
Vertical Scale (metres)

drawn	PL
approved	SGL
date	03.06.21
scale	1:2000
original size	A3

LANDER geotechnical

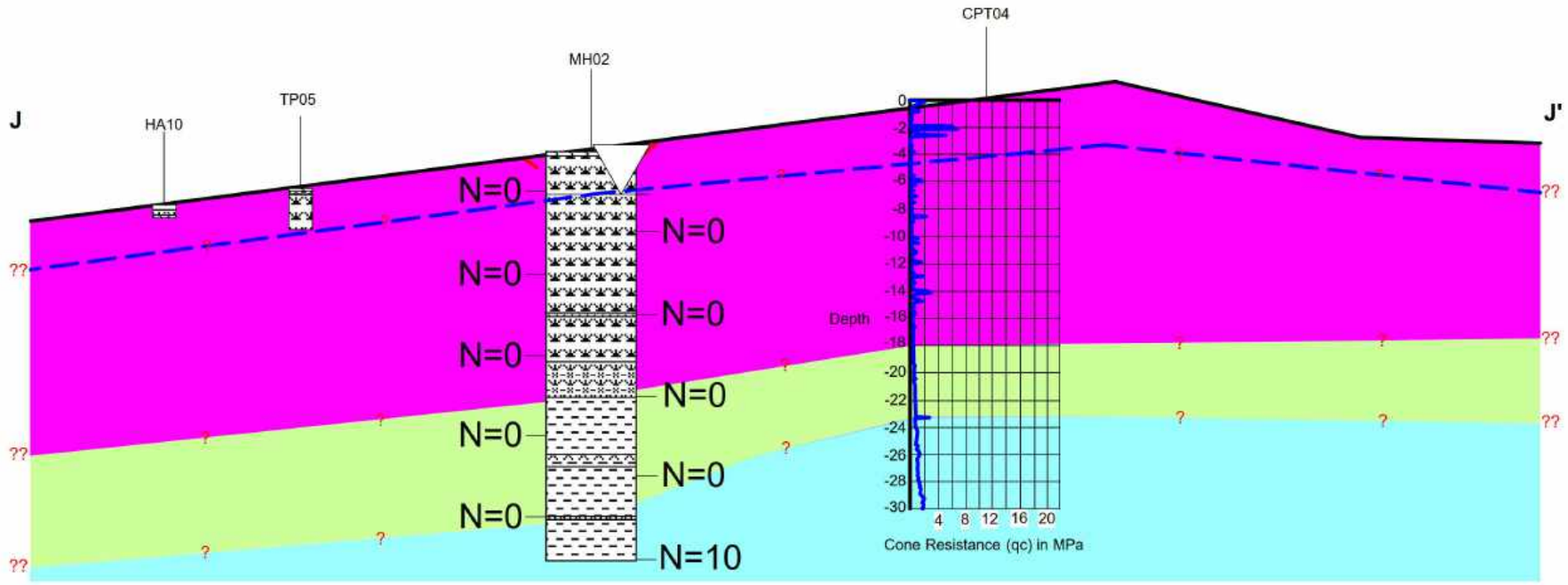
client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **CROSS SECTION HH' & II'**

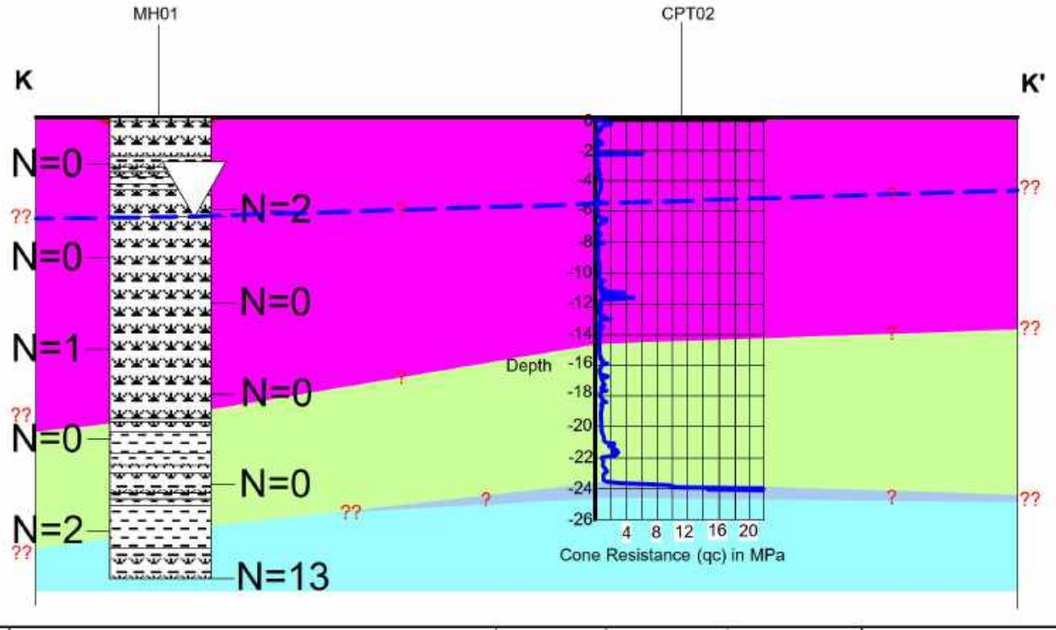
project no: **J01627** figure no: **2.9**

Template revision: 1.2000 (10/12/14)



Legend and/or Notes:

- **S1a - Zone 1: Crust material** *(Undifferentiated Alluvium; Q1al)*
- **S1b - Zone 1: Peat** *(Undifferentiated Alluvium; Q1al)*
- **S2a - Zone 2: Overconsolidated Clays/Silts (Upper)** *(Puketoka Formation; Pup)*
- **S2b - Zone 1: Normally Consolidated Clays** *(Puketoka Formation; Pup)*
- **S2c - Zone 1: Loose Sands/Dilatant Silts** *(Puketoka Formation; Pup)*
- **S2d - Zone 1: Overconsolidated Clays/Silts (Lower)** *(Puketoka Formation; Pup)*
- **S3a - Zone 2: Residual Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3b - Zone 2: Transitional Clays/Silts** *(East Coast Bays Formation; Mwe)*
- **S3c - Zone 2: Bedrock** *(East Coast Bays Formation; Mwe)*
- **Groundwater Table**
- **Proposed Ground Level**



revision	description	drawn	approved	date

0 30.0 60.0 90.0 120.0
Horizontal Scale (metres)

0 6.0 12.0 18.0 24.0
Vertical Scale (metres)

drawn	PL
approved	SGL
date	03.06.21
scale	1:2000
original size	A3

LANDER geotechnical

client: **SUNFIELD DEVELOPMENTS LIMITED**

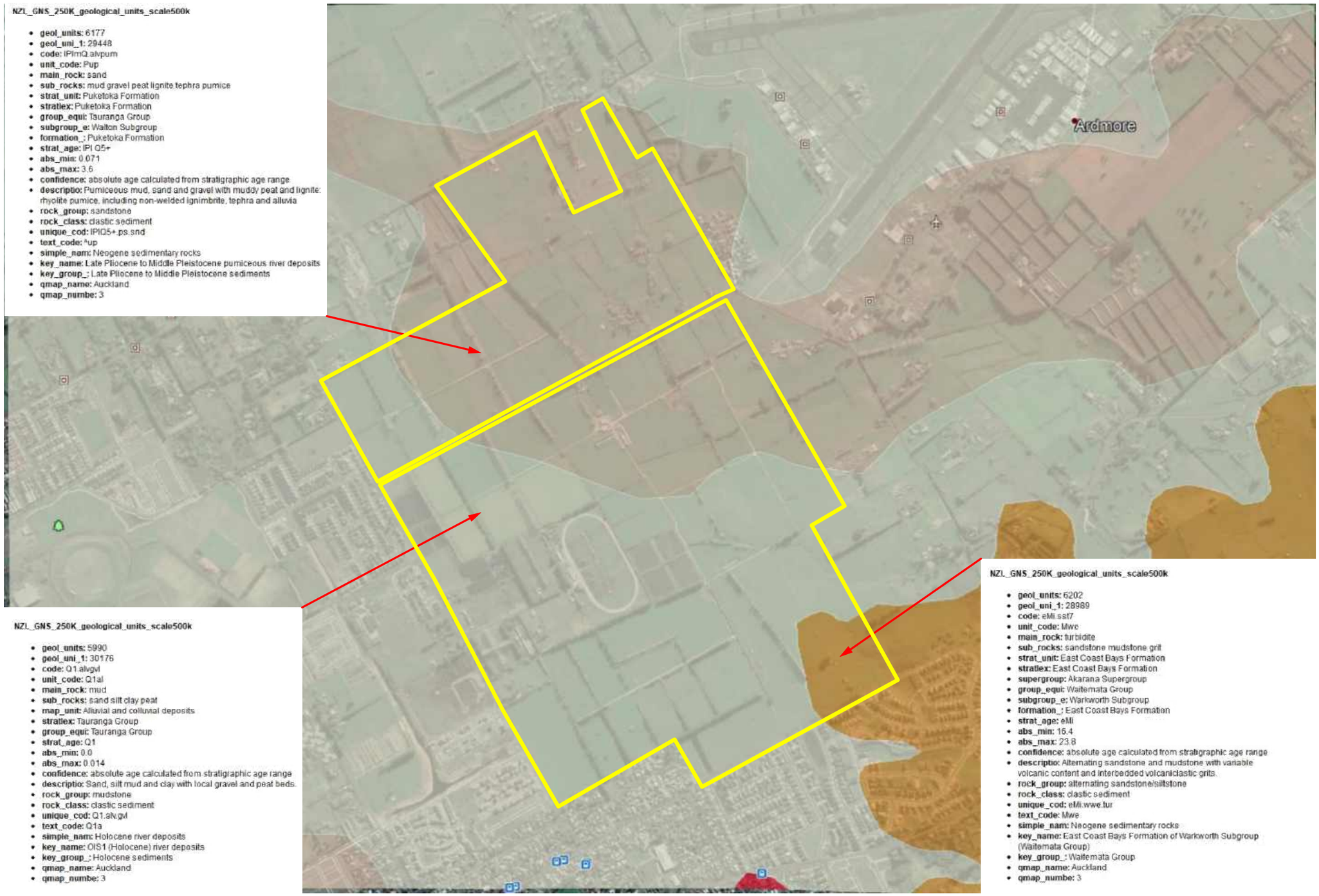
project: **SUNFIELDS, ARDMORE**

title: **CROSS SECTION JJ' & KK'**

project no: **J01627** figure no: **2.10**

Template revision: 1:2000 (10/12/14)

Legend and/or Notes:



NZL_GNS_250K_geological_units_scale500k

- **geol_units:** 6177
- **geol_uni_1:** 29448
- **code:** IPlmQ.alvpum
- **unit_code:** Pup
- **main_rock:** sand
- **sub_rocks:** mud gravel peat lignite tephra pumice
- **strat_unit:** Puketoka Formation
- **stratiex:** Puketoka Formation
- **group_equi:** Tauranga Group
- **subgroup_e:** Walton Subgroup
- **formation_:** Puketoka Formation
- **strat_age:** IPl Q5+
- **abs_min:** 0.071
- **abs_max:** 3.6
- **confidence:** absolute age calculated from stratigraphic age range
- **descriptio:** Pumiceous mud, sand and gravel with muddy peat and lignite; rhyolite pumice, including non-welded ignimbrite, tephra and alluvia
- **rock_group:** sandstone
- **rock_class:** clastic sediment
- **unique_cod:** IPlQ5+.ps.snd
- **text_code:** *up
- **simple_nam:** Neogene sedimentary rocks
- **key_name:** Late Pliocene to Middle Pleistocene pumiceous river deposits
- **key_group_:** Late Pliocene to Middle Pleistocene sediments
- **qmap_name:** Auckland
- **qmap_numbe:** 3

NZL_GNS_250K_geological_units_scale500k

- **geol_units:** 5990
- **geol_uni_1:** 30176
- **code:** Q1.alvgvl
- **unit_code:** Q1al
- **main_rock:** mud
- **sub_rocks:** sand silt clay peat
- **map_unit:** Alluvial and colluvial deposits
- **stratiex:** Tauranga Group
- **group_equi:** Tauranga Group
- **strat_age:** Q1
- **abs_min:** 0.0
- **abs_max:** 0.014
- **confidence:** absolute age calculated from stratigraphic age range
- **descriptio:** Sand, silt mud and clay with local gravel and peat beds.
- **rock_group:** mudstone
- **rock_class:** clastic sediment
- **unique_cod:** Q1.alv.gvl
- **text_code:** Q1a
- **simple_nam:** Holocene river deposits
- **key_name:** OIS1 (Holocene) river deposits
- **key_group_:** Holocene sediments
- **qmap_name:** Auckland
- **qmap_numbe:** 3

NZL_GNS_250K_geological_units_scale500k

- **geol_units:** 6202
- **geol_uni_1:** 28989
- **code:** eMi.sst7
- **unit_code:** Mwe
- **main_rock:** turbidite
- **sub_rocks:** sandstone mudstone grit
- **strat_unit:** East Coast Bays Formation
- **stratiex:** East Coast Bays Formation
- **supergroup:** Akarana Supergroup
- **group_equi:** Waitemata Group
- **subgroup_e:** Warkworth Subgroup
- **formation_:** East Coast Bays Formation
- **strat_age:** eMi
- **abs_min:** 16.4
- **abs_max:** 23.8
- **confidence:** absolute age calculated from stratigraphic age range
- **descriptio:** Alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits.
- **rock_group:** alternating sandstone/siltstone
- **rock_class:** clastic sediment
- **unique_cod:** eMi.wwe.tur
- **text_code:** Mwe
- **simple_nam:** Neogene sedimentary rocks
- **key_name:** East Coast Bays Formation of Warkworth Subgroup (Waitemata Group)
- **key_group_:** Waitemata Group
- **qmap_name:** Auckland
- **qmap_numbe:** 3

revision	description	drawn	approved	date

drawn	**KM**
approved	*SGL*
date	**28.11.23**
scale	**nts**
original size	**A3**

LDE LAND DEVELOPMENT & ENGINEERING

client: **SUNFIELD DEVELOPMENT LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **GEOLOGY**

project no: **J01627** figure no: **2.11**

Template revision: 1:1000 (10/12/14)

Legend and/or Notes:

revision	description	drawn	approved	date

drawn	**KM**
approved	*SGL*
date	**28.11.23**
scale	**nts**
original size	**A3**

client: **SUNFIELD DEVELOPMENTS LIMITED**

project: **SUNFIELDS, ARDMORE**

title: **PROXIMITY TO ACTIVE FAULTS**

project no: **J01627** figure no: **2.12**

Template revision: 1:1000 (10/12/14)

Sunfields Study Area

0 70 140 210
Meters

Scale @ A3
= 1:8,000

Date Printed:
28/11/2023

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Wastewater

Local Network

Wastewater Pipe GIS ID Label (Local)

Wastewater Pipe GIS ID Label (Local)

Wastewater Pipe (Local)

Operational

Operational Not Vested

Abandoned / Not Operational

Wastewater Structure (Local)

Wastewater Other Structure (Local)

Wastewater Other Structure (Local)

Wastewater Pump Station (Local)

Wastewater Pump Station (Local)

Transmission Network

Wastewater Pipe (Transmission)

Operational

Operational Not Vested

Abandoned/ Not Operational

Wastewater Structure (Transmission)

Stormwater

Stormwater Treatment Device

Public

Private

Stormwater Pond or Wetland Components

Stormwater Forebay

Public

Private

Stormwater Treatment Facility

Public

Private

Stormwater Watercourse

Public

Private

Stormwater Pipe SAP ID label

Stormwater Pipe SAP ID label

Stormwater Pipe

Public - Gravity Mains

Private - Gravity Mains

KiwiRail, Gravity Mains

Public - Culvert/Tunnel

Private - Culvert/Tunnel

KiwiRail, Culvert/Tunnel; KiwiRail, In Service, Culvert

Public - Rising Main

Private - Rising Main

Public - Subsoil Drain

Private - Subsoil Drain

Stormwater Connection

Public

Private

Stormwater Channel

Public lined

Public Watercourse

Private Watercourse

Stormwater Pump Station

Public

Private

Stormwater Planting

Public

Private

Stormwater Erosion And Flood Control

Public - Wall Structure

Private - Wall Structure

Public - Other Structure

Private - Other Structure

Stormwater Abandoned Assets

Stormwater Abandoned Pipe

Public - Gravity Mains

Public - Culvert/Tunnel

Public - Rising Main

Public - Subsoil Drain

Stormwater Abandoned Connection

Public

Septic Tank

Public - Hi-Tech

Private - Hi-Tech

Public - Other

Private - Other

Stormwater GPS

GPS Location (NorthShore)

GPS Location (NorthShore)

GPS Survey (North Shore)

GPS Survey (North Shore)

Water

Local Network

Water Pipe (Local)

Operational (Non-Potable)

Operational (Potable)

Operational Not Vested

Abandoned / Not Operational

Water Structure (Local)

Water Other Structure (Local)

Water Other Structure (Local)

Water Pump Station (Local)

Water Pump Station (Local)

Water Reservoir (Local)

Water Reservoir (Local)

Transmission Network

Water Fitting (Transmission)

Water Pipe (Transmission)

Operational (Non-Potable)

Operational (Potable)

Not Operational

Proposed

Water Structure (Transmission)

Water Reservoir (Transmission)

Water Reservoir (Transmission)

Water Source (Transmission)

Water Source (Transmission)

Other Watercare Assets

Other Watercare Linear Assets

Other Watercare Linear Assets

Other Watercare Structures and Areas

Other Watercare Structures and Areas

Other Non Watercare

Non Watercare Pipe

Non Watercare Pipe

Asbuilt Area

Asbuilt Area

Transpower

Transpower Pylons

Transpower Pylons

Transpower Sites

Transpower Sites

Electricity Transmission Lines

110 kv

220 kv

400 kv

LGP Pipeline

LGP Pipeline

Aviation JetA1 Fuel Pipeline

Aviation JetA1 Fuel Pipeline

Gas Transmission Lines

Gas Transmission Lines

High Pressure Gas Pipelines

High Pressure Gas Pipelines

Medium-Pressure Gas Pipeline

Medium-Pressure Gas Pipeline

RNZ Liquid Fuels Pipeline Marsden to Wiri

RNZ Liquid Fuels Pipeline Marsden to Wiri

Fibre Optic Cable - ARTA

Fibre Optic Cable - ARTA

Address

Address

Contours 2016

Contours 0m

Contours 0m

Contours 2m Intervals

Contours 100m

Contours 100m

Contours 50m

Contours 50m

Contours 10m

Contours 10m

Contours 2m

Contours 2m

Place Names

Place Name (25,000)

Place Name (25,000)

Public Open Space Names (8,000)

Public Open Space Names (8,000)

Place Name Search

Place Name Search

Rail Stations

Rail Stations (8,000)

Rail Stations (8,000)

Railway Lines

Railway (25,000)

Railway (25,000)

Auckland Council Boundary

Auckland Council Boundary

Roads

Roads (8,000)

Motorway

Motorway Under Construction

Secondary Arterial Road

Secondary Arterial Road Under Construction

Primary Arterial Road

Primary Arterial Road Under Construction

Collector Road

Collector Road Under Construction

Local Road

Local Road Under Construction

Property

Property

Rate Assessment

Rate Assessment

Parcels

Parcels

Coastline

Aerial 2019 2020 Rural

Image

Red: Band_1

Green: Band_2

Blue: Band_3

Aerial 2022 Rural

Image

Red: Band_1

Green: Band_2

Blue: Band_3

Aerial 2017 Urban

Image

Red: Band_1

Green: Band_2

Blue: Band_3

Aerial 2010 2011 Rural

Image

Red: Band_1

Green: Band_2

Blue: Band_3

Legend

Date Printed:
28/11/2023

Auckland Council
Te Kaunihera o Tāmaki Makaurau

APPENDIX 3

FIELD INVESTIGATION RECORDS

APPENDIX 3.1

GEOTECHNICAL MODEL SUMMARY

Table 3.1. Geotechnical Model Summary.

Stratum ID / Geology *S1: Undifferentiated Alluvium* *S2: Puketoka Formation* *S3: East Coast Bays Formation*	Soil Material Type	In-Situ Test Parameters – typical range & [average]			
		S_u	N-value	q_c	m_v
S1a: Crust material	Inorganic and organic stained silty CLAY/clayey SILT.	40-217 [76]	-	0.5-4.0 [1.3]	-
S1b: Peat	Fibrous PEAT. *Some beds of amorphous PEAT, CLAY, dilatant pumiceous SILT.*	1-147 [30]	0-4 [0]	0-1.1 [0.35]	$1.1x10^{-2}$ – 4.0 [1.2]
S2a: Over-consolidated Clays/Silts (Upper)	Inorganic or organic stained silty CLAY/clayey SILT. *Some beds of organic silty CLAY/clayey SILT.*	49 - 270+ [67]	0-4 [3]	0.1-3.0 [1.3]	$2.1x10^{-2}$ – 0.5 [0.2]
S2b: Normally-consolidated Clays	Inorganic and organic CLAY. *Some beds of dilatant pumiceous SILT, fibrous and amorphous PEAT.*	8-77 [38]	0-7 [0]	0.3-1.7 [1.3]	$7.0x10^{-2}$ – 0.5 [$2.7x10^{-2}$]
S2c: Loose Sands/Dilatant Silts	Dilatant pumiceous SILT, clayey SAND, silty SAND.	17-32 [25]*	1-50 [2]	3.0-35 [7.8]	$3.2x10^{-3}$ – 0.3 [$2.6x10^{-2}$]
S2d: Over-consolidated Clays/Silts (Lower)	Inorganic and organic stained CLAY/silty CLAY. *Some beds of fibrous PEAT, SAND*	37-200 [83]	0-34 [7]	0.8-2.8 [2.1]	-
S3a: Residual Soils	Inorganic silty CLAY/clayey SILT.	101-270+ [178]	4	0.6-1.9 [1.3]	$7.4x10^{-3}$ – $3.5x10^{-2}$ [$3.0x10^{-2}$]
S3b: Transitional Soils	Inorganic silty CLAY/clayey SILT, fine SAND. *Some beds of highly to completely weathered interbedded SILTSTONE and SANDSTONE.*	162-270+ [230]	26-50+ [45]	3.1-30.3 [7.1]	$6.1x10^{-3}$ – $8.3x10^{-3}$ [$6.9x10^{-3}$]
S3c: Bedrock	Slightly to completely weathered SANDSTONE		50+	-	-

**: peak undrained shear strengths only related to clayey SAND layers.*

J01627 - Sunfields Development, Ardmore

Standing Groundwater Level

Technician: JM

Table 3.2. Groundwater monitoring summary

Borehole No.	GW encountered (m below existing ground level)	Standing GWL (m below existing ground level)	Piezometer screen (m below existing ground level)	Date measured
HA01	-	-	-	12.04.21
HA02	-	-	-	12.04.21
HA03	-	-	-	12.04.21
HA04	1.2	2.8	-	12.04.21
HA05	2.8	4.5	-	12.04.21
HA06	-	-	-	12.04.21
HA07	-	-	-	12.04.21
HA08	-	-	-	12.04.21
HA09	-	-	-	12.04.21
HA10	-	-	-	12.04.21
HA11	-	-	-	12.04.21
HA12	3.3	3.8	-	12.04.21
HA13	-	-	-	12.04.21
HA14	2.0	2.2	-	12.04.21
HA15	-	-	-	12.04.21
HA16	2.2	4.0	-	13.04.21
HA17	1.4	1.8	-	13.04.21
HA18	1.5	1.5	-	14.04.21
HA19	-	-	-	14.04.21
HA20	-	-	-	14.04.21
HA21	3.1	3.7	-	15.04.21
HA22	3.1	3.5	-	12.04.21
HA23	1.9	1.9	-	14.04.21
HA24	-	-	-	14.04.21
HA25	2.3	1.5	-	12.04.21
HA26	1.9	1.8	-	12.04.21

Borehole No.	GW encountered (m below existing ground level)	Standing GWL (m below existing ground level)	Piezometer screen (m below existing ground level)	Date measured
HA27	2.0	1.9	-	14.04.21
HA28	-	-	-	20.04.21
HA29	-	-	-	12.04.21
HA30	1.4	1.5	-	14.04.21
HA31	2.0	1.9	-	12.04.21
HA32	0.6	1.8	-	12.04.21
HA33	-	-	-	12.04.21
HA34	-	-	-	12.04.21
HA35	-	-	-	15.12.23
HA36	3.5	4.2	-	15.12.23
HA37	1.4	2.0	-	15.12.23
HA38	1.5	4.2	-	15.12.23
HA39	1.4	1.0	-	15.12.23
HA40	1.0	0.7	-	15.12.23
HA41	1.0	1.2	-	15.12.23
MH01	N/A	1.66, 1.05, 1.61, 1.73	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH02	N/A	1.57, 0.50, 0.92	1.0 - 30.0	30.04.21, 30.07.21, 17.01.22
MH03	N/A	2.63, 2.10, 2.09, 1.98	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH04	N/A	3.37, 0.60, 2.92, 3.30	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH05	N/A	1.46, 0.50, 0.52, 1.00	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH06	N/A	7.17, 3.50, 4.26, 5.68	1.0 - 12.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH07	N/A	1.87, 0.60, 0.56, 0.72	1.0 - 18.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH08	N/A	3.23, 3.45, 3.39, 3.37	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH09	N/A	1.55, 0.40, 0.39, 0.91	1.0 - 15.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH10	N/A	2.69, 1.00, 0.97, 2.43	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH11	N/A	2.54, 0.20, 0.32, 1.28	1.0 - 10.5	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH12	N/A	1.30, 1.20, 1.17, 1.44	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH13	N/A	1.26, 0.60, 0.63, 1.03	1.0 - 30.0	30.04.21, 30.07.21, 27.10.21, 17.01.22
MH14	N/A	1.15	1.0 - 23.0	09.02.23
MH15	N/A	1.16	1.0 - 30.5	09.02.23

Borehole No.	GW encountered (m below existing ground level)	Standing GWL (m below existing ground level)	Piezometer screen (m below existing ground level)	Date measured
TP01	1.2	N/A		13.04.21
TP02	2.7	N/A	-	13.04.21
TP03	2.4	N/A	-	13.04.21
TP04	2.7	N/A	-	13.04.21
TP05	2.3	N/A	-	13.04.21
TP06	2.0	N/A	-	13.04.21
TP07	1.6	N/A	-	13.04.21
TP08	-	N/A	-	13.04.21

APPENDIX 3.2

MACHINE BOREHOLE RECORDS

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH01

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	JM	JM	07.04.21	07.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL	0.0	Lockable toby		Triple Tube				
Undifferentiated Alluvium	fibrous PEAT, dark brown/black. Firm, moist, low to medium plasticity	0.5	Bentonite seal			65			
	becoming high plasticity, moderately sensitive	1.0							
		1.5	Groundwater level measured 30.04.21: 1.66m						27/8 - 3.4
		2.0				84		Sample 1 Disturbed 1.9-2.4m	
	organic stained CLAY, brown. Soft, moist, high plasticity	2.5							
		3.0				SPT			SPT at 3.0-3.45m 0/0/0 N=0
	CLAY, light grey/green. Soft, moist, high plasticity, with trace organic inclusions	3.5	Gravel backfill						
	organic stained CLAY, brown. Soft, moist, high plasticity with moderately thin bed of fibrous PEAT		Piezometer screened from 1.0m to 30.0m						
	CLAY, light grey/green. Soft, moist, high plasticity, with trace rootlets	4.0				89		Sample 2 Disturbed 3.8-4.25m	
	organic stained CLAY, dark brown. Soft, moist, high plasticity, sensitive, with trace rootlets	4.5							17/3 - 5.7
	fibrous PEAT, dark brown/black. Soft, moist, medium plasticity	5.0							
	with coarse gravel sized tree gum inclusion	5.5				42			
		6.0				SPT			SPT at 6.0-6.45m 0/1/1 N=2
	becoming low plasticity	6.5							
		7.0				65			
	becoming moderately sensitive	7.5							14/5 - 2.8
		8.0				95			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH01

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 07.04.21
2153	JM	JM	Finish Date: 07.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	pumiceous SILT, light brown/white. Loose, moist, no plasticity, dilatant		8.2			Triple Tube			Sample 3 Disturbed 8.2-8.4m	
	fibrous PEAT, dark brown/black. Soft, moist, low plasticity		8.5				95			
	becoming medium plasticity									
	becoming moderately sensitive		9.0				SPT			12/5 - 2.4 SPT at 9.0-9.45m 0/0/0 N=0
	with thin bed of light brown/white dilatant pumiceous SILT		9.5							
	with thin bed of light brown/white dilatant pumiceous SILT									
	with thin bed of light brown/white dilatant pumiceous SILT		10.0				53			
	becoming sensitive		10.5							17/3 - 5.7
			11.0							
				Gravel backfill			51			
			11.5	Screened from 1.0m to 30.0m						
	becoming moderately sensitive		12.0				SPT			17/5 - 3.4 SPT at 12.0-12.45m 0/0/0 N=0
	with thin bed of light brown fine SAND		12.5							
			13.0				10			
			13.5							
			14.0				57			
			14.5							
	becoming sensitive		15.0				SPT			14/2 - 7.0 SPT at 15.0-15.45m 0/1/0 N=1
			15.5				73			
			16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH01

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date: 07.04.21
2153	JM	JM	Finish Date: 07.04.21

Borehole Location: mN mE Ground R.L.

Description: Refer to site plan Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	becoming firm, moderately sensitive		16.5			Triple Tube	73			31/9 - 3.4 SPT at 18.0-18.45m 0/0/0 N=0
			17.0							
			17.5				100			
			18.0				SPT			
			18.5							
			19.0				100			
	becoming very soft		19.5	Gravel backfill →						6/2 - 3.0
Puketoka Formation	CLAY, brown mottled light grey. Soft, moist, high plasticity, with minor organic staining			Screened from 1.0m to 30.0m →						
	organic CLAY, dark grey/brown. Soft, moist, high plasticity		20.0							
	CLAY, light grey. Firm, moist, high plasticity, sensitive		20.5				95			
	with moderately thin bed of brown CLAY with minor organic staining									
	with moderately thin bed of brown CLAY with minor organic staining		21.0				SPT			36/8 - 4.5 SPT at 21.0-21.45m 0/0/0 N=0
	becoming light grey/green		21.5							
	silty CLAY with trace fine sand, grey/green. Hard, moist, high plasticity						100			
	becoming medium plasticity, with minor fine to medium sand		22.0							
	pumiceous SILT, white. Loose, moist, no plasticity, dilatant		22.5							UTP
	organic CLAY, dark grey/brown. Firm, moist, high plasticity		23.0				77			
			23.5							
	organic stained CLAY, brown. Firm, moist, high plasticity		24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH01

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	JM	JM	07.04.21	07.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	organic CLAY, dark grey/brown. Firm, moist, medium to high plasticity, with minor woody inclusions		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/0/0 N=0
	organic stained CLAY, brown. Firm, moist, high plasticity, with trace organic inclusions									
	CLAY, light grey. Firm, moist, high plasticity, with trace organic inclusions at 24.55m, becoming grey/brown, with minor organic staining		25.0				100			
	organic CLAY, dark grey/brown. Firm, moist, medium to high plasticity, with trace woody inclusions									
	CLAY, light grey/green. Soft, moist, high plasticity, moderately sensitive		25.5							21/8 - 2.6
			26.0							
			26.5				100		Sample 4 Disturbed 26.6-27.0m	
	becoming very stiff, sensitive		27.0							101/21 - 4.8 SPT at 27.0-27.45m 0/0/2 N=2
			27.5	Gravel backfill →			SPT			
				Screened from 1.0m to 30.0m →						
	organic stained CLAY, grey/brown. Stiff, moist, high plasticity		28.0				100			
			28.5							
			29.0							
	at 29.8m, becoming brown, with minor woody inclusions		29.5				100			
	CLAY, light grey/green. Stiff, moist, high plasticity, moderately sensitive									
	EOB at 30.0m. Target Depth.		30.0				SPT			83/22 - 3.8 SPT at 30.0-30.45m 2/6/7 N=13
			30.5							
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0.0-4.0m

4.0-8.7m

8.7-15.0m

15.0-18.7m

18.7-21.7m

21.7-24.8m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH01-A
		Ardmore	compiled:	date:
	title:	MH01 Photo Summary - 0.0-24.8m	JM	07.04.21

24.8-27.8m

27.8-30.45m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH01-B
		Ardmore	compiled:	date:
	title:	MH01 Photo Summary - 24.8-30.45m	JM	07.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH02

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date: 08.04.21
2153	JM	JM	Finish Date: 09.04.21

Borehole Location: mN mE Ground R.L.

Description: Refer to site plan Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL		0.0	Lockable toby						
	fibrous PEAT, black. Firm, moist, medium to high plasticity		0.5	Bentonite seal		Triple Tube	52			
	with thin bed of light grey/brown, loose, dilatant pumiceous SILT		1.0				70		Sample 1 Disturbed 0.9-1.5m	
	becoming dark brown		1.5	Groundwater level measured 30.04.21: 1.57m			100			
	with moderately thin buried log		2.0							
Undifferentiated Alluvium			2.5				45			
			3.0				SPT			SPT at 3.0-3.45m 0/0/0 N=0
			3.5	Gravel backfill						
			4.0	Screened from 1.0m to 30.0m			0			
			4.5							
			5.0				0			
			5.5							
			6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
	with very thin bed of light grey/brown, loose, dilatant pumiceous SILT		6.5							
			7.0				50			
			7.5							
	at 7.9m, with moderately thin bed of light grey/brown, loose, dilatant pumiceous SILT		8.0				75			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked:

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH02

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 08.04.21
2153	JM	JM	Finish Date: 09.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	with thin buried log		8.5		Gravel backfill; Screened from 1.0m to 30.0m	Triple Tube	75			
	becoming very soft, moderately sensitive		9.0				SPT			8/3 - 2.7 SPT at 9.0-9.45m 0/0/0 N=0
			9.5							
			10.0				47			
			10.5							
			11.0				83			
	with thin buried log		11.5							
	pumiceous SILT, light grey/brown. Loose, moist, no plasticity, extra sensitive, dilatant		12.0						Sample 2 Disturbed 11.75-12.05m	27/2 - 13.5 SPT at 12.0-12.45m 0/0/0 N=0
	fibrous PEAT, dark brown/black. Firm, moist, medium plasticity		12.5				SPT			
			13.0				62			
			13.5							
			14.0				62			
			14.5							
			15.0				SPT			SPT at 15.0-15.45m 0/0/0 N=0
	organic CLAY, grey/brown. Firm, moist, high plasticity, with trace woody inclusions, with thin buried log		15.5				0			
	fibrous PEAT, dark brown/black. Firm, moist, low to medium plasticity, with thin buried log		16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH02

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	JM	JM	08.04.21	09.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium			16.5			Triple Tube	0			
			17.0				17			
			17.5							
Puketoka Formation	CLAY, light grey/green. Firm, moist, high plasticity		18.0				SPT			SPT at 18.0-18.45m 0/0/0 N=0
			18.5							
			19.0				100		Sample 3 Disturbed 19.1-19.5m	
			19.5	Gravel backfill →						
	with trace brown organic staining			Screened from 1.0m to 30.0m →						
			20.0							
	pumiceous SILT, light brown. Loose, moist, no plasticity, dilatant									
	with moderately thin bed of light yellow/white pumiceous clayey SILT		20.5							
	fine sandy SILT, light yellow/green. Loose, moist, no plasticity, dilatant									
	pumiceous fine sandy SILT, white. Loose, moist, no plasticity, sensitive, dilatant, with minor black organic inclusions to 20.96m		21.0				100			22/3 - 7.3
	CLAY, light grey/green. Firm, moist, high plasticity						SPT			SPT at 21.0-21.45m 0/0/0 N=0
			21.5							
			22.0				100			
	with thin bed of brown organic stained CLAY, with trace organic inclusions									
	at 22.5m, becoming moderately sensitive		22.5							49/24 - 2.0
			23.0							
	with thin bed of brown organic stained CLAY at 23.1m, with thin buried log						45			
			23.5							
			24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH02

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	JM	JM	08.04.21	09.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	organic CLAY, brown. Firm, moist, high plasticity, with trace organic inclusions		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/0/0 N=0
	CLAY, light grey/green. Firm, moist, high plasticity		25.0				100			
	with moderately thin bed of brown organic stained CLAY		25.5							
	fibrous PEAT, dark brown/black. Stiff, moist, low plasticity		26.0				100			
	CLAY, light grey/green. Stiff, moist, high plasticity, moderately sensitive, with minor fibrous organic inclusions		26.5							
	with trace organic inclusions		27.0	Gravel backfill			SPT			96/27 - 3.6 SPT at 27.0-27.45m 0/0/0 N=0
			27.5	Screened from 1.0m to 30.0m						
			28.0				100			
	with trace fine sand		28.5							
			29.0				100		Sample 4 Disturbed 28.8-29.2m	
	becoming medium to high plasticity, with minor fine sand		29.5							
	becoming medium plasticity, with some fine sand		30.0							
	EOB at 30.0m. Target Depth.		30.5				SPT			71/30 - 2.4 SPT at 30.0-30.45m 4/4/6 N=10
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

0.0-8.6m

8.6-13.1m

13.1-19.5m

19.5-22.5m

22.5-26.5m

26.5-29.4m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH02-A
		Ardmore	compiled:	date:
	title:	MH02 Photo Summary - 0.0-29.4m	JM	08.04.21-09.04.21

29.4-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH02-B
		Ardmore	compiled:	date:
	title:	MH02 Photo Summary - 29.4-30.0m	JM	08.04.21-09.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH03

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1900	RG	JM	Finish Date: 14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL			Lockable toby						
	clayey SILT, orange speckled brown. Stiff, moist, low plasticity, with trace rootlets		0.5	Bentonite seal						
	silty CLAY, orange mottled light brown/grey. Stiff, moist, high plasticity, with trace limonite		1.0				80		Sample 1 Disturbed 0.9-1.2m	
	organic silty CLAY, dark brown. Stiff, moist, high plasticity									
	fibrous PEAT, dark brown/black. Firm, moist to wet, low to medium plasticity		1.5							
			2.0							
			2.5	Groundwater level measured 30.04.21: 2.63m			93			
	pumiceous SILT, black speckled light grey. Very loose, moist, low plasticity, with minor organic inclusions		3.0							SPT at 3.0-3.45m 0/0/0 N=0
Undifferentiated Alluvium	becoming grey			Gravel backfill			SPT			
	becoming light brown/grey		3.5	Screened from 1.0m to 30.0m					Sample 2 Disturbed 3.8-4.0m	
	fibrous PEAT, dark brown. Firm, moist to wet, low plasticity		4.0				90			
			4.5							
			5.0				59			
	clayey SILT, grey. Soft, wet, low plasticity		5.5							
	fibrous PEAT, dark brown. Firm, moist to wet, low plasticity									
			6.0							SPT at 6.0-6.45m 1/0/0 N=0
			6.5				SPT			
			7.0				86			
			7.5				100			
			8.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH03

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1900	RG	JM	Finish Date: 14.04.21

Borehole Location: mN mE Ground R.L.

Description: Refer to site plan Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	slightly clayey SILT with minor fine sand, orange/brown. Stiff, moist, low plasticity, with minor pyrite flecks fibrous PEAT, dark brown. Firm, moist, low to medium plasticity, with minor woody inclusions up to 100mm in length		8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0	Gravel backfill Screened from 1.0m to 30.0m		Triple Tube	100 SPT 100 100 100 SPT 100 100 100 SPT 100		Sample 3 Disturbed 8.7-9.0m SPT at 9.0-9.45m 0/0/0 N=0 SPT at 12.0-12.45m 0/0/0 N=0 SPT at 15.0-15.45m 0/0/0 N=0	

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH03

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1900	RG	JM	Finish Date: 14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium			16.5			Triple Tube	100			
			17.0							
			17.5				100			
	silty CLAY, black streaked grey. Firm, moist, high plasticity, with trace organic streaks		18.0				SPT			SPT at 18.0-18.45m 0/0/0 N=0
			18.5							
			19.0	Gravel backfill →			100			
	organic silty CLAY, dark brown. Firm, moist, high plasticity		19.5	Screened from 1.0m to 30.0m →						
			20.0							
			20.5				100			
Puketoka Formation	pumiceous SILT with some clay, light grey/white. Very dense, moist, low plasticity		21.0						Sample 4 Disturbed 20.8-21.3m	SPT at 21.0-21.11m 50 for 35mm N>50
	silty CLAY, brown/grey. Stiff, moist, high plasticity, with trace black organic staining		21.5				SPT			
			22.0							
			22.5				100			
	without organic staining		23.0							
			23.5							
	with trace fine sand		24.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH03

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1900	RG	JM	13.04.21	14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	clayey SILT with minor fine sand, dark grey. Stiff, moist, low plasticity, with trace organic inclusions, with trace coarse sand to fine gravel sized green silt clast inclusions		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/1/3 N=4
	silty CLAY, light blue/grey. Very stiff, moist, high plasticity, with trace coarse sand sized white clast inclusions		25.0				100			
	with trace fine sand, without coarse sand sized white clast inclusions		25.5							
			26.0				100			
			26.5							
			27.0	Gravel backfill →			SPT			SPT at 27.0-27.45m 0/2/5 N=7
			27.5	Screened from 1.0m to 30.0m →						
			28.0				100			
	without fine sand		28.5							
			29.0				100			
			29.5							
	EOB at 30.0m. Target Depth.		30.0							
			30.5							
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

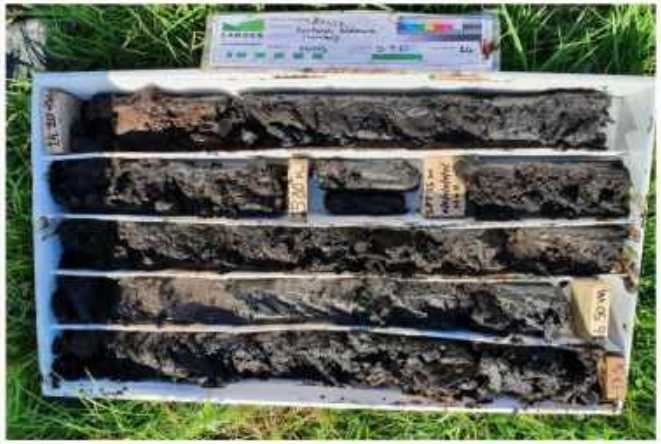
Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

0.0-3.45m

3.45-7.8m

7.8-11.1m

11.1-14.2m



14.2-17.1m

17.1-20.2m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH03-A
		Ardmore	compiled:	date:
	title:	MH03 Photo Summary - 0.0-20.2m	JM	13.04.21-14.04.21

20.2-23.1m

23.1-25.8m

25.8-28.8m

28.8-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH03-B
		Ardmore	compiled:	date:
	title:	MH03 Photo Summary - 23.1-30.0m	JM	13.04.21-14.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH04

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date: 09.04.21
2153	JM	JM	Finish Date: 12.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	TOPSOIL		0.0	Lockable toby		Triple Tube	54			
	fibrous PEAT, dark brown/black. Firm, moist, medium plasticity			Bentonite seal						
	at 0.5m, with moderately thick buried log		0.5				12			
			1.0				8			
			1.5				27			
				Gravel backfill						
			2.0	Screened from 1.0m to 30.0m						
			2.5				83			
			3.0							
				Groundwater level measured 30.04.21: 3.37m			SPT			SPT at 3.0-3.45m 0/0/0 N=0
			3.5							
			4.0				56			
			4.5							
			5.0							
			5.5				85			
			6.0							
							SPT			SPT at 6.0-6.45m 2/0/0 N=0
	with thin bed of light brown/white, dilatant pumiceous fine sandy SILT		6.5							
			7.0				100			
	with thin buried log									
	with thin bed of white speckled brown, dilatant fine SAND with trace pumiceous inclusions		7.5							8/5 - 1.6
	at 7.5m, becoming very soft, insensitive						43			
			8.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH04

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 09.04.21
2153	JM	JM	Finish Date: 12.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	becoming soft, moderately sensitive		8.5, 9.0, 9.5, 10.0, 10.5, 11.0, 11.5, 12.0, 12.5, 13.0, 13.5, 14.0, 14.5, 15.0, 15.5, 16.0	Gravel backfill; Screened from 1.0m to 30.0m		Triple Tube	43; SPT; 92; 68; SPT; 100; 41; SPT; 100		Sample 1 Disturbed 15.95-16.35m	12/5 - 2.4 SPT at 9.0-9.45m 0/0/0 N=0; 19/6 - 3.2; 6/5- 1.2 SPT at 12.0-12.45m 0/0/0 N=0; UTP - wood; SPT at 15.0-15.45m 0/0/0 N=0
	becoming very soft, insensitive									
	organic CLAY, dark grey/brown. Firm, moist, high plasticity									
	fibrous PEAT, dark brown/black. Firm, moist, low to medium plasticity									

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked:

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH04

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date: 09.04.21
2153	JM	JM	Finish Date: 12.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	with moderately thin bed of dark grey/brown, high plasticity organic CLAY					Triple Tube	100		Sample 1 Disturbed 15.95-16.35m	
	fine to medium sandy SILT, light brown. Loose, moist, no plasticity, dilatant		16.5							14/2 - 7.0
	amorphous to fibrous PEAT, dark brown/black. Soft, moist, low to medium plasticity, sensitive									
			17.0							
Puketoka Formation	pumiceous SILT, white. Loose, moist, no plasticity, dilatant, with minor brown organic staining, with trace organic inclusions		17.5				71		Sample 2 Disturbed 17.6-18.0m	
	at 17.55m, without organic staining, without organic inclusions									
	CLAY, light grey/green. Firm, moist, high plasticity, with trace organic inclusions		18.0				SPT			SPT at 18.0-18.45m 0/0/0 N=0
			18.5							
			19.0				100			
	becoming stiff, sensitive		19.5	Gravel backfill; Screened from 1.0m to 30.0m						62/15 - 4.1
	with trace fine sand, without organic inclusions		20.0						Sample 3 Disturbed 20.2-20.55m	
	organic stained CLAY with trace fine sand, brown. Soft, moist, medium to high plasticity, sensitive, with trace organic inclusions		20.5				73			
	at 20.7m, with thin bed of grey/green CLAY with some fine sand		21.0				SPT			24/5 - 4.8 SPT at 21.0-21.45m 0/0/0 N=0
	CLAY with some fine sand, grey/green. Firm, moist, medium plasticity									
	at 21.4m, with very thin woody inclusion		21.5							
	organic stained CLAY with some fine sand, brown. Firm, moist, medium plasticity		22.0				100			
	CLAY with some fine sand, grey/green. Firm, moist, medium plasticity, moderately sensitive									
	at 22.2m, with minor grey/brown organic staining									
	becoming medium to high plasticity, with minor fine sand, without organic staining		22.5							27/9 - 3.0
			23.0							
	with some fine sand						100			
	clayey fine to medium SAND, light grey/green. Firm, moist, low plasticity		23.5							
			24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH04

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date: 09.04.21
2153	JM	JM	Finish Date: 12.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	becoming soft, sensitive		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/1/1 N=2
			25.0				100		Sample 4 Disturbed 25.1-25.5m	
			25.5							17/3 - 5.7
	clayey fine to coarse SAND with minor fine gravel, grey/green. Stiff, moist, low to medium plasticity, sensitive		26.0							
			26.5				100			
	silty CLAY, dark green streaked grey/green. Stiff, moist, high plasticity		27.0							96/21 - 4.6
	becoming grey/green		27.5	Gravel backfill → Screened from 1.0m to 30.0m			SPT			SPT at 27.0-27.45m 1/2/6 N=8
			28.0				100			
	silty CLAY with trace fine to medium sand, grey. Stiff, moist, high plasticity, extra sensitive		28.5							76/6 - 12.7
			29.0							
			29.5				100			
	EOB at 30.0m. Target Depth.		30.0							SPT at 30.0-30.45m 0/0/0 N=0
			30.5				SPT			
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0.0-5.7m

5.7-10.5m

10.5-14.6m

14.6-18.3m

18.3-21.7m

21.7-22.5m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH04-A
		Ardmore	compiled:	date:
	title:	MH04 Photo Summary - 0.0-22.5m	JM	09.04.21-12.04.21

22.5-29.0m

29.0-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH04-B
		Ardmore	compiled:	date:
	title:	MH04 Photo Summary - 22.5-30.0m	JM	09.04.21-12.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH05

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	14.04.21	15.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL	0.0	Lockable toby						
	core loss	0.5	Bentonite seal		Triple Tube	7			
		1.0							
	fibrous PEAT, black. Soft, moist, medium plasticity	1.5	Groundwater level measured 30.04.21: 1.46m						
		2.0				23			
		2.5							
	becoming sensitive	3.0				SPT			19/4 - 4.8 SPT at 3.0-3.45m 1/0/0 N=0
	becoming dark grey/brown	3.5	Gravel backfill						
		4.0	Screened from 1.0m to 30.0m			48			
	with moderately thin buried log	4.5							
	silty CLAY, blue/grey. Very stiff, moist, high plasticity	5.0							
	organic silty CLAY, black mottled dark grey/brown. Very stiff, moist, high plasticity, with trace black carbonaceous inclusions	5.5				93			
	fibrous PEAT, dark grey/brown. Very stiff, moist, medium plasticity	6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
		6.5							
		7.0				86			
		7.5							
		8.0				100		Sample 1 Disturbed 7.6-8.0m	

Undifferentiated Alluvium

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH05

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	PL	JM	14.04.21	15.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	becoming black		8.5			Triple Tube	100			
			9.0				SPT			SPT at 9.0-9.45m 1/0/0 N=0
			9.5							
	with thin bed of brown/white pumiceous SILT		10.0				100			
			10.5							
			11.0	Gravel backfill →			53			
			11.5	Screened from 1.0m to 30.0m →						
			12.0				SPT			SPT at 12.0-12.45m 0/0/0 N=0
			12.5							
			13.0				57			
			13.5							
			14.0				100			
			14.5						Sample 2 Disturbed 14.7-15.0m	
	clayey SAND with trace silt, dark brown. Stiff, moist, low plasticity		15.0							
	fibrous PEAT, black. Very stiff, moist, medium plasticity		15.5				SPT			SPT at 15.0-15.45 0/0/2 N=2
			16.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH05

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	14.04.21	15.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	silty CLAY, blue/grey. Stiff, moist, high plasticity		16.5			Triple Tube	100			
			17.0							
			17.5				93			
			18.0				SPT			SPT at 18.0-18.45m 0/0/0 N=0
	fibrous PEAT, black. Stiff, moist, medium plasticity, with trace blue silty CLAY intermixed		18.5							
Puketoka Formation	silty CLAY, blue/grey. Very stiff, moist, high plasticity		19.0				100			
			19.5	Gravel backfill →						
	with trace fine sand			Screened from 1.0m to 30.0m →					Sample 3 Disturbed 19.7-20.1m	
	becoming dark grey/blue		20.0				100			
			20.5							
	becoming blue		21.0				SPT			SPT at 21.0-21.45m 0/0/0 N=0
			21.5							
	with moderately thin buried log becoming dark grey/blue, with trace fine sand		22.0				100			
			22.5							
	becoming blue, without fine sand		23.0							
	becoming grey and white streaked blue						80			
			23.5							
			24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH05

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	14.04.21	15.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	clayey SILT with trace fine sand, white and dark grey streaked light brown. Very stiff, moist, low plasticity		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/3/4 N=7
	silty SAND with trace clay, light brown streaked white. Loose, moist, low to no plasticity, with minor pumiceous inclusions		25.0				100			
			25.5							
			26.0							
			26.5				93		Sample 4 Disturbed 26.4-27.0m	
	silty CLAY, black streaked brown/grey. Very stiff, moist, high plasticity, with trace black carbonaceous inclusions, with thin bed of amorphous PEAT at top of layer becoming blue/grey		27.0	Gravel backfill			SPT			SPT at 27.0-27.45m 5/0/0 N=0
			27.5	Screened from 1.0m to 30.0m						
			28.0				100			
	amorphous PEAT, brown/black. Stiff, moist, medium plasticity, with trace black carbonaceous inclusions		28.5							
	silty CLAY, blue/grey. Very stiff, moist, medium plasticity		29.0							
	becoming black streaked brown/grey, with thin bed of amorphous PEAT		29.5				93			
	with trace woody inclusions		30.0							
	EOB at 30.0m. Target Depth.		30.5				SPT			SPT at 30.0-30.45m 0/0/0 N=0
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0.0-6.9m

6.9-10.1m

10.1-14.5m

14.5-17.6m

17.6-21.0m

21.0-24.8m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH05-A
		Ardmore	compiled:	date:
	title:	MH05 Photo Summary - 0.0-24.8m	JM	14.04.21-15.04.21

24.8-27.8m

27.8-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH05-B
		Ardmore	compiled:	date:
	title:	MH05 Photo Summary - 24.8-30.0m	JM	14.04.21-15.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH06

Sheet 1 of 2

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1900	RG	JM	14.04.21	15.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL		0.0	Lockable toby		Triple Tube	PT		PT 1 Push Tube 0.0-0.5m	
Residual East Coast Bays Formation	silty CLAY, orange. Very stiff, moist, medium to high plasticity		0.5	Bentonite seal						
	becoming orange streaked light grey		1.0				50		Sample 1 Disturbed 0.8-1.1m	
	clayey SILT, orange streaked light grey. Very stiff, moist, low to medium plasticity, with very closely spaced to extremely closely spaced thinly laminated beds of dark orange limonite		1.5						Sample 2 Disturbed 1.4-1.8m	
			2.0				87			
	silty CLAY, orange mottled light grey. Very stiff, moist, high plasticity, with trace limonite		2.5							
			3.0				SPT			SPT at 3.0-3.45m 1/2/2 N=4
Transitional East Coast Bays Formation	silty CLAY, dark grey. Very stiff, moist, high plasticity		3.5	Gravel backfill						
			4.0	Screened from 1.0m to 12.0m			100		Sample 3 Disturbed 3.5-3.8m	
			4.5							
			5.0				PT		PT 2 Push Tube 4.5-5.0m	
			5.5				100			
			6.0							
			6.5				SPT			SPT at 6.0-6.45m 10/17/21 N=38
			7.0	Groundwater level measured 30.04.21: 7.17m			100		Sample 4 Disturbed 7.1-7.4m	
	slightly clayey fine SAND, dark grey/green. Very stiff, moist, low plasticity, with laminated bed of orange limonite, with very closely spaced to extremely closely spaced irregular laminated beds of green/grey, medium plasticity silty CLAY		7.5							
	clayey SILT, dark grey. Hard, moist, low to medium plasticity		8.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH06

Sheet 2 of 2

Vane Head: 1900 | Logged By: RG | Processor : JM | Start Date: 14.04.21 | Finish Date: 15.04.21

Borehole Location: mN mE | Ground R.L.

Description: Refer to site plan | Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Transitional East Coast Bays Formation	highly weathered, dark grey SILTSTONE; Very weak to extremely weak		8.5	at 8.50m, CF at 8.60m, 1JN PL R3 0-10° at 8.90m, 1JN PL R3 90°		Triple Tube	100	24		
	clayey SILT, dark grey. Hard, moist, low plasticity		9.0				SPT			SPT at 9.0-9.3m 35/50 for 150mm N>50
	with trace fine sand		9.5	Gravel backfill →			100			
			10.0	Screened from 1.0m to 12.0m →						
	slightly clayey fine SAND, dark green/grey. Very stiff, moist, low plasticity		10.5							
	clayey SILT, dark grey. Hard, moist, low to medium plasticity		11.0				100			
	with trace fine sand		11.5							
Waitemata Group Bedrock	highly weathered, dark grey SANDSTONE; Very weak to extremely weak, fine grained at 11.9m, with extremely closely spaced thinly laminated black carbonaceous beds to 11.95m		12.0	at 11.70m, CF			SPT	0		SPT at 12.0-12.45m 50 for 125mm N>50
	EOB at 12.0m. Target Depth.		12.5							
			13.0							
			13.5							
			14.0							
			14.5							
			15.0							
			15.5							
			16.0							

LANDER geotechnical

Comments:

Driller: Drillforce | Rig: Truck

Drilling Fluid: water | Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

0.0-4.5m

4.5-8.2m

8.2-11.2m

11.2-12.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH06-A
		Ardmore	compiled:	date:
	title:	MH06 Photo Summary - 0.0-12.0m	JM	14.04.21-15.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH07

Sheet 1 of 3

Vane Head:	Logged By:	Processor :	Start Date: 15.04.21
1900 / 307	RG / RZ	JM	Finish Date: 16.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	TOPSOIL		0.0	Lockable toby		Triple Tube				
	organic clayey SILT, dark brown. Stiff, moist, low to medium plasticity, with trace rootlets		0.5	Bentonite seal			64		PT 1 Push Tube 0.5-1.0m	
			1.0				PT			
	silty CLAY, light brown. Very stiff, moist, high plasticity, with trace woody inclusions		1.5				PT		PT 2 Push Tube 1.0-1.5m	
	at 1.6m, with moderately thin bed of brown/purple organic stained silty CLAY			Groundwater level measured 30.04.21: 1.87m						
	clayey SILT with trace fine sand, orange mottled light grey/blue. Very stiff, moist, low to medium plasticity, with trace limonite		2.0				100			
	organic silty CLAY, purple/brown. Stiff, moist, high plasticity, with trace organic inclusions		2.5						Sample 1 Disturbed 2.3-2.8m	
	silty CLAY, light blue/grey. Stiff, moist, high plasticity		3.0				SPT			SPT at 3.0-3.45m 1/2/2 N=4
				Gravel backfill						
	organic clayey SILT, black mottled dark brown. Stiff, moist, medium plasticity, with trace woody inclusions		3.5	Screened from 1.0m to 18.0m			PT		PT 3 Push Tube 3.5-4.0m	
			4.0				100			
	clayey SILT, light brown. Firm, moist, low plasticity, with minor woody inclusions		4.5						Sample 2 Disturbed 4.5-4.8m	
	silty CLAY, light blue/grey. Stiff, moist, high plasticity, with trace organic inclusions									
	at 4.7m, without organic inclusions becoming green mottled light blue/grey		5.0				100			
	clayey SILT, green/grey. Stiff, moist, low to medium plasticity becoming light green/grey		5.5							
	silty CLAY, light green/grey. Stiff, moist, high plasticity		6.0				SPT			SPT at 6.0-6.45m 0/1/2 N=3
Transitional East Coast Bays Formation	clayey SILT, dark grey. Very stiff, moist, medium plasticity		6.5							
			7.0				100		Sample 3 Disturbed 7.1-7.5m	
	with irregular closely spaced to very closely spaced thin beds of clayey fine SAND		7.5				100			
			8.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH07

Sheet 2 of 3

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1900 / 307	RG / RZ	JM	15.04.21	16.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Transitional East Coast Bays Formation	with thin bed of carbonaceous staining		8.5			Triple Tube	100			
			9.0				SPT			SPT at 9.0-9.45m 13/11/15 N=26
	completely to highly weathered, dark grey SILTSTONE; Very weak to extremely weak		9.5	at 9.60m, 1JN PL R4 0-10°				0		
	silty fine SAND with minor clay, dark grey. Medium dense, moist, low plasticity		10.0	at 9.80m, CF at 9.90m, CF			100			
	at 10.1m, with moderately thin bed of dark grey, medium to high plasticity silty CLAY		10.5							
East Coast Bays Bedrock	completely to highly weathered, dark grey SILTSTONE; Very weak to extremely weak, with closely spaced to very closely spaced irregularly interbedded thin to very thin beds of dark grey, hard, moist, low plasticity silty fine SAND with minor clay		11.0	at 10.60-11.90m, 15DI PL R3 80-90°			80	0		
			11.5	Gravel backfill Screened from 1.0m to 18.0m						
	without beds of silty fine SAND		12.0				SPT	SPT		SPT at 12.0-12.3m 20/50 for 150mm N>50
			12.5	at 12.76m, 1JN UN R5 85-90°			100	38		
	with moderately thin bed of silty CLAY with trace hard silt clast inclusions		13.0	at 12.90m, CF at 13.00m, CF at 13.10-13.35m, 2JN PL R5 85-90°						
	with moderately thin bed of clayey SILT		13.5	at 13.50-13.70m, 6JN PL R5 45-90° at 13.70-13.80m, CF at 13.80-14.00m, 3JN PL R3 45-60°					Sample 4 Disturbed 3.5-4.0m	
			14.0	at 14.10-14.30m, CF			100	43		
			14.5	at 14.50-14.70m, CF						
			15.0	at 14.90m, 1JN PL R4 40-90°			SPT	SPT		SPT at 15.0-15.13m 50 for 125mm N>50
			15.5	at 15.30m, CF at 15.50m, CF at 15.60m, 1JN PL R3 40-90°			100	37		
			16.0	at 15.85m, CF at 16.00m, 1JN PL R3 70°						

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH07

Sheet 3 of 3

Vane Head: 1900 / 307 | Logged By: RG / RZ | Processor : JM | Start Date: 15.04.21 | Finish Date: 16.04.21

Borehole Location: mN mE | Ground R.L.

Description: Refer to site plan | Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
East Coast Bays Formation Bedrock	becoming highly weathered, very weak		16.5	at 16.10-16.42m, CF		Triple Tube	100	37		
			17.0	at 16.60m, 1DI PL R3 80-90° at 16.70m, 1JN PL R3 70° at 16.70-16.90m, CF						
			17.5	at 17.35m, 1JN PL R4 70-90°			100	91		
				Gravel backfill						
				Screened from 1.0m to 18.0m						
	EOB at 18.0m. Target Depth.		18.0				SPT	SPT		SPT at 18.0-18.12m 50 for 115mm N>50
			18.5							
			19.0							
			19.5							
			20.0							
			20.5							
			21.0							
			21.5							
			22.0							
			22.5							
			23.0							
			23.5							
			24.0							

LANDER geotechnical

Comments:

Driller: Drillforce | Rig: Truck

Drilling Fluid: water | Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0.0-4.9m

4.9-7.8m

7.8-10.8m

10.8-13.5m

13.5-16.5m

16.5-18.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH07
		Ardmore	compiled:	date:
	title:	MH07 Photo Summary - 0.0-18.0m	JM	15.04.21-16.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH08

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1750	PL	JM	Finish Date: 14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL		0.0	Lockable toby						
	core loss		0.5	Bentonite seal		Triple Tube	11			
			1.0							
	silty CLAY, grey/brown. Stiff, moist, high plasticity		1.5							
	fibrous PEAT, black. Firm, moist, medium plasticity		2.0				53			
			2.5							
Undifferentiated Alluvium			3.0	Groundwater level measured 30.04.21: 3.23m			SPT			SPT at 3.0-3.45m 0/0/0 N=0
			3.5							
			4.0	Gravel backfill			76			
			4.5	Screened from 1.0m to 30.0m					Sample 1 Disturbed 4.1-4.4m	
			5.0							
			5.5				67			
	organic silty CLAY, grey/brown. Firm, moist, medium to high plasticity		6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
	fibrous PEAT, black. Firm, moist, medium plasticity		6.5							
			7.0				86			
	silty CLAY, grey/blue. Firm, moist, high plasticity		7.5							
			8.0				100		Sample 2 Disturbed 7.1-7.4m	

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH08

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1750	PL	JM	Finish Date: 14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	organic silty CLAY, black/brown. Firm, moist, high plasticity, sensitive		8.5		Gravel backfill	Triple Tube	100			
	with trace woody inclusions		9.0				SPT			35/8 - 4.4 SPT at 9.0-9.45m 0/0/1 N=1
	fibrous PEAT, black. Very stiff, moist, medium plasticity		9.5				100			
	with moderately thin buried log		10.0							
	silty CLAY, grey/blue. Firm, moist, medium plasticity		10.5				47			
			11.0							
			11.5		Screened from 1.0m to 30.0m					
			12.0				SPT			SPT at 12.0-12.45m 0/0/1 N=1
	fibrous PEAT, black. Very stiff, moist, medium plasticity, with trace woody inclusions		12.5				100			
			13.0							
			13.5							
			14.0							
			14.5							
			15.0				SPT			SPT at 12.0-12.45m 0/0/0 N=0
Puketoka Formation	silty CLAY, grey/blue. Very stiff, moist, high plasticity		15.5				100			
			16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH08

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1750	PL	JM	Finish Date: 14.04.21

Borehole Location: mN mE Ground R.L.

Description: Refer to site plan Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	becoming dark grey/blue		16.5			Triple Tube	100			
	becoming grey/blue		17.0							
			17.5				100			
	organic silty CLAY, dark brown/black. Very stiff, moist, medium plasticity at 18.2, with trace woody inclusions		18.0				SPT			SPT at 18.0-18.45m 0/0/0 N=0
	with minor woody inclusions with trace woody inclusions		18.5							
	silty CLAY, dark grey. Stiff, moist, medium plasticity, moderately sensitive		19.0				100		Sample 3 Disturbed 19.0-19.4m	
	fibrous PEAT, black. Firm, moist, medium plasticity		19.5	Gravel backfill → Screened from 1.0m to 30.0m						54/15 - 3.6
	silty CLAY, grey/blue. Very stiff, moist, medium plasticity		20.0				100			
			20.5							
			21.0				SPT			SPT at 21.0-21.45 0/2/4 N=6
			21.5							
	becoming stiff, sensitive		22.0				100			
			22.5							81/12 - 6.8
			23.0							
			23.5				100			
	with trace fine sand								Sample 4 Disturbed 23.7-24.0m	
	at 24.0m, without fine sand		24.0							62/12 - 5.2

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH08

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date: 13.04.21
1750	PL	JM	Finish Date: 14.04.21

Borehole Location: mN mE Ground R.L.

Description: Refer to site plan Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	becoming firm, moderately sensitive		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 0/0/3 N=3
			25.0				100			
	becoming very stiff		25.5							46/19 - 2.4
			26.0							
			26.5							
			27.0	Gravel backfill →			SPT			SPT at 27.0-27.45m 0/0/8 N=8
			27.5	Screened from 1.0m to 30.0m →			100			
			28.0							
			28.5							
	fibrous PEAT, black. Stiff, moist, medium to high plasticity		29.0				47			
			29.5							
	EOB at 30.0m. Target Depth.		30.0				SPT			SPT at 30.0-30.45m 0/0/0 N=0
			30.5							
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0.0-6.0m

6.0-9.7m

9.7-12.45m

12.45-15.45m

15.45-18.2m

18.2-21.3m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH08-A
		Ardmore	compiled:	date:
	title:	MH08 Photo Summary - 0.0-21.3m	JM	13.04.21-14.04.21

21.3-24.5m

24.5-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH08-B
		Ardmore	compiled:	date:
	title:	MH08 Photo Summary - 21.3-30.0m	JM	13.04.21-14.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH09

Sheet 1 of 2

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	16.04.21	16.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy: Puketoka Formation

CORE DESCRIPTION	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
TOPSOIL	0.0	Lockable toby		Triple Tube	100			
silty CLAY, grey. Stiff, moist, medium plasticity	0.5	Bentonite seal			PT		PT 1 Push Tube 0.5-1.0m	
becoming orange streaked grey, with trace organic staining	1.0				80			
	1.5	Groundwater level measured 30.04.21: 1.55m						
fibrous PEAT, black. Firm, moist, medium plasticity	2.0				93			
silty CLAY, blue/grey. Stiff, moist, high plasticity	2.5							
	3.0				SPT			SPT at 3.0-3.45m 0/1/2 N=3
with trace fine sand	3.5	Gravel backfill						
	4.0	Screened from 1.0m to 15.0m			48			
	4.5							
	5.0				100			
	5.5							
sandy CLAY with trace silt, blue/grey. Very stiff, moist, medium plasticity	6.0				SPT			SPT at 6.0-6.45m 1/1/2 N=3
clayey SAND, brown/grey. Very stiff, moist, low plasticity	6.5							
organic stained silty CLAY, dark brown. Very stiff, moist, medium plasticity, with trace black carbonaceous inclusions	7.0				100		Sample 1 Disturbed 6.7-7.2m	
silty CLAY with trace fine sand, blue. Very stiff, moist, medium plasticity, moderately sensitive	7.5							173/58 - 3.0
	8.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH09

Sheet 2 of 2

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	16.04.21	16.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	clayey SAND, brown/grey, Hard, moist, low plasticity with trace woody inclusions		8.5			Triple Tube	100			
			9.0				SPT			SPT at 9.0-9.45m 0/3/4 N=7
			9.5	Gravel backfill			86			
			10.0	Screened from 1.0m to 15.0m						
			10.5							
			11.0				73			
East Coast Bays Formation Bedrock	completely weathered, dark grey, fine grained SANDSTONE; Extremely weak		11.5	at 11.80m, 1DI IR R4 60°				90		
			12.0	at 12.00m, CF			SPT	SPT		SPT at 12.0-12.38m 16/30/20 for 75mm N>50
	slightly weathered, dark grey, fine grained SANDSTONE; Very weak		12.5	at 12.45-13.30m, 6DI IR R4 45°			100	71		
			13.0	at 13.30-13.50m, CF						
			13.5	at 13.50-13.80m, 3DI IR R4 80°			SPT	SPT		SPT at 13.5-13.64m 50 for 135mm N>50
			14.0	at 13.90-14.20m, CF						
			14.5	at 14.30-14.35m, 2DI IR R4 85°			100	62		
			15.0	at 15.00m, 1JN PL R4 45°						
	EOB at 15.0m. Target Depth.		15.5				SPT	SPT		SPT at 15.0-15.24m 32/50 for 90mm N>50
			16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0-4.5m

4.5-7.6m

7.6-10.8m

10.8-13.9m

13.9-15m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH09
		Ardmore	compiled:	date:
	title:	MH09 Photo Summary - 0.0-15.0m	PL	16.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH10

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date: 16.04.21
307 / 2153	RZ / JM	JM	Finish Date: 19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	TOPSOIL			Lockable toby		Triple Tube				
	organic silty CLAY, dark red/brown. Stiff, moist, low plasticity			Bentonite seal			100			
	fibrous PEAT, dark brown. Firm, moist, medium plasticity		0.5				PT		PT 1 Push Tube 0.5-1.0m	
			1.0				PT		PT 2 Push Tube 1.0-1.5m	
			1.5						Sample 1 Disturbed 1.5-2.0m	
			2.0				50			
			2.5	Groundwater level measured 30.04.21: 2.69m						
	with thin hard tree gum inclusion		3.0				SPT			SPT at 3.0-3.45m 2/0/0 N=0
				Gravel backfill						
			3.5	Screened from 1.0m to 30.0m						
	with thin tree gum inclusion		4.0				100			
			4.5						Sample 2 Disturbed 4.5-5.0m	
			5.0				100			
			5.5							
			6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
	with some grey clay intermixed		6.5							
			7.0				100			
			7.5							
	at 8.0m, without grey clay		8.0				PT		PT 3 Push Tube 7.5-8.0m	

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH10

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date: 16.04.21
307 / 2153	RZ / JM	JM	Finish Date: 19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	becoming dark brown/black		8.5, 9.0, 9.5, 10.0			Triple Tube	50, SPT, 90			SPT at 9.0-9.45m 0/0/0 N=0
	becoming very soft, moderately sensitive		10.5							6/2 - 3.0
			11.0, 11.5	Gravel backfill; Screened from 1.0m to 30.0m			70			
	with moderately thick buried log		12.0, 12.5				SPT, 100			5/2 - 2.5 SPT at 12.0-12.45m 0/1/2 N=3
	becoming low plasticity		13.0, 13.5, 14.0, 14.5				100			
			15.0				SPT			SPT at 15.0-15.45m 0/0/0 N=0
	at 16.0m, becoming medium plasticity		15.5, 16.0				47			

LANDER geotechnical

Comments: SPT at 9.0m slipped out.

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH10

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date: 16.04.21
307 / 2153	RZ / JM	JM	Finish Date: 19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	becoming soft		16.5			Triple Tube	47			19/8 - 2.4
			17.0				100			
	CLAY, light grey/green. Soft, moist, high plasticity, moderately sensitive		17.5							
	with minor fine to medium sand									
Puketoka Formation	slightly clayey fine to medium SAND, grey/blue. Soft, moist, low to no plasticity		18.0				SPT			21/8 - 2.6 SPT at 18.0-18.45m 0/0/0 N=0
	becoming low plasticity		18.5							
			19.0				100		Sample 3 Disturbed 19.0-19.5m	
	becoming clayey fine to medium SAND, low to medium plasticity			Gravel backfill						
			19.5	Screened from 1.0m to 30.0m						
			20.0							
	pumiceous SILT, white. Loose, moist, no plasticity, sensitive, dilatant		20.5				100		Sample 4 Disturbed 20.6-21.0m	
	becoming very dense		21.0				SPT			SPT at 21.0-21.33m 28/43/7 for 25mm N>50
			21.5							
	organic CLAY, grey/brown mottled black. Firm, moist, high plasticity		22.0				61			
	fibrous PEAT, dark brown/black. Very soft, moist, medium plasticity, insensitive		22.5							8/5 - 1.6
			23.0				100			
			23.5							
	silty CLAY, light grey. Firm, moist, high plasticity, moderately sensitive		24.0							36/15 - 2.4

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH10

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date: 16.04.21
307 / 2153	RZ / JM	JM	Finish Date: 19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	organic stained silty CLAY, brown. Stiff, moist, high plasticity		24.0			Triple Tube	SPT			SPT at 24.0-24.45m 0/0/0 N=0
	fibrous PEAT, dark brown/black. Firm, moist, low plasticity		24.5							
			25.0				100			
	silty CLAY, light grey. Firm, moist, high plasticity, moderately sensitive		25.5						Sample 5 Disturbed 25.5-26.0m	37/18 - 2.1
			26.0							
			26.5				100			
	with trace fine sand		27.0							48/24 - 2.0 SPT at 27.0-27.45m 0/0/0 N=0
	becoming light grey/green, with minor fine sand		27.5	Gravel backfill Screened from 1.0m to 30.0m			SPT			
			28.0				100			
	becoming stiff becoming grey, with trace fine sand		28.5							77/27 - 2.9
			29.0							
	slightly clayey fine to medium SAND with minor silt, grey. Firm, moist, low to no plasticity, moderately sensitive		29.5				100			
	at 30.0m, becoming firm		30.0							27/12 - 2.3 SPT at 30-30.45m 0/1/2 N=3
	EOB at 30.0m. Target Depth.		30.5				SPT			
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

0-4.5m

4.5-6.72m

6.72-9.0m

9.0-13.0m

13.0-17.0m

17.0-20.2m

LANDER geotechnical

client:	Ardmore Developments Limited	project no:	figure no:
project:	Sunfields	J01627	Figure MH10-A
	Ardmore	compiled:	date:
title:	MH10 Photo Summary - 0.0-20.1m	PL	16.04.21-19.04.21

20.2-23.3m

23.3-26.8m

26.8-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH10-B
		Ardmore	compiled:	date:
	title:	MH10 Photo Summary - 20.1-30m	PL	19.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH11

Sheet 1 of 2

Vane Head:	Logged By:	Processor :	Start Date: 21.04.21
2153	JM	JM	Finish Date: 21.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL			Lockable toby						
	silty CLAY, orange mottled light yellow/grey. Stiff, moist, high plasticity		0.5	Bentonite seal		Triple Tube	59			
	pumiceous silty CLAY, orange mottled light grey/white. Firm, moist, high plasticity		1.0							
	becoming stiff, moderately sensitive		1.5							55/24 - 2.3
Puketoka Formation			2.0				80			
			2.5	Groundwater level measured 30.04.21: 2.54m					Sample 1 Disturbed 2.35-2.8m	
	silty CLAY, dark grey. Stiff, moist, high plasticity		3.0				SPT		Sample 2 Disturbed 2.9-3.45m	SPT at 3.0-3.45m 0/0/0 N=0
			3.5	Gravel backfill						
			4.0	Screened from 1.0m to 10.5m			100			
			4.5							
			5.0				75			
			5.5							
Transitional East Coast Bays Formation	slightly weathered, dark grey SILTSTONE; Very weak		6.0	at 5.84m, CF at 5.94m, 1DI PL R3 90°			SPT	0		SPT at 6.0-6.45m 14/21/23 N=44
			6.5	at 6.48m, CF at 6.66-7.46m, 10JN PL R3-4 80-90° with very thin fine sand infill				SPT		
			7.0	at 6.94-7.14m, CF			97	10	Sample 3 Disturbed 7.05-7.5m	
	with closely spaced to very closely spaced thin to very thin beds of fine grained SANDSTONE		7.5				SPT	SPT		SPT at 7.5-7.28m 22/50 for 125mm N>50
			8.0	at 7.81-8.92m, 12JN PL R3-4 80-90° at 7.96-8.15m, 1JN PL R4 15°			100	26		

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH11

Sheet 2 of 2

Vane Head:	Logged By:	Processor :	Start Date: 21.04.21
2153	JM	JM	Finish Date: 21.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Transitional East Coast Bays Formation	with moderately thin bed of hard dark grey CLAY with thin bed of hard dark grey CLAY at 8.4m, with thin bed of hard dark grey CLAY		8.5 9.0 9.5	Gravel backfill Screened from 1.0m to 10.5m at 8.55m, CF at 9.22-10.30m, 6JN PL R3-4 75-90° at 9.45m, CF at 9.56-9.69m, 2JN PL R3-4 90° with very thin fine sand infill		Triple Tube	100 SPT 100	26 SPT 85	Sample 4 Disturbed 9.23-9.65m	SPT at 9.0-9.23m 43/50 for 75mm N>50
	CLAY, dark grey. Hard, moist, high plasticity		10.0							
	slightly weathered, dark grey SILTSTONE; Very weak, with closely spaced to very closely spaced thin to very thin beds of fine grained SANDSTONE at 10.4m, with moderately thin bed of fine sand		10.5				83 SPT	SPT		SPT at 10.5-10.28m 22/50 for 125mm N>50
	EOB at 10.5m. Target Depth.		11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

0-3.9m

3.9-7.5m

7.5-10.5m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH11
		Ardmore	compiled:	date:
	title:	MH11 Photo Summary - 0.0-10.5m	PL	21.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH12

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	19.04.21	19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL		0.0	Lockable toby						
Undifferentiated Alluvium	fibrous PEAT, black. Soft, moist, medium plasticity		0.5	Bentonite seal		Triple Tube	20			
			1.0							
			1.5	Groundwater level measured 30.04.21: 1.30m			47			
			2.0							
			2.5							
	becoming wet		3.0				SPT			SPT at 3.0-3.45m 0/0/4 N=4
			3.5	Gravel backfill						
			4.0	Screened from 1.0m to 30.0m			48			
			4.5							
			5.0				47		Sample 1 Disturbed 4.8-5.3m	
			5.5							
			6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
			6.5							
			7.0				57			
			7.5							
			8.0				87			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH12

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	14.04.21	14.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	silty CLAY with minor fine sand, black. Soft, wet, medium plasticity		8.5			Triple Tube	87			
			9.0				SPT			SPT at 9-9.45m 0/1/0 N=1
	amorphous PEAT, black. Soft, wet, medium plasticity		9.5				48			
	fibrous PEAT, black. Soft, wet, medium plasticity		10.0							
			10.5				0			
			11.0	Gravel backfill →						
			11.5	Screened from 1.0m to 30.0m →						
			12.0				SPT			SPT at 12-12.45m 0/0/0 N=0
Puketoka Formation	silty CLAY with trace fine sand, grey/blue. Firm, moist, medium to high plasticity		12.5				100			
	at 12.45, becoming brown/grey, without sand		13.0							
	becoming blue/grey with trace woody inclusions		13.5							
	with trace fine sand		14.0				100			
	organic stained silty CLAY, black/dark grey. Firm, moist, medium plasticity		14.5							
	fibrous PEAT, black. Soft, moist, medium plasticity		15.0				SPT			SPT at 15-15.45m 0/0/0 N=0
	silty CLAY with minor fine sand, blue. Soft, moist, medium plasticity		15.5							
	without sand		16.0				100			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH12

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	19.04.21	19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	silty CLAY with minor fine sand, blue. Soft, moist, medium plasticity, with minor fine sand		16.5			Triple Tube	100			
			17.0							
	sandy CLAY with minor fine silt, blue/grey. Soft, moist, medium plasticity		17.5				100			
	slightly clayey SAND, dark grey. Stiff, moist, no plasticity		18.0				SPT			SPT at 18-18.45m 2/2/0 N=2
	becoming clayey SAND		18.5							
			19.0				86			
	becoming white, low plasticity, dilatant			Gravel backfill						
	becoming dark grey		19.5	Screened from 1.0m to 30.0m						
	silty CLAY, with trace fine sand, grey/blue. Very stiff, moist, medium plasticity		20.0							
	with minor fine sand, white streaked black		20.5				100			
			21.0				SPT			SPT at 21-21.45m 4/4/5 N=9
			21.5							
	becoming grey with trace woody inclusions		22.0				100			
			22.5							
			23.0				86			
	silty CLAY, blue. Very stiff, moist, medium plasticity		23.5							
	clayey SAND, grey/blue. Very stiff, moist, low plasticity		24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH12

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	JM	19.04.21	19.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	silty CLAY with trace fine sand, dark blue streaked blue. Very stiff, moist, medium plasticity		24.5			Triple Tube	SPT			SPT at 24.0-24.45m 4/4/5 N=9
			25.0				100			
			25.5							
			26.0							
	with minor fine sand		26.5				100			
	with trace fine sand									
			27.0				SPT			SPT at 27.0-27.45m 1/2/2 N=4
	becoming brown/grey, without fine sand			Gravel backfill →						
	with trace fine sand		27.5	Screened from 1.0m to 30.0m →						
	with some fine sand						100			
	becoming blue, without fine sand		28.0							
			28.5							
	slightly clayey SILT, blue/grey. Hard, moist, low to no plasticity		29.0							
	with alternating beds of slightly clayey SILT and silty CLAY		29.5				93			
	EOB at 30.0m. Target Depth.		30.0				SPT			SPT at 30.0-30.45m 7/13/21 N=34
			30.5							
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

0-6.8m

6.8-12.45m

12.45-15.2m

15.2-18.0m

18.0-21.2m

21.2-24.2m

LANDER geotechnical

client:	Ardmore Developments Limited	project no:	figure no:
project:	Sunfields	J01627	Figure MH12-A
	Ardmore	compiled:	date:
title:	MH12 Photo Summary - 0.0-24.4m	PL	19.04.21

24.2-27.1m

27.1-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH12-B
		Ardmore	compiled:	date:
	title:	MH12 Photo Summary - 24.4-30.0m	JM	19.04.21

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH13

Sheet 1 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	20.04.21	20.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
	TOPSOIL		0.0	Lockable toby		Triple Tube				
	fibrous PEAT, black. Soft, moist, medium plasticity		0.5	Bentonite seal			30			
			1.0	Groundwater level measured 30.04.21: 1.26m			PT		PT1 Push Tube 1.0-1.5m	
	clayey SAND with trace silt, brown. Soft, moist, no to low plasticity		1.5							
	fibrous PEAT, black. Soft, moist, low plasticity		2.0				66			
			2.5							
Undifferentiated Alluvium	becoming wet, medium plasticity		3.0				SPT			SPT at 3.0-3.45m 0/0/0 N=0
			3.5	Gravel backfill						
			4.0	Screened from 1.0m to 30.0m			48			
			4.5							
	becoming brown/black		5.0							
	with moderately thin bed of clayey SAND, brown. Soft, moist, low plasticity		5.5				100			
	with moderately thin layer of wood		6.0				SPT			SPT at 6.0-6.45m 0/0/0 N=0
			6.5							
	sandy CLAY, white mottled dark brown. Soft, moist, no to low plasticity		7.0				86			
	fibrous PEAT, black. Soft, wet, medium plasticity		7.5							
			8.0				96			

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH13

Sheet 2 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	20.04.21	20.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater/ Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Undifferentiated Alluvium	amorphous PEAT, black. Soft, wet, medium plasticity		8.5			Triple Tube	96			
			9.0				SPT			SPT at 9.0-9.45m 0/0/0 N=0
			9.5				93			
			10.0							
			10.5							
	fibrous PEAT, black. Soft, wet, medium plasticity		11.0				93			
			11.5	Gravel backfill → Screened from 1.0m to 30.0m						
			12.0				SPT			SPT at 12.0-12.45m 0/0/0 N=0
			12.5							
			13.0				100			
			13.5				PT		PT2 Push Tube 13.5-14.0	
			14.0				0			
			14.5							
Puketoka Formation	organic stained silty CLAY, black streaked brown. Very stiff, moist, high plasticity		15.0				SPT			SPT at 15.0-15.45m 0/0/0 N=0
			15.5				48			
	slightly pumiceous silty SAND, brown. Loose, moist, no plasticity, dilatant		16.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH13

Sheet 3 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
1750	PL	RZ	20.04.21	20.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	with minor pumiceous inclusions, with minor organic inclusions		16.5			Triple Tube	48			
			17.0							
			17.5				60			
	pumiceous SILT with minor sand, white. Very loose, moist, no plasticity, quick		18.0				SPT			32/2 - 16.0 SPT at 18.0-18.45m 14/1/0 N=1
			18.5							
			19.0				0			
			19.5	Gravel backfill; Screened from 1.0m to 30.0m						
	silty CLAY, blue/grey. Stiff, moist, high plasticity, with trace organic inclusions		20.0							
			20.5				47			
	becoming blue streaked brown/grey		21.0				SPT			SPT at 21-21.45m 0/0/2 N=2
	becoming blue		21.5							
			22.0				100			
	becoming brown mottled grey/blue, with minor organic staining		22.5							
			23.0							
	becoming light blue/grey		23.5				100			
			24.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Machine Borehole No. MH13

Sheet 4 of 4

Vane Head:	Logged By:	Processor :	Start Date:	Finish Date:
2153	JM	RZ	20.04.21	20.04.21

Borehole Location: mN mE

Description: Refer to site plan

Ground R.L.

Orientation: vertical

Stratigraphy	CORE DESCRIPTION	Legend	Depth (m)	DEFECTS	Groundwater / Piezometer	Drilling Method & Casing	Recovery (%)	RQD (%)	Sample and Laboratory Test Details	Vane Dial / Sensitivity & SPT
Puketoka Formation	silty CLAY, light blue/grey. Very stiff, moist, high plasticity, with trace carbonaceous inclusions, minor organic staining		24.5			Triple Tube	SPT			SPT at 24-24.45m 0/3/4 N=7
	becoming grey, with thin bed of organic staining		25.0				100		Sample 4 Disturbed 24.55-25.05m	
	fine to medium SAND, grey. Loose, moist, no plasticity		25.5							
	CLAY with trace fine to medium sand, grey. Stiff, moist, high plasticity, moderately sensitive at 26.5m, with very closely to closely spaced thin to moderately thin beds of fine to medium sand		26.0				75			
			26.5							
			27.0	Gravel backfill			SPT			52/14 3.8 SPT at 27-27.45m 5/5/10 N=15
			27.5	Screened from 1.0m to 30.0m						
	silty CLAY, grey. Hard, moist, medium to high plasticity, with occasional very thin beds of fine to coarse sand at 27.9m, with thin bed of fine of white silty clay		28.0				100			UTP
	with thin bed of white silty clay		28.5							
			29.0							
	silty CLAY, grey. Firm, moist, medium plasticity, moderately sensitive		29.5							
	EOB at 30.0m. Target Depth.		30.0				60			37/8 4.8 SPT at 30-30.45m 1/2/3 N=5
			30.5				SPT			
			31.0							
			31.5							
			32.0							

LANDER geotechnical

Comments:

Driller: Drillforce Rig: Truck

Drilling Fluid: water

Checked: PL

Topsoil	Sand	Sandstone	Plutonic			
Fill	Gravel	Siltstone	No Core			
Clay	Organic	Limestone				
Silt	Pumice	Volcanic				

0-5.0m

5.0-8.5m

8.5-11.4m

11.4-15.7m

15.7-22.1m

22.1-25.1m

LANDER geotechnical

client:	Ardmore Developments Limited	project no:	figure no:
project:	Sunfields	J01627	Figure MH13-A
	Ardmore	compiled:	date:
title:	MH13 Photo Summary - 0.0-25.2m	PL	20.04.21

25.1-28.7m

28.7-30.0m

LANDER geotechnical	client:	Ardmore Developments Limited	project no:	figure no:
	project:	Sunfields	J01627	Figure MH13-B
		Ardmore	compiled:	date:
	title:	MH13 Photo Summary - 25.2-30.0m	PL	20.04.21

BOREHOLE LOG

Hole No.: MH14

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	15/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	16/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
	TS	TOPSOIL.							
	Undifferentiated Alluvium	Clayey SILT, with trace sand and gravel; brown. Firm; moist; low plasticity; sand, fine, gravel, fine; moderately sensitive; with trace rootlets.			44 / 22 kPa				
		0.80m: becoming dark brown/grey, without rootlets							
-1		1.00m: becoming stiff	1		73 / 23 kPa				
		1.20m: with trace rootlets							
		Organic silty CLAY; dark brown/grey. Firm; wet; high plasticity.			0/0//0/0/0/0 N = 0				
		Fibrous PEAT; dark brown/grey. Soft; wet; low plasticity to no plasticity; insensitive.							
-2		2.10m: with thin buried log	2						
		2.25m: with thin buried log							
		2.80m: with trace fine to medium gravel for 100mm							
-3			3		17 / 13 kPa 0/0//0/0/0/0 N = 0				
		Organic stained silty CLAY; brown mottled light grey. Stiff; wet; high plasticity; with woody inclusions.							
		Amorphous PEAT; dark grey/brown. Soft; wet; low plasticity; insensitive.							
-4		4.00m: with thin buried log	4						
					20 / 15 kPa 0/0//0/0/0/0 N = 0				
-5	Puketoka Formation	Organic clayey SILT; brown/grey. Stiff; wet; low plasticity; with carbonaceous inclusions	5						
		5.60m: with thin bed of light pumiceous silt							
		Clayey SILT, with trace sand; green/grey. Stiff; moist; low plasticity; sand, fine; moderately sensitive.			73 / 20 kPa				

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
1	Open Barrel	100				Bentonite
	Open Barrel	70				
	Open Barrel	56				1.0
	SPT	100				
2	Open Barrel	100				
3	SPT	95				Gravel
4	Open Barrel	100				
	SPT	90				
5	Open Barrel	90				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.15	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth: 23.00	**Inclination:** 90.00
Logged By: DS	**Checked By:** JM
FINAL	Sheet 1 of 4

BOREHOLE LOG

Hole No.: MH14

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	15/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	16/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
					0/0//1/1/1/2 N = 5						SPT	100				
		Clayey SILT, with some sand; light grey/blue. Very stiff; moist; sand, fine; low plasticity to non-plastic.														
		6.45m: becoming hard, with some fine to medium SAND														
-7			7							7	Open Barrel	100				
		7.00m: with thin laminations of dark blue/grey coarse sand														
		7.40m: with some fine to coarse SAND; with trace carbonaceous inclusions			UTP 2/1//3/3/3/5 N = 14						SPT	100				
-8			8							8	Open Barrel	100				
-9	Puketoka Formation		9		UTP 1/1//2/2/2/3 N = 9					9	SPT	100				Gravel
-10		Silty SAND, with some gravel; blue/grey. Medium dense; moist; non-plastic; sand, fine to coarse; gravel, fine.	10							10	Open Barrel	100				
		SILT, with some sand and gravel; grey/blue. Medium dense; moist; non-plastic; sand, fine to medium, gravel, fine.			UTP 1/2//3/3/4/4 N = 14						SPT	100				
-11			11							11	Open Barrel	81				
		Clayey SILT, with some gravel; grey/blue. Hard; moist; low plasticity; gravel, fine.														

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.15	

Hole Depth:	Inclination:
23.00	90.00
Logged By:	**Checked By:**
DS	JM
FINAL	Sheet 2 of 4

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

BOREHOLE LOG

Hole No.: MH14

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	15/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	16/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
-13	Puketoka Formation	Clayey SILT; blue/grey. Hard; moist; low plasticity.	13		6/11//11/11/13/13 N = 48				
-14		Silty SAND; blue/grey. Medium dense; moist; non-plastic.	14		7/11//13/8/5/8 N = 34				
-15			15		3/4//5/4/4/7 N = 20				
-16		Silty SAND, with some clay; blue/grey. Hard; moist; low plasticity.	16						
		16.80m: with trace clay							
-17			17		7/8//11/13/13/13 N = 50				
		17.60m: with moderately thin bed of moderately strong; slightly weathered; grey; SANDSTONE							
		Silty CLAY; brown/grey. Hard; moist; high plasticity.							

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
13	SPT	0				Gravel
	Triple Tube	82				
	Triple Tube	95				
14	SPT	0				
15	Triple Tube	29				
	SPT	100				
16	Triple Tube	100				
17	SPT	100				
	Triple Tube	94	22			

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.15	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	Inclination:
23.00	90.00
Logged By:	**Checked By:**
DS	JM
FINAL	Sheet 3 of 4

BOREHOLE LOG

Hole No.: MH14

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	15/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	16/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
-19	Transitional East Coast Bays Formation	Moderately weathered; grey/brown; SILTSTONE; moderately strong.			5/12//26/20 for 5mm N = 50+	VW	MW		18.20m: 2 Joint , 80-90°, Undulating-planar, smooth.		Triple Tube	94	22			
		Silty SAND; grey/blue. Dense; moist; non-plastic.									SPT	0				
		Clayey SILT, with trace sand; grey/blue. Hard; moist; low plasticity; sand, fine.	19							19	Triple Tube	83	54			
-20	East Coast Bays Formation Bedrock	Slightly weathered; grey; SILTSTONE; strong; sand, fine.				VW	SW									
			20		12/15//16/13/14/7 for 35mm N = 50+					20	SPT	0				
-21		Slightly weathered; grey; fine fabric; SANDSTONE; strong.	21			MS			20.60m: 1 Joint, 20°- 60°, irregular, smooth. 20.70m: 1 Joint, 80°- 90°, planar to irregular, smooth. 20.78m: 1 Drilling induced fracture, 90°, planar, polished 21.00m: 1 Drilling induced fracture, 90°, planar, polished 21.05m: chaotic fracture 21.33m: 1 Drilling induced fracture, 90°, planar, polished 21.40m: 1 Joint, 80°- 90°, planar to irregular, smooth.	21	Triple Tube	100	41			
					18/32 for 60mm N = 50+						SPT	0				
-22			22						21.85m: -21.95m: 2 Joints, 80°-90°, planar, smooth. 22.30m: -22.55m: Chaotic fracture 22.55m: -22.70m: 2 Joints, 60°-90°, planar, smooth.	22	Triple Tube	86	46			
		Slightly weathered; grey; fine fabric; SILTSTONE; strong.														
-23		EOH: 23.00m	23		17/33 for 60mm N = 50+					23	SPT	0				

Gravel

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.15	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	Inclination:
23.00	90.00
Logged By:	**Checked By:**
DS	JM
FINAL	Sheet 4 of 4

CORE PHOTOS

Hole No.: MH14
Project ID: J01627

0.00m - 3.00m

3.00m - 6.00m

6.00m - 9.00m

9.00m - 12.00m

12.00m - 17.00m

17.00m - 21.00m

21.00m - 23.00m

BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
-1	TS	TOPSOIL.							
	Undifferentiated Alluvium	Clayey SILT, with trace sand; dark grey streaked dark brown. Stiff; moist; low plasticity; sand, fine; moderately sensitive; with some rootlets.			73 / 20 kPa				
		0.50m - 1.00m: Core loss	1						
		Amorphous to fibrous PEAT; dark grey/brown. Firm; moist; insensitive; non-plastic.			22 / 15 kPa 0/0//0/0/0/0 N = 0				
		Clayey SILT; brown/orange. Soft; moist; high plasticity; insensitive; with some carbonaceous inclusions.							
-2		Amorphous to fibrous PEAT; dark grey/ brown. Soft; moist; insensitive; non-plastic.							
		1.95m: with moderately thin buried log	2						
-3			3		15 / 10 kPa 0/0//0/0/0/0 N = 0				
		3.40m: with some woody inclusions to 3.5m							
-4		4.00m: becoming amorphous PEAT	4						
		4.40m: with some woody inclusions to 4.5m			15 / 12 kPa 0/0//0/0/0/0 N = 0				
-5			5						
		5.40m: with some woody inclusions to 5.5m							
					22 / 15 kPa				

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
1	Open Barrel	92				Bentonite
	Open Barrel	0				
	Open Barrel	52				1.0
	SPT	100				
2	Open Barrel	76				Gravel
3	SPT	100				
4	Open Barrel	82				
	SPT	100				
5	Open Barrel	67				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth: 30.50	**Inclination:** 90.00
Logged By: DS/ML	**Checked By:** JM
FINAL	Sheet 1 of 6

BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
-7	Undifferentiated Alluvium	6.40m: becoming amorphous to fibrous PEAT	7		0/0//0/0/0/0 N = 0				
		6.90m: with moderately thin bed of pumiceous sand							
		Pumiceous silty SAND; light brown/grey. Loose; moist; non-plastic; sand, fine to coarse; insensitive.			29 / 15 kPa 0/0//2/3/3/2 N = 10				
-8		Organic stained clayey SILT; grey/green. Stiff; moist; low plasticity; with trace rootlets.	8						
		Amorphous PEAT; dark grey/brown. Stiff; moist; insensitive; non-plastic.							
-9			9		73 / 29 kPa 0/0//0/0/0/0 N = 0				
-10			10						
					0/0//0/0/0/0 N = 0				
-11			11						
		11.30m: becoming fibrous PEAT							
		11.50m: with moderately thin buried log							
					UTP				

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
7	SPT	100				Gravel
	Open Barrel	100				
	SPT	100				
8	Open Barrel	100				
9	SPT	100				
10	Open Barrel	0				
	SPT	100				
11	Open Barrel	0				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Hole Depth: 30.50 | **Inclination:** 90.00

Logged By: DS/ML | **Checked By:** JM

FINAL | Sheet 2 of 6

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

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BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
-13	Undifferentiated Alluvium	12.40m: with some woody inclusions to 12.45m 12.45m: becoming amorphous to fibrous PEAT			0/0//1/0/0/0 N = 1				
		13.00m: with some woody inclusions	13						
		13.50m: becoming firm; moderately sensitive			44 / 12 kPa 0/0//0/0/0/0 N = 0				
		Silty CLAY; light grey. Firm; moist; high plasticity.							
-14		14.20m: becoming grey	14						
		14.70m: with moderately thin bed of black amorphous PEAT							
		Pumiceous SILT; light grey/white. Dense; moist; non-plastic; with trace organic staining.							
-15			15		UTP 3/4//6/7/10/11 N = 34				
		15.45m - 15.95m: Core loss							
-16	Puketoka Formation	15.95m: with trace fine sand; without organic staining	16						
		16.50m: becoming medium dense			0/0//2/4/6/6 N = 18				
-17			17						

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
13	SPT	100				Gravel
	Open Barrel	90				
	SPT	100				
14	Open Barrel	100				
15	SPT	100				
	Open Barrel	52				
16	SPT	100				
17	Open Barrel	100				
	Triple Tube	100				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth:	Inclination:
30.50	90.00
Logged By:	**Checked By:**
DS/ML	JM
FINAL	Sheet 3 of 6

BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
		18.50m: becoming very loose			0/0//0/0/0/0 N = 0				
-19		Organic stained clayey SILT, with trace sand; grey. Stiff; moist; medium plasticity; sand, fine; with thin bed of brown organic silty clay.	19						
		Organic silty CLAY; brown. Stiff; moist; high plasticity.							
-20		Organic stained clayey SILT, with trace sand; grey. Stiff; moist; medium plasticity; sand, fine.	20						
		Clayey SILT; grey. Very stiff; moist; medium plasticity; with organic inclusions.			0/0//0/1/1/2 N = 4				
-21	Puketoka Formation	Clayey SILT, with some sand; green/grey. Hard; moist; sand, fine to medium; low plasticity to non-plastic; with trace pumiceous inclusions.	21		4/5//15/24/11 for 30mm N = 50+				
-22		21.90m: becoming green; without sand	22						
-23		Sandy SILT; green. Loose; moist; non-plastic; sand, fine to medium; with trace pumiceous inclusions.	23		4/3//2/1/2/1 N = 6				
		23.60m: with trace coarse sand							

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
19	Triple Tube	100				
	SPT	100				
	Triple Tube	100				
20	SPT	100				
	Triple Tube	92				Gravel
	SPT	73				
22	Triple Tube	92				
23	SPT	0				
	Triple Tube	100				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Hole Depth: 30.50

Inclination: 90.00

Logged By: DS/ML

Checked By: JM

FINAL

Sheet 4 of 6

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks
-25	Puketoka Formation		25		0/1//0/1/2/2 N = 5				
		Clayey SILT, with some sand; green/grey. Stiff; moist; low plasticity to non-plastic.							
		Organic stained clayey SILT; dark grey. Tiff; moist; low to no plasticity.							
-26		Pumiceous SAND; grey. Medium dense; moist; non-plastic; sand, coarse.	26		4/5//7/6/8/7 N = 26				
		Clayey SAND; grey. Very stiff; moist; low plasticity; sand, coarse.							
-27		Pumiceous SAND; grey. Very dense; wet; non-plastic; sand, coarse.	27		3/5//11/12/17/10 for 35mm N = 50+				
-28			28						
		Clayey SILT; grey. Hard; moist; low to non-plastic; with trace pumiceous coarse sand.							
-29			29		6/8//7/7/7/8 N = 29				
		29.45m: becoming green/grey; without coarse pumiceous sand							

Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
25	Triple Tube	100				Gravel
	SPT	100				
	Triple Tube	100				
26	SPT	100				
	Triple Tube	100				
27	Triple Tube	100				
	SPT	91				
28	Triple Tube	100				
29	SPT	0				
	Triple Tube	100				

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth: 30.50	**Inclination:** 90.00
Logged By: DS/ML	**Checked By:** JM
FINAL	Sheet 5 of 6

BOREHOLE LOG

Hole No.: MH15

Client:	Sunfield Developments Limited	**Contractor:**	Pro-Drill	**Project ID:**	J01627
Project:	Geotechnical Investigation	**Rig:**	SLG	**Start Date:**	16/12/2022
Site Location:	Sunfields Landholding, Ardmore	**Driller:**	Willie	**End Date:**	19/12/2022
Test Location:	See plan	**Coordinates:**		**Grid:**	NZTM
Located By:	Site plan/map	**Elevation:**	Not set	**Datum:**	Ground

RL (m)	Geology	Material Description	Depth (m)	Graphic Log	In Situ Testing (SPT blows/75mm; Shear vane peak/residual)	Strength	Weathering	Defect Spacing	Defects and Drilling Remarks	Depth (m)	Drilling Method	TCR (%)	RQD (%)	Sampling	Progress (Depth / Time / Fluid Lvl.)	Backfill/ Installation/ Groundwater
	ketoka Formati										Triple Tube	100				Gravel
		EOH: 30.50m			5/5//7/8/12/12 N = 39						SPT	0				
-31			31							31						
-32			32							32						
-33			33							33						
-34			34							34						
-35			35							35						

Remarks: Lockable toby installed.

PIEZO	DATE	LEVEL	REMARK
1	9/02/2023	1.16	

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).

Hole Depth: 30.50	**Inclination:** 90.00
Logged By: DS/ML	**Checked By:** JM
FINAL	Sheet 6 of 6

0.00m - 4.00m

4.00m - 7.30m

7.30m - 11.45m

11.45m - 14.70m

14.70m - 17.40m

17.40m - 20.45m

20.45m - 24.65m

24.65m - 27.00m

27.00m - 30.50m

APPENDIX 3.3

TRIAL PIT RECORDS

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP01

Sheet 1 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Vane Dial Reading	Soil Sensitivity
Undifferentiated Alluvium	TOPSOIL			
	clayey SILT, brown/red. Stiff, dry to moist, low plasticity			
	organic silty CLAY, dark brown. Firm, moist, medium plasticity, insensitive	0.5	46/20	1.8
	amorphous to fibrous PEAT, black. Firm, wet, medium plasticity, insensitive	1.0	46/20	1.8
	organic stained pumiceous fine sandy SILT, light brown. Very loose, wet, no plasticity, insensitive	1.5	40/26	1.6
	amorphous to fibrous PEAT, black. Soft, wet, medium plasticity, moderately sensitive, with moderately thin buried log	2.0	20/6	3.5
	becoming amorphous PEAT	2.5	70/40	1.9
	EOTP at 2.6m. Too hard to excavate further due to tree remains.	3.0		
		3.5		
		4.0		
		4.5		
		5.0		
		5.5		
		6.0		

LANDER geotechnical

Comments: groundwater inflow at : 1.2m trickle, 1.7m trickle, 2.0m medium flow, standing at 2.4m and rising

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP02

Sheet 2 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Vane Dial Reading	Soil Sensitivity
	TOPSOIL			
Undifferentiated Alluvium	amorphous PEAT, dark brown. Firm, moist, medium plasticity, insensitive, with trace woody inclusions	0.5	43/26	1.7
	with moderately thin bed of loose, light brown organic stained pumiceous SILT			
	at 1.1m, becoming stiff, moderately sensitive	1.0	58/26	2.2
	becoming brown, high plasticity, with some logs			
	becoming soft, insensitive	1.5	17/12	1.5
	becoming fibrous PEAT, moderately sensitive	2.0	20/9	2.5
	becoming, firm insensitive	2.5	40/26	1.6
	EOTP at 3.0m. Target depth.	3.0	26/20	1.3

3.5 4.0 4.5 5.0 5.5 6.0

Groundwater

Sample and Laboratory Test Details

LANDER geotechnical

Comments: groundwater inflow at : 2.7m trickle, standing at 2.9m

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil | Fill | Clay | Silt | Sand | Gravel | Organic | Pumice | Sandstone | Siltstone | Limestone | Volcanic | Plutonic | No Core

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP03

Sheet 3 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Vane Dial Reading	Soil Sensitivity
	TOPSOIL			
Undifferentiated Alluvium	fibrous PEAT, dark brown/black. Stiff, moist, low plasticity, moderately sensitive	0.5	69/23	2.0
	with moderately thin bed of loose, no plasticity, light brown organic stained pumiceous SILT becoming firm, insensitive	1.0	29/17	1.7
		1.5	32/17	1.7
	becoming amorphous to fibrous PEAT, dark brown, moderately sensitive	2.0	40/12	3.5
	becoming insensitive	2.5	43/29	1.5
	EOTP at 3.0m. Target depth.	3.0	40/29	1.4
		3.5		
		4.0		
		4.5		
		5.0		
		5.5		
		6.0		

LANDER geotechnical

Comments:
groundwater inflow at : 2.4m trickle

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP04

Sheet 4 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Vane Dial Reading	Soil Sensitivity
Undifferentiated Alluvium	TOPSOIL			
	clayey SILT, brown/red. Firm, dry to moist, low plasticity, moderately sensitive	0.5	40/14	2.8
	organic silty CLAY, dark brown. Firm, wet, medium plasticity, moderately sensitive, with some woody inclusions	1.0		
	at 1.2m, with thin bed of very loose, no plasticity, light brown organic stained pumiceous fine sandy SILT		46/20	2.3
	amorphous to fibrous PEAT, black. Firm, wet, medium plasticity, moderately sensitive			
	at 1.45m, with some buried logs	1.5	43/14	3.0
	becoming fibrous PEAT			
		2.0	29/14	2.0
	becoming insensitive	2.5	26/17	1.5
	becoming saturated (▽)			
	at 3.1m, becoming sensitive	3.0	49/9	5.7
	EOTP at 3.1m. Target depth.	3.5		
		4.0		
		4.5		
		5.0		
		5.5		
		6.0		

LANDER geotechnical

Comments:
groundwater inflow at :
2.7m

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP05

Sheet 5 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Vane Dial Reading	Soil Sensitivity
Undifferentiated Alluvium	TOPSOIL			
	organic silty CLAY, dark brown. Stiff, moist, medium plasticity, with trace woody inclusions			
	organic stained pumiceous SILT, light brown. Loose, wet, no plasticity			
	amorphous to fibrous PEAT, black. Soft, wet, medium plasticity, insensitive	0.5	14/14	1.0
	becoming stiff, moderately sensitive	1.0	83/29	2.9
	becoming soft, insensitive	1.5	17/12	1.5
	becoming fibrous PEAT, brown	2.0	17/12	1.5
	becoming firm	2.5	32/20	1.6
	becoming sensitive			
	EOTP at 3.0m. Target depth.	3.0	26/6	4.5
		3.5		
		4.0		
		4.5		
		5.0		
		5.5		
		6.0	UTP	

LANDER geotechnical

Comments: groundwater inflow at : 2.3m dripping

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP06

Sheet 6 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Depth (m)	Groundwater	Vane Dial Reading	Soil Sensitivity
Undifferentiated Alluvium	TOPSOIL organic stained silty CLAY, orange mottled light brown. Very stiff, moist, medium to high plasticity, sensitive	0.5		115/29	4.0
	amorphous PEAT, dark brown/grey. Stiff, moist, medium plasticity, insensitive, with trace rootlets	1.0		55/29	1.9
	becoming firm, moderately sensitive	1.5		40/14	2.8
	with moderately thin bed of loose, no plasticity, light brown organic stained pumiceous SILT	2.0	▽	29/12	2.5
	becoming soft, insensitive	2.5	▽	17/12	1.5
	EOTP at 3.0m. Target depth.	3.0		37/26	1.4
		3.5			
		4.0			
		4.5			
		5.0			
		5.5			
		6.0			

LANDER geotechnical

Comments:
groundwater inflow at : 2.0 - 2.1m gushing, standing at 2.7m and rising

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic
Fill	Gravel	Siltstone	No Core
Clay	Organic	Limestone	
Silt	Pumice	Volcanic	

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP07

Sheet 7 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Stratigraphy	Soil Description	Depth (m)	Vane Dial Reading	Soil Sensitivity
	TOPSOIL			
Undifferentiated Alluvium	organic stained silty CLAY, brown. Very stiff, moist, high plasticity, sensitive, with trace woody inclusions	0.5	167/32	5.3
	amorphous PEAT, dark brown/grey. Stiff, wet, high plasticity, moderately sensitive, with trace woody inclusions	1.0	55/20	2.7
	becoming soft, insensitive	1.5	17/12	1.5
		2.0	17/12	1.5
	becoming moderately sensitive	2.5	12/6	2.0
	silty CLAY, grey. Soft, saturated, high plasticity, moderately sensitive	3.0	12/6	2.0
	EOTP at 3.2m. Target depth	3.5		
		4.0		
		4.5		
		5.0		
		5.5		
		6.0		

LANDER geotechnical

Comments:
groundwater inflow at : 1.6m heavy flow, standing at 3.0m and rising

Excavator Used: Kubota U48-4

Checked:

Topsoil	Sand	Sandstone	Plutonic	
Fill	Gravel	Siltstone	No Core	
Clay	Organic	Limestone		
Silt	Pumice	Volcanic		

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS, ARDMORE

Job Number: J01627

Trial Pit No. TP08

Sheet 8 of 8

Vane Head:	Logged By:	Processor :	Date:
307	RZ	MB	13.04.21

Pit Location: mN | mE | Ground R.L.

Description: Refer to site plan

Stratigraphy	SOIL DESCRIPTION	Legend	Depth (m)	Groundwater	Vane Dial Reading	Soil Sensitivity	Sample and Laboratory Test Details
	TOPSOIL						
Undifferentiated Alluvium	amorphous PEAT, black. Firm, moist, medium plasticity, moderately sensitive, with trace rootlets		0.5		37/17	2.2	
	becoming wet		1.0		40/20	2.0	
	becoming soft, insensitive		1.5		23/14	1.6	
	with thin bed of loose, no plasticity, brown organic stained SILT						
	becoming firm		2.0		29/1.7	1.7	
	becoming soft		2.5		17/12	1.5	
	at 2.9m, becoming firm, moderately sensitive, with some buried log inclusions				37/17	2.2	
	EOTP at 2.9m. Target depth.		3.0				
			3.5				
			4.0				
			4.5				
			5.0				
			5.5				
			6.0				

LANDER geotechnical

Comments:
No groundwater inflow

Excavator Used: Kubota U48-4

Checked: RZ

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

APPENDIX 3.4

HAND AUGER BOREHOLE RECORDS

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA01

Sheet 1 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
silty CLAY, red mottled orange. Very stiff, moist, medium plasticity, moderately sensitive [RESIDUAL EAST COAST BAYS FORMATION]					
	0.5		173/69	2.5	
becoming light grey mottled orange					
	1.0		178/83	2.1	
becoming insensitive	1.5		118/78	1.5	
	2.0		109/60	1.8	
	2.5		101/60	1.7	
clayey SILT, light grey mottled orange. Hard, moist, low plasticity	3.0		201+		
	3.5		201+		
becoming grey	4.0		201+		
	4.5		201+		
EOB at 5.0m. Target depth	5.0		201+		
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA02

Sheet 2 of 34

Vane Head:	Logged By:	Processor :	Date:
1750	PL	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
silty CLAY, orange streaked light grey. Hard, moist, medium plasticity, moderately sensitive, with trace topsoil leaching [RESIDUAL EAST COAST BAYS FORMATION]				
0.5		220/85	2.6	
without topsoil leaching				
becoming high plasticity				
1.0		235/119	2.0	
1.5		270+		
becoming orange streaked grey, medium plasticity				
becoming high plasticity				
becoming very stiff, insensitive				
2.0		169/96	1.8	
2.5		169/104	1.6	
3.0		181/96	1.9	
becoming light grey and orange streaked orange/brown				
3.5		181/96	1.9	
silty CLAY, dark grey. Hard, moist, medium to high plasticity, insensitive [TRANSITIONAL EAST COAST BAYS FORMATION]				
4.0		227/127	1.8	
becoming very stiff				
4.5		196/135	1.5	
at 5.0m, becoming hard				
5.0		239/154	1.6	
EOB at 5.0m. Target depth				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA03

Sheet 3 of 34

Vane Head:	Logged By:	Processor :	Date:
1750	PL	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	clayey SILT, orange streaked light brown. Hard, moist, low to medium plasticity, moderately sensitive [RESIDUAL EAST COAST BAYS FORMATION]				
0.5			204/58	3.5	
	silty CLAY, orange and brown streaked light grey. Very stiff, moist, medium plasticity, insensitive				
1.0	becoming orange streaked light grey, high plasticity		177/104	1.7	
1.5			169/96	1.8	
2.0	becoming orange streaked light brown		169/96	1.8	
2.5	becoming light grey streaked orange		154/96	1.6	
3.0			104/65	1.6	
3.5	silty CLAY, dark grey. Hard, moist, medium plasticity, insensitive [TRANSITIONAL EAST COAST BAYS FORMATION]		212/162	1.3	
4.0	becoming very stiff, moderately sensitive		162/62	2.6	
4.5	becoming hard		227/104	2.2	
5.0	EOB at 5.0m. Target depth.		270+		
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA04

Sheet 4 of 34

Vane Head:	Logged By:	Processor :	Date:
1900	RG	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
fibrous PEAT, dark brown/black. Firm, moist, low plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]				
0.5		49/25	2.0	
1.0		34/15	2.3	
becoming saturated with moderately thin bed of brown/grey pumiceous SILT, loose, wet, low plasticity				
becoming insensitive				
1.5		37/28	1.3	
becoming soft				
2.0		22/12	1.8	
becoming stiff				
2.5	▽	61/49	1.2	
		UTP		
EOB at 2.9m. Too hard to auger further. Inferred tree root/stump.				
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 1.2m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA05

Sheet 5 of 34

Vane Head:	Logged By:	Processor :	Date:
1900	RG	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
fibrous PEAT, dark brown/black. Firm, moist, low plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		37/15	2.5	
	1.0		31/9	3.4	
with moderately thin bed of stiff, light brown/grey pumiceous SILT becoming wet					
becoming soft, insensitive	1.5		18/12	1.5	
becoming firm, moderately sensitive	2.0		31/12	2.6	
becoming stiff, insensitive	2.5		52/31	1.7	
becoming saturated, with limited sample recovery					
becoming firm	3.0		31/18	1.7	
becoming stiff	3.5		65/43	1.5	
becoming firm, moderately sensitive	4.0		31/12	2.6	
		▽			
EOB at 4.5m. Too hard to auger further. Inferred tree root/stump.	4.5		UTP		
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 2.8m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA06

Sheet 6 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	silty CLAY, orange mottled light grey. Hard, moist, medium plasticity [PUKETOKA FORMATION]				
0.5			201+		
1.0	becoming very stiff, moderately sensitive		176/63	2.8	
	clayey SILT, light brown. Very stiff, moist, low plasticity, moderately sensitive				
1.5	becoming brown, medium plasticity becoming wet, with trace limonite		196/92	2.1	
2.0	organic silty CLAY, dark brown. Stiff, wet, high plasticity, moderately sensitive		86/26	3.3	
2.5	becoming insensitive		60/32	1.9	
3.0	becoming moderately sensitive		52/26	2.0	
	EOB at 3.3m. Too sticky to auger further.				
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA07

Sheet 7 of 34

Vane Head:	Logged By:	Processor :	Date:
1750	PL	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
slightly clayey SILT, orange streaked light grey. Hard, moist, no to low plasticity [PUKETOKA FORMATION]		0.5		270+		
silty CLAY, orange and white streaked grey. Hard, moist, medium plasticity		1.0		270+		
becoming medium to high plasticity						
becoming orange streaked grey, high plasticity						
becoming insensitive		1.5		208/169	1.2	
organic stained silty CLAY, orange streaked purple/grey. Very stiff, moist, low plasticity, insensitive, with trace rootlets		2.0		135/77	1.8	
without rootlets, with trace black carbonaceous streaks		2.5		100/77	1.3	
silty CLAY, grey/blue. Very stiff, moist, high plasticity, insensitive		3.0		112/73	1.5	
becoming stiff		3.5		92/73	1.3	
		4.0		77/58	1.3	
becoming very stiff		4.5		100/65	1.5	
EOB at 5.0m. Target depth		5.0		108/77	1.4	
		5.5				
		6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA08

Sheet 8 of 34

Vane Head:	Logged By:	Processor :	Date:
1750	PL	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
silty CLAY, light grey streaked orange. Hard, moist, medium plasticity, sensitive [PUKETOKA FORMATION]	0.5		208/39	5.3	
becoming orange streaked light grey	1.0		208/39	5.3	
becoming high plasticity					
becoming insensitive	1.5		208/119	1.7	
becoming very stiff,	2.0		177/119	1.5	
	2.5		131/100	1.3	
	3.0		131/85	1.5	
becoming orange streaked blue/grey	3.5		135/100	1.4	
becoming moderately sensitive	4.0		131/65	2.0	
silty CLAY, dark grey. Hard, moist, high plasticity [TRANSITIONAL EAST COAST BAYS FORMATION]	4.5		270+		
EOB at 5.0m. Target depth	5.0		270+		
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA09

Sheet 9 of 34

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
fibrous PEAT, dark brown/black. Firm, moist, low plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		37/12	3.1	
becoming wet					
becoming insensitive	1.0		43/25	1.7	
EOB at 1.5m. Too hard to auger further. Inferred tree root/stump.	1.5		UTP		
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA10

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
fibrous PEAT, dark brown/black. Stiff, moist, low to medium plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]						
with very thin bed of low plasticity, light orange/brown pumiceous SILT with minor clay, with mottles of black PEAT intermixed		0.5		61/28	2.2	
pumiceous SILT with minor clay, light brown/grey. Hard, moist, low plasticity, with black PEAT intermixed				UTP		
EOB at 1.0m. Too hard to auger further. Inferred tree root/stump.		1.0				
		1.5				
		2.0				
		2.5				
		3.0				
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA11

Sheet 11 of 34

Vane Head:	Logged By:	Processor :	Date:
1900	RG	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
fibrous PEAT, dark brown/black. Firm, moist, low to medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		46/25	1.8	
	1.0		28/15	1.9	
pumiceous SILT with minor clay, light brown/grey. Stiff, moist, low plasticity	1.5		UTP		
EOB at 1.5m. Too hard to auger further. Inferred tree root/stump.					
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered..
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA12

Sheet 12 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	silty CLAY, orange mottled light grey. Very stiff, moist, medium plasticity, moderately sensitive [PUKETOKA FORMATION]				
0.5			148/43	3.4	
	organic stained silty CLAY, light brown. Very stiff, moist, medium plasticity, moderately sensitive				
1.0			176/55	3.2	
	becoming dark brown, stiff, high plasticity				
1.5			58/17	3.3	
	becoming wet				
	becoming firm, insensitive				
2.0			49/29	1.7	
	becoming light brown, stiff				
2.5			86/55	1.6	
	becoming very stiff, moderately sensitive				
3.0			115/58	2.0	
	clayey SILT, light orange/light grey. Stiff, wet, medium plasticity, moderately sensitive				
	becoming saturated				
	becoming light grey/white				
3.5		▽	58/23	2.5	
	becoming hard				
4.0			201+		
	becoming stiff				
4.5			60/29	2.1	
5.0			55/26	2.1	
	EOB at 5.0m. Target Depth				
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater encountered at 3.3m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA13

Sheet 13 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
clayey SILT, light grey streaked orange. Hard, moist, low plasticity [PUKETOKA FORMATION]				
0.5		205+		
becoming light orange streaked light grey				
1.0		205+		
becoming very stiff, insensitive becoming wet				
1.5		159/83	1.9	
silty CLAY, light orange streaked light grey. Very stiff, wet, medium plasticity, insensitive				
2.0		155/91	1.7	
2.5		155/88	1.8	
3.0		159/97	1.6	
3.5		159/109	1.5	
becoming moderately sensitive, with trace fine sand				
4.0		155/77	2.0	
becoming hard, insensitive				
4.5		202/106	1.9	
at 5.0m, becoming very stiff, moderately sensitive				
5.0		186/71	2.6	
EOB at 5.0m. Target Depth.				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client :	ARDMORE DEVELOPMENTS LIMITED	**Auger Borehole No.**	HA14
Project Location :	SUNFIELDS ARDMORE		Sheet 14 of 34
Job Number:	J01627	Vane Head: 2784 / Logged By: NM / Processor : PL / Date: 12.04.21	

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
0.5 organic stained silty CLAY, light orange streaked grey/brown. Hard, wet, medium plasticity [UNDIFFERENTIATED ALLUVIUM]		205+		
1.0 becoming very stiff, insensitive		189/106	1.8	
1.5 becoming moderately sensitive		199/100	2.0	
becoming grey, high plasticity 2.0 becoming stiff, saturated, insensitive	▽	80/44	1.8	
amorphous PEAT, light grey streaked dark brown/black. Very soft, saturated medium plasticity at 2.4m, push probed to 5.0m 2.5		sunk under own weight		
3.0 becoming stiff, insensitive, with limited sample recovery		59/32	1.8	
3.5 becoming very soft		sunk under own weight		
4.0		sunk under own weight		
4.5		sunk under own weight		
5.0		sunk under own weight		
EOB at 5.0m. Target Depth.				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 2.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA15

Sheet 15 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	PL	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
organic stained silty CLAY, orange mottled light brown. Very stiff, moist, medium plasticity, moderately sensitive [PUKETOKA FORMATION]	0.5		164/43	3.8	
becoming insensitive	1.0		138/101	1.4	
	1.5		115/60	1.7	
	2.0		176/127	1.4	
silty CLAY, orange streaked light grey. Very stiff, moist, high plasticity, insensitive	2.5		141/109	1.3	
	3.0		150/115	1.3	
becoming light grey/light brown	3.5		132/83	1.6	
becoming moderately sensitive	4.0		155/75	2.1	
becoming medium plasticity					
becoming insensitive	4.5		184/109	1.7	
EOB at 5.0m. Target Depth.	5.0		196/115	1.7	
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA16

Sheet 16 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	13.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	clayey SILT, orange streaked light grey. Very stiff, moist, low plasticity [PUKETOKA FORMATION]				
0.5	silty CLAY, orange streaked light grey. Very stiff, moist, medium plasticity, moderately sensitive		155/74	2.1	
1.0	becoming insensitive		144/106	1.4	
1.5			171/127	1.3	
2.0	becoming wet becoming saturated		137/71	1.9	
2.5			106/62	1.7	
3.0			109/77	1.4	
3.5	becoming moderately sensitive		133/62	2.1	
4.0	becoming insensitive	▽	127/74	1.7	
4.5			121/77	1.6	
5.0	at 5.0m, becoming moderately sensitive		140/68	2.1	
	EOB at 5.0m. Target Depth.				
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater encountered at 2.2m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA17

Sheet 17 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	13.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
0.5	organic stained clayey SILT, orange mottled grey/brown. Hard, moist, low plasticity [UNDIFFERENTIATED ALLUVIUM]		205+		
	becoming dark brown				
1.0	becoming very stiff, moderately sensitive		140/65	2.2	
	amorphous PEAT, dark brown. Very stiff, moist to wet, medium plasticity, moderately sensitive, with trace rootlets				
	becoming saturated				
1.5		▽	136/62	2.2	
2.0	becoming firm, push probed to 5.0m		32/13	2.5	
2.5	becoming very soft		sunk under own weight		
3.0	becoming firm, insensitive		47/26	1.8	
3.5	becoming very soft		sunk under own weight		
4.0			sunk under own weight		
4.5			sunk under own weight		
5.0	EOB at 5.0m. Target Depth.		sunk under own weight		
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater encountered at 1.4m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA18

Sheet 18 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
fibrous PEAT, dark brown/black. Stiff, moist, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		68/59	1.2	
becoming wet					
becoming firm	1.0		47/29	1.6	
becoming saturated	1.5	▽	32/17	1.9	
becoming very soft	2.0		sunk under own weight		
	2.5		sunk under own weight		
	3.0		sunk under own weight		
	3.5		sunk under own weight		
			UTP		
EOB at 3.9m. Too hard to auger further. Inferred tree root/stump.	4.0				
	4.5				
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 1.5m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client :	ARDMORE DEVELOPMENTS LIMITED	**Auger Borehole No.**	HA19
Project Location :	SUNFIELDS ARDMORE		Sheet 19 of 34
Job Number:	J01627	Vane Head: 2784 / Logged By: NM / Processor : PL / Date: 14.04.21	

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity
TOPSOIL			
amorphous PEAT, dark brown/black. Stiff, moist, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]	0.5	77/44	1.8
becoming firm	1.0	32/23	1.4
push probed to 4.2m			
becoming very soft	1.5	sunk under own weight	
	2.0	sunk under own weight	
	2.5	sunk under own weight	
	3.0	sunk under own weight	
	3.5	sunk under own weight	
	4.0	sunk under own weight	
EOB at 4.2m. Too hard to auger further. Inferred tree root/stump.	4.5		
	5.0		
	5.5		
	6.0		

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA20

Sheet 20 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
0.5	fibrous PEAT, dark brown/black. Very stiff, wet, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]		121/68	1.8	
	push probed to 2.9m				
1.0	becoming stiff		68/35	1.9	
1.5	becoming very soft		sunk under own weight		
2.0			sunk under own weight		
2.5			sunk under own weight		
	EOB at 2.9m. Too hard to auger further. Inferred tree root/stump.				
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic				
Fill	Gravel	Siltstone	No Core				
Clay	Organic	Limestone					
Silt	Pumice	Volcanic					

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA21

Sheet 21 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	PL	15.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
clayey SILT, orange/red mottled grey. Very stiff, moist, low plasticity, moderately sensitive [PUKETOKA FORMATION]	0.5		144/47	3.1	
becoming hard	1.0		205+		
silty CLAY, orange mottled grey. Very stiff, moist, medium plasticity, insensitive	1.5		174/112	1.6	
	2.0		144/85	1.7	
becoming wet	2.5		155/106	1.5	
becoming saturated, high plasticity	3.0		109/65	1.7	
	3.5	▽	136/91	1.5	
with trace coarse sand sized pumiceous inculsions	4.0		152/91	1.7	
becoming hard	4.5		205+		
	5.0		205+		
EOB at 5.0m. Target Depth.	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 3.1m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client :	ARDMORE DEVELOPMENTS LIMITED	**Auger Borehole No.**	HA22
Project Location :	SUNFIELDS ARDMORE		Sheet 22 of 34
Job Number:	J01627	Vane Head: 2784 / Logged By: NM / Processor : PL / Date: 12.04.21	

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity
TOPSOIL			
clayey SILT, orange mottled light grey. Hard, moist, low plasticity, with trace rootlets [UNDIFFERENTIATED ALLUVIUM]	0.5	217+	
with trace black organic streaks			
becoming very stiff, moderately sensitive	1.0	189/90	2.1
organic stained silty CLAY, black streaked orange mottled light grey. Very stiff, moist, medium plasticity, moderately sensitive	1.5	152/78	2.0
	2.0	140/62	2.3
fibrous PEAT, dark brown/black. Very stiff, wet, medium plasticity, insensitive	2.5	155/96	1.6
becoming dark brown/black streaked grey			
becoming dark brown/black			
becoming saturated	3.0	143/78	1.8
becoming moderately sensitive	3.5 ▽	143/68	2.1
	4.0	127/62	2.1
becoming insensitive	4.5	109/93	1.2
at 5.0m, becoming firm			
EOB at 5.0m. Target Depth.	5.0	47/34	1.4
	5.5		
	6.0		

LANDER geotechnical

Comments:
Groundwater encountered at 3.1m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA23

Sheet 23 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	RZ	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
0.5	fibrous PEAT, dark brown/black. Stiff, moist, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]		68/50	1.4	
1.0	becoming soft		19/16	1.2	
1.5	becoming firm, wet, moderately sensitive		34/16	2.2	
	becoming saturated	▽			
2.0	becoming insensitive		31/25	1.3	
2.5			31/25	1.3	
3.0			34/28	1.2	
3.5			43/28	1.6	
4.0			37/25	1.5	
	EOB at 4.1m. Too hard to auger further. Inferred tree root/stump.				
4.5					
5.0					
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater encountered at 1.9m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA24

Sheet 24 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	RZ	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL						
fibrous PEAT, dark brown/black. Very stiff, moist to wet, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]		0.5		124/68	1.8	
becoming stiff, moderately sensitive		1.0		68/34	2.0	
push probed to 2.9m becoming very soft		1.5		sunk under own weight		
		2.0		sunk under own weight		
		2.5		sunk under own weight		
EOB at 2.9m. Too hard to auger further. Inferred tree root/stump.		3.0				
		3.5				
		4.0				
		4.5				
		5.0				
		5.5				
		6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA25

Sheet 25 of 34

Vane Head:	Logged By:	Processor :	Date:
2784	NM	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
fibrous PEAT, dark brown/black. Stiff, moist, medium plasticity, insensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		78/43	1.8	
becoming moderately sensitive	1.0		84/22	3.9	
becoming very soft	1.5	▽	sunk under own weight		
	2.0		sunk under own weight		
becoming saturated	2.5		sunk under own weight		
	3.0		sunk under own weight		
	3.5		sunk under own weight		
organic stained silty CLAY, black streaked light grey. Very stiff, saturated, medium plasticity, moderately sensitive	4.0		140/62	2.3	
EOB at 4.4m. Too hard to auger further. Inferred tree root/stump.	4.5				
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 2.3m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA26

Sheet 26 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
organic stained silty CLAY, light brown. Stiff, dry to moist, low plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]	0.5	77/23	3.1	
becoming moist, high plasticity	1.0	83/32	2.6	
amorphous PEAT, black. Soft, moist, high plasticity, insensitive	1.5	17/12	1.5	
becoming saturated, push probed to 3.4m	2.0	23/14	1.6	
becoming firm	2.5	40/29	1.4	
becoming moderately sensitive	3.0	43/17	2.5	
EOB at 3.4m. Too hard to auger further. Inferred tree root/stump.	3.5			
	4.0			
	4.5			
	5.0			
	5.5			
	6.0			

Standing Water Level: ▽ at 1.8m

LANDER geotechnical

Comments:
Groundwater encountered at 1.9m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA27

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
organic stained silty CLAY, light brown. Stiff, moist, medium plasticity, sensitive [UNDIFFERENTIATED ALLUVIUM]				
0.5		92/23	4.0	
amorphous PEAT, black. Stiff, moist, medium plasticity, moderately sensitive				
1.0		75/35	2.2	
becoming very stiff				
1.5		112/32	3.5	
becoming stiff, saturated	▽			
2.0		60/29	2.1	
becoming very stiff				
2.5		147/55	2.7	
EOB at 2.6m. Too hard to auger further. Inferred tree root/stump.				
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 2.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA28

Vane Head:	Logged By:	Processor :	Date:
1750	PL	RZ	20.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
slightly clayey SILT, orange. Hard, moist, no plasticity, moderately sensitive [PUKETOKA FORMATION]	0.5		220/69	3.2	
silty CLAY, orange/brown. Hard, moist, medium plasticity, moderately sensitive					
becoming orange streaked light grey/orange	1.0		200/65	3.1	
with trace organic staining	1.5		270/131	2.1	
becoming orange streaked white, very stiff, insensitive, with trace pumicious inclusions	2.0		173/123	1.4	
	2.5		173/112	1.5	
becoming yellow/orange streaked white, wet	3.0		104/54	1.9	
becoming white, with trace fine sand					
becoming stiff	3.5		77/54	1.4	
becoming green/blue streaked light blue					
becoming light blue	4.0		58/42	1.4	
becoming very stiff	4.5		104/73	1.4	
at 5.0m, becoming stiff	5.0		77/54	1.4	
EOB at 5.0m. Target Depth.	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA29

Sheet 29 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	silty CLAY, orange/brown. Very stiff, moist, no plasticity, sensitive [PUKETOKA FORMATION]				
0.5	becoming yellow/light grey		164/32	5.2	
1.0	becoming hard becoming orange and red mottled white		201+		
1.5	becoming very stiff, insensitive		184/121	1.5	
2.0	becoming high plasticity		155/86	1.8	
2.5	becoming stiff		86/60	1.4	
3.0	becoming orange and white mottled		60/43	1.4	
3.3	EOB at 3.3m. Too sticky to auger further.				
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA30

Sheet 30 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	14.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Legend	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
organic stained silty CLAY, orange mottled light brown. Very stiff, moist, medium plasticity, moderately sensitive [UNDIFFERENTIATED ALLUVIUM]	0.5		127/35	3.7	
amorphous PEAT, dark brown/black. Firm, dry, low plasticity, moderately sensitive					
becoming moist, medium plasticity	1.0		43/17	2.5	
becoming saturated					
push probed to 4.2m	1.5	▽	46/20	2.3	
becoming very soft					
	2.0		sunk under own weight		
	2.5		sunk under own weight		
becoming firm, insensitive	3.0		29/17	1.7	
	3.5		37/23	1.6	
	4.0		46/40	1.1	
EOB at 4.2m. Too hard to auger further. Inferred tree root/stump.	4.5				
	5.0				
	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater encountered at 1.4m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA31

Sheet 31 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Soil Description	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
	TOPSOIL				
	organic silty CLAY, light brown. Stiff, moist, medium plasticity [UNDIFFERENTIATED ALLUVIUM]				
0.5	amorphous PEAT, dark brown/black. Stiff, moist, medium plasticity, moderately sensitive		52/17	3.0	
1.0			55/26	2.1	
1.5	becoming firm		31/14	2.2	
2.0	becoming very stiff, saturated	▽	130/46	2.8	
	EOB at 2.2m. Too hard to auger further. Inferred tree root/stump				
2.5					
3.0					
3.5					
4.0					
4.5					
5.0					
5.5					
6.0					

LANDER geotechnical

Comments:
Groundwater encountered at 2.0m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA32

Sheet 32 of 34

Vane Head:	Logged By:	Processor :	Date:
307	RZ	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
organic stained silty CLAY, brown. Stiff, wet, high plasticity [UNDIFFERENTIATED ALLUVIUM]				
amorphous PEAT, dark brown. Stiff, wet, high plasticity, sensitive, with trace woody inclusions becoming saturated	0.5	60/14	4.2	
becoming firm, moderately sensitive	1.0	35/14	2.4	
becoming soft, insensitive	1.5	17/12	1.5	
becoming very stiff, sensitive	2.0	181/37	4.8	
becoming extra sensitive	2.5	101/12	8.8	
becoming firm, insensitive	3.0	46/35	1.3	
EOB at 3.3m. Too hard to auger further. Inferred tree root/stump.	3.5			
	4.0			
	4.5			
	5.0			
	5.5			
	6.0			

Standing Water Level: ▽ at 1.8m

LANDER geotechnical

Comments:
Groundwater encountered at 0.6m.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA33

Sheet 33 of 34

Vane Head:	Logged By:	Processor :	Date:
2396	KM	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION	Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL					
slightly clayey SILT, orange/brown. Very stiff, moist, no to low plasticity, sensitive [PUKETOKA FORMATION]	0.5		161/40	4.0	
clayey SILT, orange/brown streaked light grey. Hard, moist, medium plasticity	1.0		253+		
becoming moderately sensitive	1.5		232/78	2.8	
silty CLAY, light grey. Very stiff, moist, medium plasticity, insensitive	2.0		136/74	1.8	
clayey SILT, light grey. Stiff, moist, low to medium plasticity, moderately sensitive	2.5		146/56	2.6	
	3.0		107/43	2.5	
becoming wet	3.5		128/35	3.7	
becoming stiff	4.0		89/42	2.1	
becoming insensitive, push probed to 5.0m	4.5		56/38	1.5	
at 5.0m, becoming very stiff, moderately sensitive	5.0		184/71	2.6	
EOB at 5.0m. Target depth.	5.5				
	6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Client : ARDMORE DEVELOPMENTS LIMITED

Project Location : SUNFIELDS ARDMORE

Job Number: J01627

Auger Borehole No. HA34

Sheet 34 of 34

Vane Head:	Logged By:	Processor :	Date:
2153	JM	RZ	12.04.21

Borehole Location: mN | mE | Ground R.L.

Description: Refer to site plan

SOIL DESCRIPTION

Depth (m)	Standing Water Level	Vane Shear(kPa) peak / residual	Soil Sensitivity	Sample and Laboratory / Other Test Details
TOPSOIL				
organic stained silty CLAY, black mottled grey/brown. Stiff, moist, medium plasticity, sensitive [UNDIFFERENTIATED ALLUVIUM]				
0.5		77/17	4.5	
becoming black mottled brown, firm, wet, medium to high plasticity, with trace organic inclusions, push probed to 2.9m				
1.0		45/11	4.1	
amorphous PEAT, dark brown. Stiff, wet, medium to high plasticity, sensitive				
1.5		76/19	4.1	
becoming moderately sensitive				
2.0		52/17	3.1	
becoming firm, insensitive				
2.5		43/28	1.6	
with moderately thin log				
		UTP		
EOB at 2.9m. Too hard to auger futher. Inferred tree root/stump.				
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				
6.0				

LANDER geotechnical

Comments:
Groundwater not encountered.
UTP = unable to penetrate.
EOB = end of borehole.

Borehole Diameter: 50mm

Checked: RG

Topsoil	Sand	Sandstone	Plutonic		
Fill	Gravel	Siltstone	No Core		
Clay	Organic	Limestone			
Silt	Pumice	Volcanic			

Hand Auger Borehole Log

Test ID:	**HA35**
Project ID:	J01627
Sheet:	1 of 1

Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	MK
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	MK
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Graphic Log	Material Description	Water
0.0	TS - Topsoil	TS	TOPSOIL.	
0.5	Puketoka Formation		Sandy SILT, with trace clay; brown mottled grey. Firm; moist; low plasticity; moderately sensitive.	
1.0			Silty CLAY; orange streaked grey. Firm; moist; high plasticity; moderately sensitive; with trace limonite.	
1.5			1.50m: becoming very stiff, insensitive	Groundwater not encountered
2.0				
2.5			2.50m: becoming hard	
3.0				
3.5				
4.0				
4.5				
5.0				
5.5				

In-situ Testing

Dynamic cone penetrometer (blows / 50mm): 2, 4, 6, 8

Vane undrained shear strength, s_u (kPa): 50, 100, 150, 200

Values	
Vane ID: 3476	peak / residual (sensitivity)
0.5	43 / 21 (2.0)
1.0	29 / 14 (2.1)
1.5	114 / 86 (1.3)
2.0	143 / 114 (1.3)
2.5	200+

Hole Depth: 2.70m

Termination: Too hard to auger further

Remarks: Scala penetrometer testing commenced and found effective refusal at 3.40m.

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

- Vane peak
- Vane residual
- Vane UTP
- Standing water level
- Groundwater inflow
- Groundwater outflow

UTP = Unable to Penetrate

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Hand Auger Borehole Log

Test ID:	**HA36**				
Project ID:	J01627				
Sheet:	1 of 1				
Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	MK
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	MK
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 3476 peak / residual (sensitivity)	Depth (m)
0.0	TS	TOPSOIL.				0.0
0.5	Puketoka Formation	Sandy SILT, with trace clay; brown mottled grey. Very stiff; moist; low plasticity; moderately sensitive.			143 / 57 (2.5)	-0.5
1.0		Silty CLAY; grey. Very stiff; moist; high plasticity; insensitive.			121 / 71 (1.7)	-1.0
1.5		Pumiceous silty CLAY; light grey/white. Very stiff; moist; high plasticity; insensitive.			143 / 86 (1.7)	-1.5
2.0		Silty CLAY; orange streaked light grey. Hard; moist; high plasticity. 2.00m: becoming hard			200+	-2.0
2.5		2.50m: becoming very stiff			129 / 107 (1.2)	-2.5
3.0		3.00m: with trace limonite 3.20m: becoming orange streaked light blue; with trace fine sand			121 / 86 (1.4)	-3.0
3.5		3.50m: becoming stiff, saturated	◁		57 / 36 (1.6)	-3.5
4.0		4.00m: becoming firm; with trace fine to medium sand	▼		39 / 29 (1.3)	-4.0
4.5		4.50m: becoming very stiff; moderately sensitive			143 / 50 (2.9)	-4.5
5.0		5.00m: becoming sensitive			171 / 43 (4.0)	-5.0
5.5						-5.5

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Test ID:	**HA37**				
Project ID:	J01627				
Sheet:	1 of 1				
Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	MK
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	MK
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 3476 peak / residual (sensitivity)
0.0	TS	TOPSOIL.			
0.5	Undifferentiated Alluvium	Sandy SILT, with trace clay; brown mottled grey. Very stiff; moist; low plasticity; moderately sensitive.			100 / 34 (2.9)
1.0		Silty CLAY; brown streaked light brown/grey. Stiff; moist; high plasticity; moderately sensitive; with trace limonite.			63 / 26 (2.4)
1.5		1.40m: becoming saturated	◁		57 / 40 (1.4)
		Amorphous PEAT; black; Stiff; saturated; medium plasticity; insensitive; with traced decayed wood inclusions.			
2.0		2.00m: becoming very stiff; moderately sensitive	▼		114 / 57 (2.0)
2.5		2.50m: becoming stiff			71 / 36 (2.0)
3.0					63 / 29 (2.2)
3.5		3.50m: becoming hard			200+
4.0					200+
4.5					200+
5.0		4.80m: with minor clay			200+
5.5					

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Test ID:	**HA38**				
Project ID:	J01627				
Sheet:	1 of 1				
Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	MK
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	MK
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 3476 peak / residual (sensitivity)
0.0	TS	TOPSOIL.			
0.0	Puketoka Formation	Sandy SILT, with trace clay; brown mottled grey. Very stiff; moist; low plasticity; moderately sensitive.			
0.5					114 / 29 (3.9)
1.0		Silty CLAY; brown motted light brown. Firm; moist; high plasticity; insensitive; with trace peat.			43 / 29 (1.5)
1.5		1.50m: becoming stiff, saturated	◁		57 / 31 (1.8)
2.0		Amorphous PEAT, black; Firm; saturated; medium plasticity; moderately sensitive			46 / 21 (2.2)
2.5		2.50m: becoming stiff; insensitive			71 / 43 (1.7)
3.0		3.00m: becoming firm			31 / 26 (1.2)
3.5		3.50m: becoming very stiff			171 / 129 (1.3)
4.0		Silty CLAY; light blue. Hard; saturated; high plasticity.	▼		200+
4.5					200+
5.0					200+
5.5					

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Test ID:	**HA39**
Project ID:	J01627
Sheet:	1 of 1

Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	BS
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	BS
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 307 peak / residual (sensitivity)
0.0	TS	TOPSOIL.			
0.5	Puketoka Formation	Silty CLAY, with trace sand; orange mottled brown/grey. Very stiff; moist; high plasticity; sand, fine; sensitive.			111 / 18 (6.2)
1.0		1.00m: becoming insensitive	▼		131 / 87 (1.5)
1.5		Amorphous PEAT; dark grey/black. Very stiff; moist; insensitive. 1.40m: becoming saturated 1.50m: becoming stiff; moderately sensitive; with rootlets	◁		86 / 35 (2.5)
2.0		Silty CLAY, with trace sand; black streaked brown with trace rootlets. Stiff; saturated; sand, fine; medium to high plasticity; moderately sensitive.			69 / 21 (3.3)
2.5		2.50m: becoming insensitive; with limited to no sample recovery due to water suction 2.70m: becoming low to medium plasticity			63 / 36 (1.8)
3.0					63 / 33 (1.9)
3.5					56 / 47 (1.2)
4.0		4.00m: becoming moderately sensitive			81 / 27 (3.0)
4.5		4.50m: becoming blue/grey; very stiff; insensitive			153 / 104 (1.5)
5.0					135 / 104 (1.3)
5.5					

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Test ID:	**HA40**				
Project ID:	J01627				
Sheet:	1 of 1				
Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	BS
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	BS
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 307 peak / residual (sensitivity)
0	TS	TOPSOIL.			
0		Clayey SILT, with some sand; brown. Very stiff; moist; low plasticity; sand, fine; sensitive.			
0.3		0.30m: becoming orange streaked brown			108 / 26 (4.2)
0.6			▼		
1.0			◁		162 / 87 (1.9)
1.0		PEAT (AMORPHOUS); dark grey. Very stiff; saturated; low plasticity to non-plastic; insensitive.			
1.2		Clayey SILT, with some sand; orange. Very stiff; saturated; low plasticity; sand, fine.			
1.4		PEAT (AMORPHOUS); dark grey. Very stiff; saturated; low plasticity to medium plasticity.			111 / 72 (1.5)
1.4		1.40m: with limited to no sample recovery due to groundwater suction			
2.0	Undifferentiated Alluvium				102 / 56 (1.8)
2.5		2.50m: becoming stiff			72 / 63 (1.1)
3.0					51 / 36 (1.4)
3.2		3.20m: with some rootlets			
3.5		3.50m: becoming moderately sensitive			72 / 35 (2.1)
4.0		4.00m: becoming insensitive			75 / 63 (1.2)
4.5		4.50m: becoming very stiff			111 / 93 (1.2)
5.0		5.00m: becoming stiff			95 / 81 (1.2)

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

Hand Auger Borehole Log

Test ID:	**HA41**				
Project ID:	J01627				
Sheet:	1 of 1				
Client:	Sunfield Developments Limited	**Coordinates:**	Not defined	**Test Date:**	15/12/2022
Project:	Geotechnical Investigation	**System:**	NZTM	**Logged By:**	BS
Location:	Sunfields Landholding, Ardmore	**Elevation:**	Ground	**Prepared By:**	BS
Test Site:	Refer to site plan	**Located By:**	Site plan/map	**Checked By:**	JM

Depth (m)	Geology	Material Description	Water	In-situ Testing: Dynamic cone penetrometer (blows / 50mm) 2 4 6 8; Vane undrained shear strength, s_u (kPa) 50 100 150 200	Values: Vane ID: 307 peak / residual (sensitivity)	Depth (m)
0.0	Undifferentiated Alluvium	TOPSOIL.				0.0
		Clayey SILT, with trace sand; brown. Stiff; moist; medium plasticity; sand, fine.				
0.5		Silty CLAY, with trace sand; orange streaked brown. Stiff; moist; sand, fine; medium to high plasticity.			63 / 36 (1.8)	-0.5
		Clayey SILT, with trace sand; dark grey mottled brown. Stiff; wet; low plasticity; sand, fine; insensitive.				
1.0		Amorphous PEAT; dark grey; low to medium plasticity; stiff; saturated	◁		57 / 11 (5.2)	-1.0
		1.20m: with limited to no sample recovery	▼			
1.5		1.50m: becoming insensitive; with some rootlet inclusion			63 / 45 (1.4)	-1.5
2.0					59 / 41 (1.4)	-2.0
2.5		2.50m: becoming hard			UTP	-2.5
		Silty CLAY, with trace sand; brown. Hard; saturated; sand, fine; low to medium plasticity.				
		With no sample recovery due to water suction				
3.0		3.00m: becoming very stiff; moderately sensitive			135 / 48 (2.8)	-3.0
3.5		3.50m: becoming hard			UTP	-3.5
4.0		4.00m: becoming very stiff; insensitive			188 / 123 (1.5)	-4.0
4.5		4.50m: becoming stiff			90 / 63 (1.4)	-4.5
5.0					78 / 50 (1.6)	-5.0
5.5						-5.5

Hole Depth: 5.00m **Termination:** Reached target depth

Remarks:

Materials are described in general accordance with NZGS 'Field Description of Soil and Rock' (2005).
No correlation is implied between shear vane and DCP values.

● Vane peak ▼ Standing water level
○ Vane residual ◁ Groundwater inflow
◆ Vane UTP ▷ Groundwater outflow
UTP = Unable to Penetrate

APPENDIX 3.5

FALLING HEAD PERCOLATION TEST RESULTS

STORMWATER PERCOLATION TEST

Client:	Ardmore Developments Limited	Job No:	J01627
Location:	Sunfields	Date:	20.04.21
	Ardmore	Page	1 of 2
Hole No:	P01	Diameter:	0.1 (m)
Location:	Refer to site plan	Depth:	2 (m)
Weather conditions preceding test:		Wet	
Details of presoaking:		7 Days	

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
12:01	-	0.30	1.70	0
12:02	1	0.39	1.61	1
12:04	2	0.56	1.44	3
12:08	4	0.62	1.38	7
12:12	4	0.66	1.34	11
12:22	10	0.72	1.28	21
12:22	0	0.36	1.64	21
12:23	1	0.45	1.55	22
12:25	2	0.53	1.47	24
12:30	5	0.61	1.39	29
12:40	10	0.66	1.34	39
12:50	10	0.68	1.32	49
13:00	10	0.72	1.28	59
13:00	0	0.20	1.80	59
13:02	2	0.29	1.71	61
13:04	2	0.38	1.62	63
13:10	6	0.62	1.38	69
13:20	10	0.68	1.32	79
13:30	10	0.70	1.30	89
13:31	1	0.32	1.68	90
13:33	2	0.4	1.60	92
13:35	2	0.55	1.45	94
13:40	5	0.61	1.39	99
13:50	10	0.68	1.32	109
14:00	10	0.74	1.26	119
14:30	30	0.83	1.17	149
15:00	30	0.89	1.11	179
15:30	30	0.96	1.04	209
16:00	30	1.05	0.95	239

Test	P01	
Gradient	0.0030	m/min
Percolation	0.0754	$L/m^2/min$

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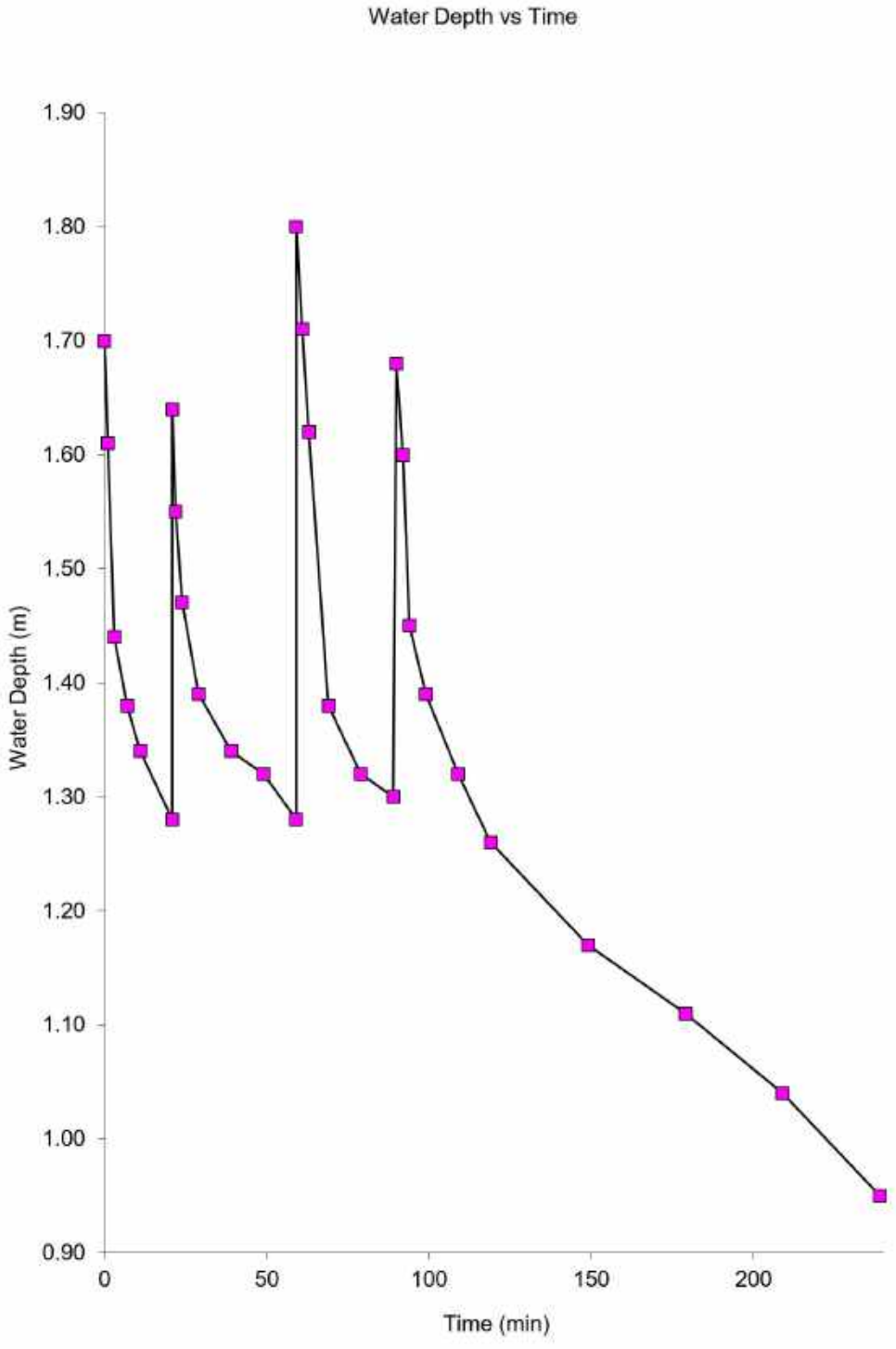
Operator: RZ

Checked: JM

STORMWATER PERCOLATION TEST

Client:	Ardmore Developments Limited	Job No:	J01627
Location:	Sunfields	Date:	20.04.21
	Ardmore	Page	2 of 2
Hole No:	P01	Diameter:	0.1 (m)
Location:	Refer to site plan	Depth:	2.0 (m)



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STORMWATER PERCOLATION TEST

Client:	Ardmore Developments Limited	Job No:	J01627
Location:	Sunfields	Date:	14.04.21
	Ardmore	Page	1 of 2
Hole No:	P02	Diameter:	0.1 (m)
Location:	Refer to site plan	Depth:	2 (m)
Weather conditions preceding test:		Wet	
Details of presoaking:		48 Hours	

Time of Test (hr.min)	Time Interval (min)	Depth Reading (m)	Water Depth (m)	Cum Time (min)
11:21	-	0.30	1.70	0
11:22	1	0.33	1.67	1
11:24	2	0.38	1.62	3
11:27	3	0.44	1.56	6
11:32	5	0.48	1.52	11
11:42	10	0.54	1.46	21
11:57	15	0.62	1.38	36
12:27	30	0.73	1.27	66
12:57	30	0.78	1.22	96
13:27	30	0.84	1.16	126
13:57	30	0.86	1.14	156
14:27	30	0.94	1.06	186
14:57	30	0.99	1.01	216

Test	P02	
Gradient	0.0007	m/min
Percolation	0.01	L/m^2/min

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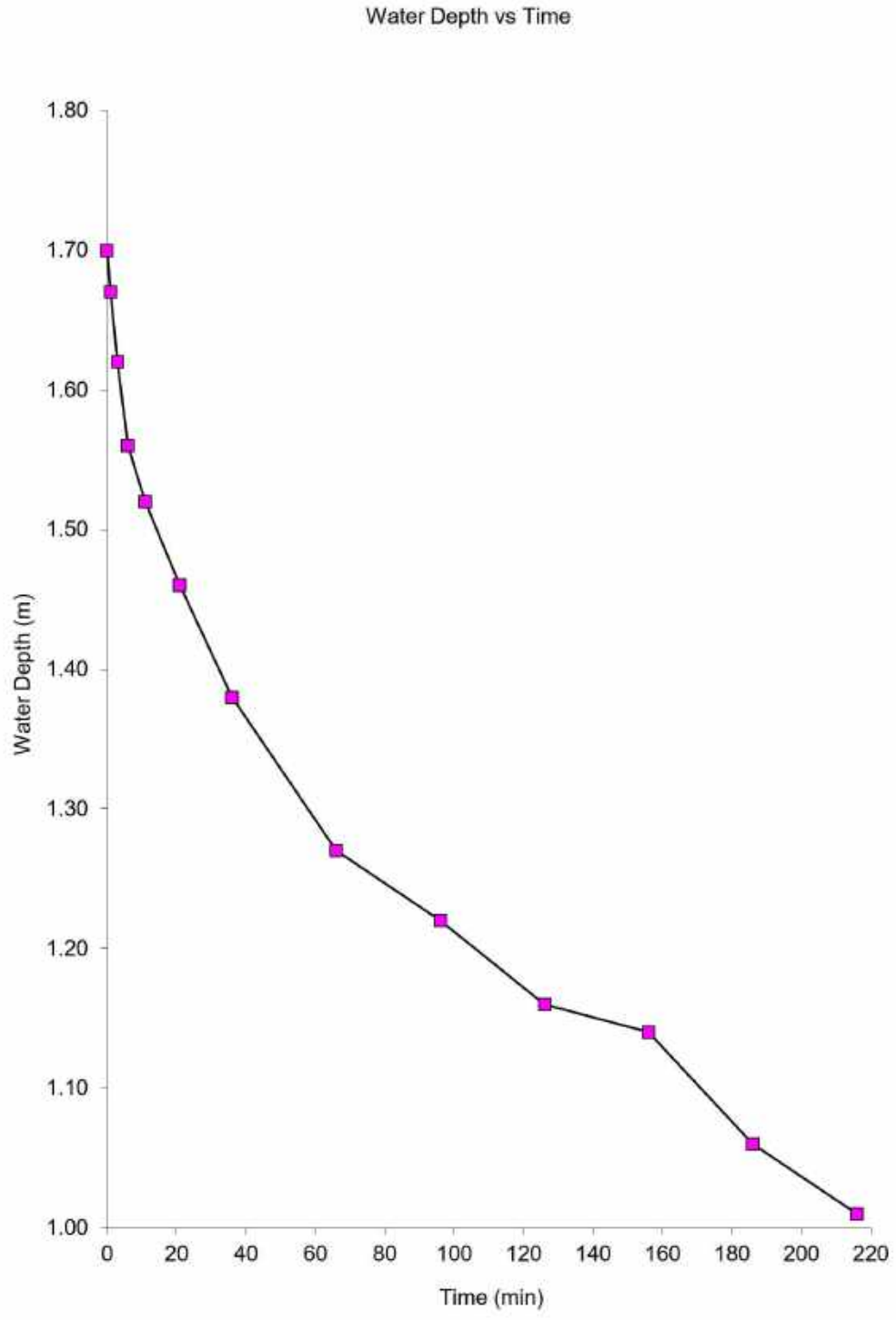
STORMWATER PERCOLATION TEST

Client:	Ardmore Developments Limited	Job No:	J01627
Location:	Sunfields	Date:	14.04.21
	Ardmore	Page	2 of 2

Hole No:	P02	Diameter:	0.1	(m)
Location:	Refer to site plan	Depth:	2.0	(m)



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APPENDIX 3.6

CONE PENETRATION TEST RESULTS