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O'HARA WAIUKU PLAN CHANGE
45A, 92 AND 130 CONSTABLE ROAD,
WAIUKU

GEOTECHNICAL ASSESSMENT REPORT

Gardon Trust

O'HARA WAIUKU PLAN CHANGE
45A, 92 AND 130 CONSTABLE ROAD, WAIUKU

GEOTECHNICAL ASSESSMENT REPORT

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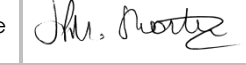
Status	Final	Signature	
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SUMMARY

The visual appraisal and geotechnical assessment reported herein address the geotechnical considerations relating to the proposed plan change for future proposed residential subdivisional development at 45A, 92 and 130 Constable Road, Waiuku.

The borehole logs, presented in Appendix A of this report, indicate that the subject site is underlain by material, inferred to be reworked volcanic ash deposits of Holocene age, Puketoka Formation inorganic and organic alluvial soils of the Tauranga Group of Pliocene to Pleistocene Age and/or Awhitu Group sand dunes and associated facies of Pliocene age.

In general terms and within the limits of the high-level geotechnical assessment as outlined and reported herein, it is our opinion that the site is, suitable for the proposed plan change from Mixed Rural Zone to Mixed Housing Suburban Zone and associated future subdivisional development.

Conclusions arising from the investigation and recommendations affecting the proposed development are presented in Section 9.0 of this report.

GEOTECHNICAL ASSESSMENT REPORT

O'HARA WAIUKU PLAN CHANGE
45A, 92 AND 130 CONSTABLE ROAD

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1.0 INTRODUCTION

This report presents the results of a high-level geotechnical assessment undertaken for a proposed Plan Change at 45A, 92 and 130 Constable Road, Waiuku.

The Proposed Plan Change involves changing the zoning at 45A, 92 and 130 Constable Road, Waiuku, from Rural – Mixed Rural Zone to Residential – Mixed Housing Suburban Zone.

The subsurface conditions at the site have been investigated by means of nine hand augered boreholes and associated dynamic cone (Scala) penetrometer (DCP) tests.

A visual appraisal of the site and a study of geological maps relating to the site have also been undertaken.

The purpose of the geotechnical investigation reported herein was to determine the subsoil conditions beneath the site as they may affect the proposed plan change.

2.0 PREVIOUS REPORTS

2.1 COFFEY SERVICES (NZ) LTD REPORT

A Geotechnical Investigation Report, reference 12838, dated 21 November 2006, was prepared by Coffey Services (NZ) Ltd (Coffey) for the then proposed "Residential Subdivision at 39 Constable Road, Waiuku", the property shown as 45 Constable Road on the attached Fraser Thomas Ltd drawing 64932/1 and located to the immediate south of 45A Constable Road.

As part of the Coffey report, a review of the preliminary findings of an August 2006 geotechnical investigation by Russell J Watt was undertaken. The field investigation completed for the August 2006 report, comprising 10 trial pits, has been supplemented with 12 hand auger boreholes undertaken as part of the field investigation for the November 2006 Coffey report. Three sets of soil expansivity tests were carried out by Coffey as part of their November 2006 report.

The November 2006 report states that:

> *"The natural subsoils investigated by our* [Coffey] *boreholes generally comprised an initial layer of firm to stiff inorganic, orange / brown / grey silty clays and clayey silts, sometimes with fine sandy inclusions. This horizon varied between 1 and 3 metres in thickness across the site and is underlain by a horizon of soft, inorganic, light brown/ light grey/ pink/ cream clayey silts and silty clays. Interestingly, no organic (peat) deposits were identified in any of our* [Coffey] *boreholes."*

and that:

> *"Organic soils and peat were identified in Trial Pits 5 and 6 undertaken by Russel* [sic] *J Watt. The absence of these materials at our* [Coffey] *borehole locations suggests that these deposits are not persistent across the site but rather they are present in discontinuous lenses or pockets."*

And that:

> *"……the groundwater table was measured at approximately 1.5 metres from the current surface, although it was also not encountered at some locations."*

The November 2006 report states that with respect to bearing capacity:

> *"A geotechnical ultimate bearing capacity of 300 kPa should generally be available for shallow strip and pad foundations……*
>
> *However, due to lower shear strength material within 2 metres of the current ground surface and the potential to daylight these in deep cuts, a value of less that 300 kPa may be specified for shallow pad and strip foundation design on some lots.*"

The results of the laboratory testing completed for the November 2006 report are not appended to the report, however the report states that "*an average Linear Shrinkage of 10 %*" was determined for the subsoils tested, which we assess to correspond to a characteristic ground surface movement (y_s) value of 20 mm.

2.2 NATURAL KNOWLEDGE LTD REPORT

A Land Use Capability and Soil Assessment Report, dated September 2020, was prepared by Natural Knowledge Ltd (NKL) to determine the Land Use Capability (LUC) and soil characteristics of the site.

The September 2020 report states that:

> *"The site had formed from ancient pumiceous alluvium covered in ash and loess. Peat occurred in some low parts that were former swamps."*

and that:

> "*….the soil in the southern half of the site was mainly well drained Karaka silt loam. In the northern half the soils were mainly poorly drained Ake Ake loamy peats, Whatapaka clay loams and peaty loams and imperfectly drained Karaka mottled silt loams.*"

and that:

> *"Karaka silt loam and mottled silt loam formed from younger volcanic ash and loess which covers older clayey Hamilton ash material or weathered ancient pumiceous alluvium. Karaka soils typically occur on flatter or stable slopes which have prevented the younger ash cover from erosion."*

and that:

> *"Firm strong brown clay from the older Hamilton ash can be encountered from 60 to 80 cm depth."*

The September 2020 report defines Class 2 and 3 land as "*very good agricultural and horticultural land with slight (Class 2) to moderate (Class 3) physical limitations to arable use*" and also states that Class 2 and 3 land that was "*well or moderately well drained was defined as 'prime' land."*

3.0 GEOLOGY

In carrying out the appraisal of the site, reference has been made to the Institute of Geological and Nuclear Sciences map, scale 1:250,000, geological map 3, 2001, Geology of the Auckland Area and the Provisional Geological Map of New Zealand, scale 1:50,000, Pukekohe, Sheet R12.

The geological maps indicate that the site is in general underlain by Puketoka Formation alluvial soils of the Tauranga Group of Pliocene to Pleistocene Age and Awhitu Group sand dunes and associated facies of Pliocene age.

The results of the visual appraisal and borehole investigation undertaken for the site, as reported herein, generally confirm that the site is underlain by Tauranga Group alluvial inorganic and organic soils and Awhitu Group sediments. However, a surficial veneer of reworked volcanic ash was encountered in the south half of the site. Surficial material, inferred to be Recent alluvial sediments, was also encountered adjacent to overland flowpaths, shown on Auckland Council Geomaps.

4.0 VISUAL APPRAISAL AND GEOMORPHOLOGY

4.1 GENERAL

A visual appraisal of the site was undertaken by a Fraser Thomas Ltd engineering geologist on 26 January 2021.

The main geomorphological features have been mapped and are shown on the appended Fraser Thomas Ltd drawing 64932/1. The geomorphological mapping is primarily based on topographical features noted during the visual appraisal undertaken on 26 January 2021 and a study of the Auckland Council Geomaps GIS aerial imagery including the catchments and hydrology overlay.

A ridge feature extends from 130 Constable Road to 45A Constable Road across the south-eastern part of the site. North-west of this ridge feature, the site is generally moderately undulating comprising a series of benched up to approximately 1.0 m in vertical height slopes. Low-lying areas within the site have arcuate features, benched and hummocky topography, indicative of localised, shallow-seated slope instability and soil creep features. The low-lying areas of the site generally coincide with overland flow paths and flood prone areas as shown on the attached Fraser Thomas Ltd drawing 64932/1, based on Council Geomaps overland flowpath and flood prone area mapping.

The north-western site boundary generally abuts the crest of a north-west to south-east trending ridge that generally slopes down into 38 Harvey Road, Waiuku at an angle of approximately 8^{o} to the horizontal.

4.2 130 CONSTABLE ROAD

A gravel accessway extended north-west from Constable Road, providing vehicular access to the property.

An existing single-story dwelling and minor dwelling/garage were located in the western part of the site. The existing dwellings generally comprised light timber frame, timber cladding and shallow timber pile foundations. The existing dwellings appeared in good condition with no damage observed at the time of the appraisal that may be attributable to foundation movement.

An existing shed was located to the north-west of the existing dwellings, comprising light timber frame construction with corrugated iron cladding.

Numerous, up to approximately 10 m tall trees, were located to the north-west and south-east of the existing dwellings and along the south-western site boundary, proximal to the existing dwellings.

The southern part of the site, adjacent to Constable Road, was generally low-lying, showing evidence of water ponding which may potentially be associated with the formation of Constable Road blocking a previously existing overland flowpath. [refer Photograph 1.1]

A horse arena was located approximately 50 m north-west of the existing dwellings. It is, in our opinion likely, that non-engineered fill material has been placed to form the level platform associated with the arena. [refer Photograph 1.2]

The northern part of the site, generally slopes gently to moderately, at up to 10° to the horizontal, with a north-westerly aspect. The north-western corner of the site features farm drains incised up to 0.5 m depth with standing water noted at the time of the appraisal. Arcuate features, benched topography and terracettes, inferred to be evidence of shallow-seated soil creep and slope instability, were noted on the slopes abutting the drains and overland flowpaths (as shown on Geomaps) manifested within slopes steeper than 8° to the horizontal. [refer Photographs 1.3, 1.4 and 1.5]

Figure 1: Photographs for 130 Constable Road, Waiuku

	**Photograph 1.1:** Looking south-west across southern part of site, showing low lying area.
	**Photograph 1.2:** Looking north across horse arena. Note arena likely to have been formed from historic cut and fill earthworks.

	**Photograph 1.3:** Looking north-west across northern part of site. Note area slopes gently to moderately, at up to 10° to the horizontal, with a north-westerly aspect. Slopes display evidence of shallow-seated slope instability
	**Photograph 1.4:** Looking north-west across northern part of site. Note overland flowpath in center of photograph intersecting overland flow path flowing left to right (as shown on Geomaps).
	**Photograph 1.5:** Looking south-east across northern part of site. Note overland flowpath in center of photograph intersecting overland flow path flowing right to left (as shown on Geomaps).

4.3 92 CONSTABLE ROAD

Two gravel accessways extended north-west from Constable Road providing vehicular access to the decommissioned milk shed and paddocks (south-western accessway) and existing dwelling and associated farm buildings (south-eastern accessway).

An existing single-storey dwelling and a number of farm buildings were located adjacent to the north-eastern site boundary in the south-eastern corner of the site. The existing dwelling and farm buildings comprised light timber frame construction with timber cladding and shallow timber pile foundations. The existing dwelling appeared in good condition with no damage observed at the time of the appraisal that may be attributable to foundation movement.

Three additional farm buildings/sheds were located in the central part of the site, generally comprising light timber frame construction with timber and/or corrugated iron cladding and conventional concrete slab-on-ground foundations. The farm buildings/sheds appeared in poor condition.

The south-western corner of the site, adjacent to Constable Road and 130 Constable Road was generally low-lying, showing evidence of water ponding which may potentially be associated with the formation of Constable Road blocking a previously existing overland flow path.

A large, approximately 10 m high, arcuate bowl feature with a south-easterly aspect, was located adjacent to the south-east site boundary. The side slopes associated with the bowl feature sloped steeply at up to approximately 25° to the horizontal and comprised a series of stepped benches separated by vertical scarp features up to approximately 2.5 m height. [refer Photograph 2.1]

The area at the toe of the arcuate bowl feature was low-lying, showing evidence of water ponding. It was noted that Constable Road, which forms the south eastern site boundary, has been formed on a fill embankment up to 2.0 m in vertical height. The ponding area may potentially be associated with the formation of Constable Road blocking a previously existing overland flow path. [refer Photograph 2.2]

Two additional, smaller bowl-like head scarp features were noted in the south-eastern corner of the site, south of the existing dwellings.

The central part of the site generally comprised gently undulating farm paddocks.
[refer Photographs 2.3 and 2.4]

The north-eastern part of the site was gently undulating and contained several lower lying paddocks. An, approximately 2 m deep, incised constructed drain was located adjacent the north-eastern site corner within 38 Harvey Road, Waiuku. The drain extended to the north-west, along the property boundaries of 38 Harvey Road and 13 Lina Place, Waiuku. [refer Photograph 2.5]

The north western part of the property generally comprised gently to moderately sloping, up to 10° to the horizontal, paddocks with a north-westerly aspect. Arcuate features, benched topography and terracettes, inferred to be evidence of shallow-seated soil creep and slope instability, were noted on slopes steeper than 8° to the horizontal. [refer Photograph 2.6]

An, up to 1.0 m deep, north-west trending overland flowpath was noted within the north-western paddock. The overland flowpath appeared to originate from the central part of the paddock – the owner has advised that this is where novaflo drains from the large flat area discharge to. These drains are understood to be responsible for the scouring present in this area. . [refer Photograph 2.7].

Figure 2: Photographs for 92 Constable Road, Waiuku

	**Photograph 2.1:** Looking north-west across southern part of site. Note large, approximately 10 m high, arcuate bowl feature comprising a series of stepped benches separated by vertical scarp features up to approximately 2.5 m height.
	**Photograph 2.2:** Looking south-west at toe of bowl feature. Note evidence of water ponding, attributed to to Constable Road, which forms the south eastern site boundary, being formed on a fill embankment up to 2.0 m in vertical height.
	**Photograph 2.3:** Looking north across central part of site. Note gently rolling topography
	**Photograph 2.4:** Looking south across central part of site. Note gently rolling topography.

	**Photograph 2.5:** 2 m deep, incised constructed drain at north-eastern corner of the site.
	**Photograph 2.6:** Looking south across western part of the property. This area generally comprised gently to moderately sloping, up to 10° to the horizontal, paddocks with a north-westerly aspect. Arcuate features, benched topography and terracettes, inferred to be evidence of shallow-seated soil creep and slope instability, were noted on the slopes steeper than 8° to the horizontal
	**Photograph 2.7:** Overland flowpath (as shown on Geomaps) up to 1m deep in NW paddock, originating from central part of paddock – landowner has advised novaflo drains from large Flats area discharge here, creating the scouring shown.

4.4 45A CONSTABLE ROAD

At the time of the appraisal reporting herein, bulk earthworks associated with the subdivision of the neighbouring property at 39 Constable Road, were being undertaken within 45A Constable Road. [refer Photograph 3.1]

An up to 2.5 m deep, erosion and sediment control pond had been excavated along the north-western and south-western site boundaries of 45A Constable Road. A horizon of fibrous peat was noted from a depth of 1.6 m below the ground surface in the pond cut batter.

An, approximately 60 m long x 24 m wide x 7 m high unsuitable stockpile, was located in the central area of 45A Constable Road. [refer Photograph 3.3]

An, approximately 20 m long x 5 m wide x 2 m high, stockpile was located adjacent to the erosion and sediment control pond.

The site generally comprised gently undulating farm paddocks that had previously been used to grow maize. [refer Photographs 3.3 and 3.4]

Figure 3: Photographs for 45A Constable Road, Waiuku

	**Photograph 3.1:** Looking south-east across eastern part of site. Note bulk earthworks and erosion and sediment control pond.
	**Photograph 3.2:** Looking north-east at eastern cut batter of pond. Note fibrous peat exposed in cut face.
	**Photograph 3.3:** Looking north-east across central part of site. Note unsuitable stockpile in central part of site.

5.0 FIELD INVESTIGATION

5.1 GENERAL

The field investigation comprised a visual appraisal and nine hand augered boreholes, numbered H1 to H9 inclusive and associated DCP tests.

The approximate locations of the hand augered boreholes are shown on Fraser Thomas Ltd drawing 64932/1.

5.2 HAND AUGERED BOREHOLE INVESTIGATION

Nine hand augered boreholes, numbered H1 to H9 inclusive, were put down at the site in order to investigate the subsurface conditions. The approximate locations of the boreholes are shown on the appended Fraser Thomas Ltd drawing 64932/1.

The boreholes were put down by qualified Fraser Thomas Ltd engineering geologists and geotechnical engineers. The borehole logs are presented in Appendix A of this report.

Boreholes H1, H2, H5 and H7 were terminated at target depths of approximately 5.0 m below the ground surface existing at the time of the investigation (the existing ground surface). Boreholes H3, H4, H6, H8 and H9 were terminated due to hole collapse, at depths ranging between approximately 2.7 m to 3.6 m below the existing ground surface.

In-situ undrained shear strength measurements were carried out in the boreholes at approximately 0.5 m intervals of depth using hand held field shear vane equipment in accordance with the NZ Geotechnical Society 'Test Method for Determining the Vane Shear Strength of a Cohesive Soil using a Hand-Held Shear Vane, August 2001'. These tests were carried out down the boreholes, enabling a strength profile of the cohesive soils to be obtained from the boreholes.

DCP tests were undertaken in accordance with NZS 4402: 1988, Test 6.5.2 in the base of Boreholes H3, H4, H6, H8 and H9 to depths of approximately 4.9 m to 5.0 m below the existing ground surface. The results of the DCP tests are presented on the borehole logs in Appendix A.

All soils in the boreholes were carefully logged following the methods and procedures in the NZ Geotechnical Society 'Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes'.

6.0 SUBSURFACE CONDITIONS

6.1 GENERAL

The borehole logs, attached to this report, indicate that the subject site is underlain by material, inferred to be Puketoka Formation alluvial sediments and Awhitu Group sand dunes and associated facies.

It has been assumed that even though the various subsoil strata, their depths and thicknesses and the locations of groundwater levels have been determined only at the locations and within the depths of the boreholes recorded herein, these various subsurface features can be projected between the various boreholes for appraisal purposes. Even though such inference is made, no guarantee can be given as to the validity of this inference or of the nature and continuity of these various subsurface features.

It has been assumed that even though the various subsoil strata, their depths and thicknesses and the locations of groundwater levels have been determined only at the locations and within the depths of the boreholes recorded herein, these various subsurface features can be projected between the various boreholes. Even though such inference is made, no guarantee can be given as to the validity of this inference or of the nature and continuity of these various subsurface features.

The subsurface material and groundwater levels are summarised in Table 1 of this report.

Table 1. Summary of Subsurface Material and Groundwater Depths

Borehole	Topsoil (m)	Reworked Volcanic Ash (m)	Puketoka Formation Non-Organic Sediments (m)	Puketoka Formation Peat (m)	Awhitu Sands (m)	Groundwater Depth (m)
H1	0.0 – 0.3	0.3 – 1.8	1.8 – 5.0	-	-	GWNE
H2	0.0 – 0.2	-	0.2 – 2.7	-	2.7 – 5.0	2.7
H3	0.0 – 0.5	-	0.5 – 1.0	1.0 – 2.7*	-	1.5
H4	0.0 – 0.3	0.3 – 1.0	1.0 – 3.5	-	3.5 – 4.3*	3.6
H5	0.0 – 0.1	0.1 – 2.1	2.1 – 5.0	-	-	GWNE
H6	0.0 – 0.6	-	0.6 – 1.7	1.7 – 2.2	2.2 – 2.8*	1.8
H7	0.0 – 0.9	-	0.9 – 5.0	-	-	2.6
H8	0.0 – 0.6	-	0.6 – 3.6*	-	-	1.3
H9	0.0 – 0.4	-	0.4 – 0.8 2.4 – 3.4*	0.8 – 2.4	-	0.8

Notes: GWNE – Groundwater not encountered
* Indicates a minimum known depth due to collapse of borehole.

6.2 TOPSOIL

Topsoil material, comprising silts, was encountered to depths of between approximately 0.1 m and 0.6 m depth in Boreholes H1 to H6, H8 and H9. Topsoil material to a depth of approximately 0.9 m was encountered in Borehole H7.

6.3 REWORKED VOLCANIC ASH

Material, generally comprising clayey silts and silty clays, inferred to be reworked volcanic ash or 'Karaka silt loam', was encountered beneath the topsoil in Boreholes H3, H4 and H5, to depths ranging between approximately 1.0 m and 2.1 m.

In-situ undrained shear strength values measured in the reworked volcanic ash ranged between approximately 74 kPa and 154 kPa, corresponding to a stiff to very stiff consistency.

6.4 PUKETOKA FORMATION NON-ORGANIC SEDIMENTS

Material, generally comprising clayey silts and silty clays, inferred to be Puketoka Formation alluvial sediments of the Tauranga Group, was encountered beneath the topsoil or reworked volcanic ash in the boreholes, to depths ranging between approximately 1.0 m and 5 m.

In-situ undrained shear strength values measured in the alluvial sediments ranged between approximately 29 kPa and greater than 200 kPa, corresponding to a firm to hard consistency. In general, the in-situ undrained shear strength values were greater than 50 kPa, corresponding to a stiff consistency.

DCP tests undertaken within the alluvial sediments ranged between approximately 2 and 8 blows per 100 mm penetration.

6.5 PUKETOKA FORMATION ORGANIC SOILS

Material, generally comprising peat, inferred to be Puketoka Formation organic alluvial sediments of the Tauranga Group, was encountered in Boreholes H3, H6 and H9 from depths of approximately 1.0 m, 1.7 m and 0.8 m below the existing ground surface to depths of approximately 2.7 m (minimum), 2.2 m, and 2.4 m respectively.

In-situ undrained shear strength values measured in the peat soils ranged between approximately 32 KPa and 64 kPa, however the undrained shear strength values are likely unreliable in the peat due to the borehole squeezing.

DCP tests undertaken within the peat soils ranged between approximately 1 and 4 blows per 100 mm penetration, however the DCP tests values are likely unreliable due to squeezing.

6.6 AWHITU GROUP SANDS

Material, generally comprising sands, inferred to be Awhitu Group sand dune deposits and associated facies, was encountered in Boreholes H2, H4, and H6 at depths of 2.7 m, 3.5 m and 2.2 m respectively below the existing ground surface, to the extent of the boreholes.

DCP tests undertaken within the Awhitu Group deposits ranged between approximately 2 and greater than 20 blows per 100 mm penetration, corresponding to a loose to very dense consistency. Generally, DCP tests ranged between 4 and 10 blows per 100 mm penetration, corresponding to a medium dense to dense consistency.

6.7 GROUNDWATER

Groundwater strikes were encountered in Boreholes H2 to H4 and H6 to H9 inclusive at depths ranging between approximately 0.8 m and 3.6 m below the existing ground surface.

Groundwater was not encountered in Boreholes H1 and H5 at the time of the investigation reported herein.

7.0 GEOTECHNICAL HAZARDS

7.1 GENERAL

Two main geotechnical hazards have been identified within the site:

1. Slope instability,
2. Settlement/Subsidence.

Three geotechnical risk zones have been developed with regard to these hazards, as shown on the appended Fraser Thomas drawing 64932/1. The drawing provides a high-level classification of the land suitability to inform a Masterplan, with blue (Zone 1) being low risk, yellow (Zone 2) having moderate risk and red (Zone 3) high risk.

The extent of the zones should not be taken as being definitive, but rather, is intended to be a guide to identify areas requiring more detailed geotechnical appraisal. The locations and extents of the hazard zones can be reappraised if further detailed specific geotechnical investigation and appraisal is undertaken.

Residential building development is not precluded from the moderate to high-risk zones but, as discussed in Section 7.5 of this report, any proposed development would require a detailed geotechnical investigation and appraisal in support of the consent application, which may show that slope stabilisation or foundation improvement measures are required.

7.2 ZONE 1 – LOW RISK

This zone generally comprises flat to gently rolling topography that exhibits no signs of significant slope instability and is unlikely to be underlain by compressible organic and/or soft cohesive soils that would be subject to significant settlement under fill or building loads. This zone is considered likely to be suitable for NZS3604 type development, subject to expansive soil requirements and site-specific geotechnical investigation.

7.3 ZONE 2 – MODERATE RISK

This zone generally comprises gently to slightly sloping topography, with evidence of minor slope instability and/or likely underlain by highly compressible organic and/or soft cohesive soils. Development in this zone should be subject to site-specific geotechnical investigations and specific foundation or earthworks design where deemed necessary.

7.4 ZONE 3 – HIGH RISK

This zone comprises steeply sloping (greater than 1V:4H) topography or areas in close proximity to such slopes, and/or evidence of significant slope instability features. Development in this zone should be subject to geotechnical investigations and slope remediation and/or specific foundation design and/or earthworks where deemed necessary.

7.5 RECOMMENDED GEOTECHNICAL ASSESSMENT AND REMEDIATION MEASURES

7.5.1 LOW RISK ZONE

It is anticipated that the land comprising the Low Risk Zone should generally be suitable for residential development with conventional shallow foundations.

It is considered that there are no significant geotechnical constraints within the Low Risk Zone that would restrict residential building development beyond those which would normally be identified during any subdivisional development.

It is recommended that any proposed residential development in the Low Risk Zone be subject to site-specific geotechnical investigation and appraisal at the subdivision consent application stage and a report submitted to confirm the suitability of any particular site for such building development.

7.5.2 MODERATE TO HIGH RISK ZONES

It is considered that there is a moderate to high risk that slopes within these risk zones and in particular the High Risk Zone adjacent to Constable Road, could be affected by slope instability due to natural events, such as extreme transient rainfall events, or due to inappropriate land modification or development. In particular, instability could be caused by inappropriate cut or fill earthworks or inappropriate discharge of stormwater or wastewater.

Furthermore, areas within the Moderate and High Risk Zones are underlain by highly compressible organic and/or soft cohesive soils. It is possible that any proposed development fill or building foundations will impose a significant vertical stress on the underlying highly compressible organic or soft soils resulting in differential settlement which may adversely affect any proposed building or structure underlain by such soils.

Due to the risk of land instability and/or settlement, which may be exacerbated by land or building development, detailed geotechnical investigation, appraisal and reporting is therefore required in support of any application for subdivision or building consent in order to demonstrate that the proposed development will not accelerate, worsen or result in the land being subject to erosion, slippage or inundation by slip debris or be adversely impacted by settlement, to the satisfaction of Council.

It is possible that the geotechnical investigation and appraisal carried out for any proposed development will show that slope stabilisation or foundation improvement works are required in order to mitigate the risk of slope instability or foundation settlement.

Slope stabilisation works could include earthworks (to reduce the slope gradient or to provide a toe buttress or shear key), groundwater drainage works (such as buttress trench drains or horizontal drainage bores), retaining structures, erosion protection and planting.

Foundation improvement could include earthworks to undercut unsuitable material and replace it with engineered fill or, alternatively, piled foundations could be utilised. Further geotechnical investigation may require a machine boreholes and/or a cone penetration tests (CPTs), in order to determine the thickness and nature of any highly compressible organic or soft soil layer and pile design parameters.

8.0 SEISMIC ASSESSMENT AND LATERAL SPREADING RISK

As discussed in Section 5.0 of this report, material generally comprising cohesive silts and clays was encountered within the boreholes. However, sand of the Awhitu Group was encountered at depths ranging between approximately 2.2 m and 5.0 m in Boreholes H2, H4 and H6.

Given the low seismicity risk in the greater Auckland area and that the soils encountered in the boreholes comprise either cohesive silts and clays or dense to very dense sands, it is our opinion

that liquefaction and/or lateral spreading does not pose a significant risk to the proposed development.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Our conclusions and recommendations based on the field data obtained from the site and as presented in this report, our visual appraisal of the site, our study of the geological maps relating to the area and our professional judgement and opinions, are as follows:

(a) Provided that the conclusions and recommendations discussed herein are followed, it is our opinion, on the basis of this high-level geotechnical investigation, that in terms of geotechnical risk the site is generally suitable for residential development.

(b) On the basis of the topography and subsurface conditions, two main geotechnical hazards have been identified within the site:

1. Slope instability,
2. Settlement/Subsidence.

(c) Three geotechnical risk zones have been developed with regard to these hazards, as shown on the appended Fraser Thomas Ltd drawing 64932/1 and discussed in Section 7.0 of this report.

(d) It is anticipated that there will be no significant geotechnical constraints within the Low Risk Zone that would restrict residential building development beyond those which would normally be identified during any subdivisional development. And that the land comprising the Low Risk Zone should generally be suitable for residential development with conventional shallow foundations.

(e) It is considered that within the Moderate and High Risk Zones there is a moderate to high risk of slope instability and/or settlement of highly compressible organic soils or soft sediments. However, land within the Moderate to High Risk zones should be suitable for residential development although slope stabilisation and/or foundation improvement measures may be required.

(f) Within any risk zone, site-specific geotechnical investigation, appraisal and reporting is required in support of any application for subdivision or building consent in order to identify potential geotechnical risks and demonstrate that the proposed development will not accelerate, worsen or result in the land being subject to erosion, slippage or inundation by slip debris or be adversely impacted by settlement, to the satisfaction of Council.

(g) Site-specific geotechnical investigation may include machine boreholes and/or CPTs, in order to determine the thickness and nature of any highly compressible organic or soft soil layer and pile design parameters.

(h) Given the low seismicity risk in the greater Auckland area and that the soils encountered in the boreholes comprise either cohesive silts and clays or dense to very dense sands, it is our opinion that liquefaction and/or lateral spreading does not pose a significant risk to the proposed development.

10.0 LIMITATIONS

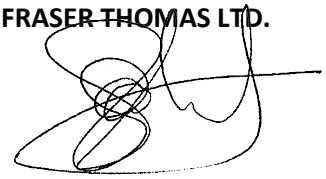
The professional opinion expressed herein has been prepared solely for, and is furnished to Auckland Council and our client, Gardon Trust, for their purposes only with respect to the particular brief given to us, on the express condition that it will not be relied upon by any other person or for any other purposes without our prior written agreement.

No liability is accepted by this firm or by any principal, or director, or any servant or agent of this firm, in respect of its use by any other person, and any other person who relies upon any matter contained in this report does so entirely at its own risk.

Notwithstanding the foregoing, if the circumstances at the subject site change with respect to topography or the proposed development concept, or if a period of more than three years has elapsed since the date of this report, this report should not be used without our prior review and written agreement. Notwithstanding the foregoing conclusions and recommendations, the proposed building development should be designed to satisfy the relevant requirements of the Building Code, so as to ensure compliance with the Building Act.

The conclusions and recommendations expressed herein should be read in conjunction with the remainder of this Geotechnical Assessment Report and should not be referred to out of context with the remainder of this report.

Report prepared by:
FRASER THOMAS LTD.



A G J STUART
Senior Engineering Geologist
Chartered Professional Engineering Geologist

Report reviewed and approved by:

J P M SHORTEN
Principal
Chartered Professional Engineer

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Appendix A
Field Test Results

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BOREHOLE AND TEST PIT LOGS SYMBOLS AND TERMS

SYMBOLS AND ABBREVIATIONS

RL	Reduced Level
EOH	End of Hole
•	Shear vane test result
UTP	Unable to Penetrate
TDTA	Too Difficult to Auger
SPT	Standard Penetration Test
N	SPT blows per 300mm penetration
35/90	35 blows per 90mm penetration after seating for SPT
(s)	Inclusive of seating blow count for SPT
GWL	Ground Water Level

Wf	Field water content
Wp	Plastic limit (%)
WL	Liquid Limit (%)
RQD	Rock Quality Designation
SG	Specific Gravity
%F	Percentage fines (<75 microns)
PSD	Particle size distribution
CONS	Consolidation test
COMP	Compaction test
UCS	Unconfined Compressive Strength
k	Permeability coefficient (m/s)
LS	Linear Shrinkage (%)
OC	Organic Content (%)

SOIL

TOPSOIL
CLAY
SILT
SAND
GRAVEL
COBBLES
BOULDERS
PEAT
FILL

CONSISTENCY TERMS

Cohesive Description	Undrained Shear Strength (kPa)
Very Soft	<12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	>200

RELATIVE DENSITY

Non-cohesive Description	SPT "N" Value
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

ROCK

LIMESTONE
MUDSTONE
SANDSTONE
CONGLOMERATE
BRECCIA
RYHOLITE
ANDESITE
BASALT

STRENGTH

Description	Unconfined Compressive Strength MPa
Extremely Weak	< 1
Very Weak	1 - 5
Weak	5 - 20
Moderately Strong	20 - 50
Strong	50 - 100
Very Strong	100 - 250
Extremely Strong	> 250

WEATHERING

UW - Unweathered (fresh rock)
SW - Slightly Weathered
MW - Moderately Weathered
HW - Highly Weathered
CW - Completely Weathered
RS - Residual Soil

SPACING OF DISCONTINUITIES

Term	Aperture (mm)
Very widely spaced	>2000
Widely spaced	600 - 2000
Moderately widely spaced	200 - 600
Closely spaced	60 - 200
Very closely spaced	20 - 60
Extremely closely spaced	<20

Notes

1. Based on New Zealand Geotechnical Society " Field Description of Soil and Rock,Guideline for the Field Classification and Description of Soil and Rock for Engineering Purposes" December 2005
2. Composite soil types are signified by combined symbols

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HAND AUGER LOG

Hole No: H1

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO1830	26/01/2021	M. Drew	P. Shorten

Depth (m)	Description of Strata	Geological Unit	Graphic Log	Undrained Shear Strength (kPa)	Values	Depth (m)	Dynamic Cone Penetrometer	Groundwater
0.2	[TOPSOIL], SILT, dark brown, moist, friable	T/S		Vane readings corrected as per BS 1377 ● Shear Vane ○ Residual Shear Vane 50 100 150 200		0.2	Test Method: NZS 4402:1988, Test 6.5.2 (Blows / 0mm) 2 4 6 8 10 12 14 16	GWNE
0.4	SILT, clayey, orange/brown, very stiff, dry, friable [VOLCANIC ASH]	Tauranga Group			154 (27)	0.4		
0.6						0.6		
0.8						0.8		
1.0	0.9 m: becomes moist, slightly plastic				153 (60)	1.0		
1.2	CLAY, silty, minor sand (fine to medium), orange streaked brown, stiff, moist, moderately plastic					1.2		
1.4					74 (47)	1.4		
1.6						1.6		
1.8						1.8		
2.0	CLAY, silty, orange mottled grey/brown, very stiff, moist, highly plastic [PUKETOKA FORMATION]				101 (34)	2.0		
2.2	2.1 m: minor sand (fine to medium), becomes grey streaked orange, moderately plastic					2.2		
2.4						2.4		
2.6	CLAY, silty, some sand (fine to medium), light grey streaked red speckled white, very stiff, moist, moderately plastic				134 (60)	2.6		
2.8						2.8		
3.0	CLAY, white streaked red and orange, stiff, moist, highly plastic				94 (27)	3.0		
3.2	3.2 m - 3.3 m: Sand lense (fine to medium), wet					3.2		
3.4						3.4		
3.6					67 (24)	3.6		
3.8						3.8		
4.0	CLAY, silty, some sand (fine to medium), white streaked orange/red, very stiff, moist, moderately plastic				150 (40)	4.0		
4.2						4.2		
4.4	CLAY, white streaked orange/red, very stiff, moist, highly plastic					4.4		
4.6	4.3 m: becomes streaked brown speckled black				81 (32)	4.6		
4.8	4.4 m: becomes silty, stiff					4.8		
5.0	EOH: 5.00 m TARGET DEPTH				148 (74)	5.0		
5.2						5.2		
5.4						5.4		
5.6						5.6		
5.8						5.8		
6.0						6.0		
6.2						6.2		
6.4						6.4		
6.6						6.6		
6.8						6.8		

Remarks:

1. Groundwater not encountered on 26/01/2021

Datum:

Coordinates:

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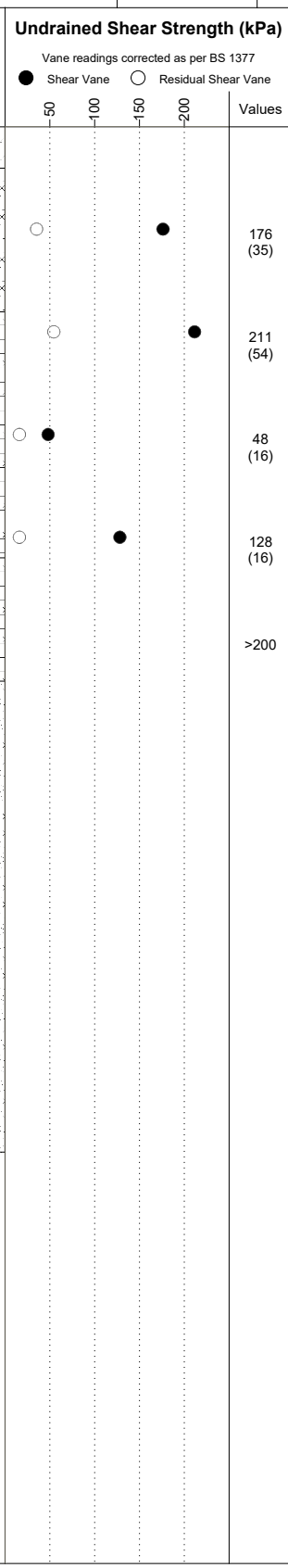
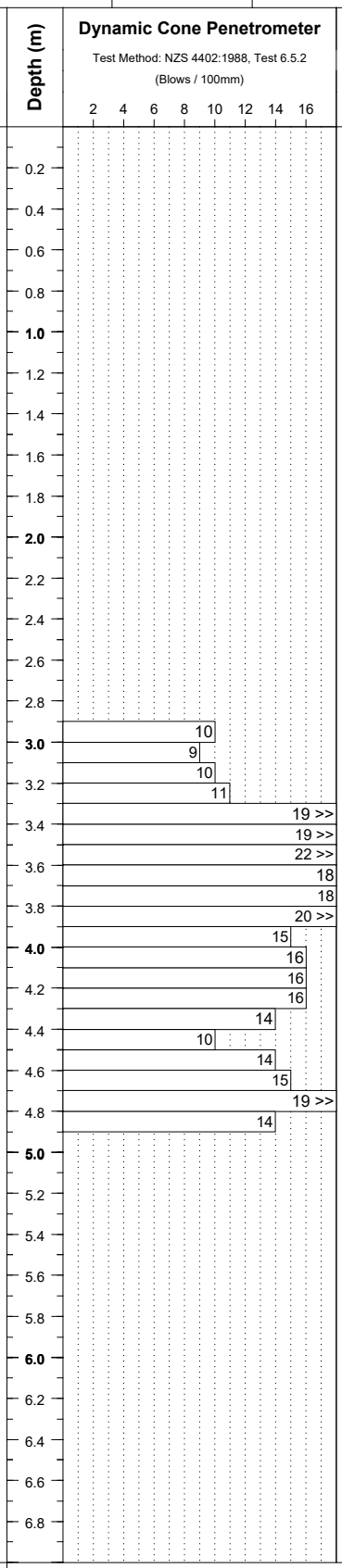
HAND AUGER LOG

Hole No: H2

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO703	26/01/2021	M. Carter	P. Shorten

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL], SILT, dark brown, moist, friable	T/S
0.2	SILT, clayey, grey streaked brown speckled black, very stiff, slightly plastic [PUKETOKA FORMATION]	Tauranga Group
0.4	0.4 m: becomes dark brown	
0.6	0.5 m: becomes grey streaked brown	
0.8		
1.0	CLAY, silty, grey streaked orange, hard, moist, highly plastic	
1.2	1.2 m: becomes brown streaked orange, firm	
1.4	1.3 m: some organic fibrous inclusions	
1.6		
1.8	1.4 m: becomes brown/grey, firm	
2.0	1.8 m: Becomes very stiff	
2.2	CLAY, silty, some sand (fine to medium), grey/green, hard, moist, moderately plastic	
2.4		
2.6		
2.8	SAND (fine to coarse), silty, some clay, light grey streaked yellow, very dense, wet, poorly graded [AWHITU GROUP]	Awhitu Group
3.0		
3.2		
3.4	3.4 m: SAND becoming fine to medium	
3.6		
3.8		
4.0		
4.2		
4.4		
4.6		
4.8		
5.0	EOH: 5.00 m TARGET DEPTH	
5.2		
5.4		
5.6		
5.8		
6.0		
6.2		
6.4		
6.6		
6.8		





Groundwater
▼ 26/01/2021

Remarks:

1. Groundwater encountered at 2.7m BEGL on 26/01/2021
2. DCP test undertaken from 2.9m to 4.9m BEGL

Datum:

Coordinates:

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HAND AUGER LOG

Hole No: H3

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO703	26/01/2021	C. Lee	P. Shorten

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL], SILT, dark brown, dry, friable	T/S
0.5	CLAY, silty, dark brown, stiff, moist, slightly plastic [PUKETOKA FORMATION]	Tauranga Group
1.0	PEAT, black/dark brown, moist, spongy, fibrous	
1.1	SILT, clayey, brown, firm, moist, slightly plastic	
1.5	CLAY, silty, dark brown/black, firm, wet, highly plastic, contains minor organic inclusions	
1.8	PEAT, black, moist, firm, plastic, amorphous, contains minor wood fragments.	
2.0	2.0 m: minor roots and plant material present, strong odour	
2.7	EOH: 2.70 m HOLE COLLAPSE	

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

Depth (m)	Values
0.5	96 (16)
1.0	56 (8)
1.5	35 (8)
2.0	32 (19)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2 (Blows / 100mm)

Depth (m)	Blows / 100mm
3.0	1
3.1	1
3.2	2
3.3	2
4.0	2
4.1	5
4.2	3
4.3	4
4.4	3
4.5	4
4.6	3
4.7	2

Groundwater: ▼ 26/01/2021

Remarks:

1. Groundwater encountered at 1.5m BEGL on 26/01/2021
2. DCP test undertaken from 2.7m to 4.9m BEGL
3. DCP dropped under own weight from 2.7m to 3.15m and 3.5m to 4.2m BEGL

Datum:

Coordinates:

Fraser Thomas
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HAND AUGER LOG

Hole No: H4

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO1830	26/01/2021	M. Drew	P. Shorten

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.2	[TOPSOIL], SILT, clayey, dark brown, dry, friable	T/S	
0.4	CLAY, silty, orange/brown, hard, moist, slightly plastic [VOLCANIC ASH]	Tauranga Group	
0.8	0.8 m: becomes light grey streaked orange		
1.0			
1.2	CLAY, silty, light grey streaked orange, hard, moist, slightly plastic [PUKETOKA FORMATION]		
1.4	SILT, clayey, light grey speckled white, very stiff, moist, slightly plastic		
1.6			
1.8	CLAY, silty, light grey streaked white, very stiff, moist, moderately plastic		
2.0	1.8 m: becomes stiff		
2.2	CLAY, silty, brown, stiff, moist, highly plastic		
2.4	2.4 m: becomes streaked orange		
2.6	CLAY, minor silt, orange streaked grey, firm, moist, highly plastic		
2.8	2.7 m: becomes light grey streaked orange and speckled black		
3.0			
3.2	3.2 m: becomes sandy (fine)		
3.4			
3.6	SAND (fine to coarse), clayey, light brown, medium dense, moist, poorly graded [AWHITU GROUP] 3.6 m: becomes silty, wet	Awhitu Group	
3.8			
4.0	CLAY, sandy (fine to medium), dark brown, very stiff, moist, moderately plastic, contains trace organic material (tree fibres)		
4.2			
4.4	SAND (fine to medium), silty, light brown/light grey, dense to very dense, wet, poorly graded		
4.6	EOH: 4.30 m HOLE COLLAPSE		
4.8			
5.0			
5.2			
5.4			
5.6			
5.8			
6.0			
6.2			
6.4			
6.6			
6.8			

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

50 100 150 200

Values
>200
>200
118 (54)
70 (32)
43 (13)
81 (27)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100mm)

2 4 6 8 10 12 14 16

Depth (m)	Blows / 100mm
3.4	2
3.6	4
3.8	8
4.0	8
4.2	5
4.4	12
4.6	13
4.8	17
5.0	18
5.2	16
5.4	15
5.6	10
5.8	24 >>
6.0	16
6.2	12

Groundwater

▼ 26/01/2021

Remarks:

1. Groundwater encountered at 3.6m BEGL on 26/01/2021
2. DCP test undertaken from 3.4m to 4.9m BEGL

Datum:

Coordinates:

Fraser Thomas
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HAND AUGER LOG

Hole No: H5

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO703	26/01/2021	M. Carter	P. Shorten

Depth (m)	Description of Strata	Geological Unit	Graphic Log	Undrained Shear Strength (kPa)	Values	Depth (m)	Dynamic Cone Penetrometer	Groundwater
0.0	[TOPSOIL], SILT, dark brown, moist, friable	T/S		Vane readings corrected as per BS 1377 ● Shear Vane ○ Residual Shear Vane 50 100 150 200		0.0	Test Method: NZS 4402:1988, Test 6.5.2 (Blows / 0mm) 2 4 6 8 10 12 14 16	
0.2	SILT, some clay, orange, hard, moist, friable [VOLCANIC ASH]				UTP	0.2		
0.7	0.7 m: becomes clayey, slightly plastic				>200	0.7		
1.0	CLAY, silty, orange streaked brown, hard, moist, moderately plastic				150 (70)	1.0		
1.5	1.5 m: becomes very stiff					1.5		
1.7	1.7 m: becomes streaked light grey, highly plastic				128 (88)	1.7		
2.0	SILT, clayey, light grey streaked orange/brown, very stiff, moist, highly plastic [PUKETOKA FORMATION]	Tauranga Group			140 (96)	2.0		GWNE
2.7	2.7 m: becomes light grey speckled orange/white streaked brown, moderately plastic					2.7		
3.0	SILT, clayey, minor sand (fine to medium), light grey streaked orange, very stiff, moist, moderately plastic				131 (86)	3.0		
3.4	CLAY, silty, orange streaked brown, very stiff, moist, highly plastic				112 (51)	3.4		
3.8	SILT, clayey, dark brown streaked orange/grey, very stiff, moist, moderately plastic				112 (83)	3.8		
4.2	SILT, clayey, red/brown streaked grey, hard, moist, moderately plastic				>200	4.2		
4.6	4.6 m: becomes orange/red, very stiff					4.6		
5.0	EOH: 5.00 m TARGET DEPTH				112 (54)	5.0		

Remarks:
1. Groundwater not encountered on 26/01/2021

Datum:

Coordinates:

Fraser Thomas
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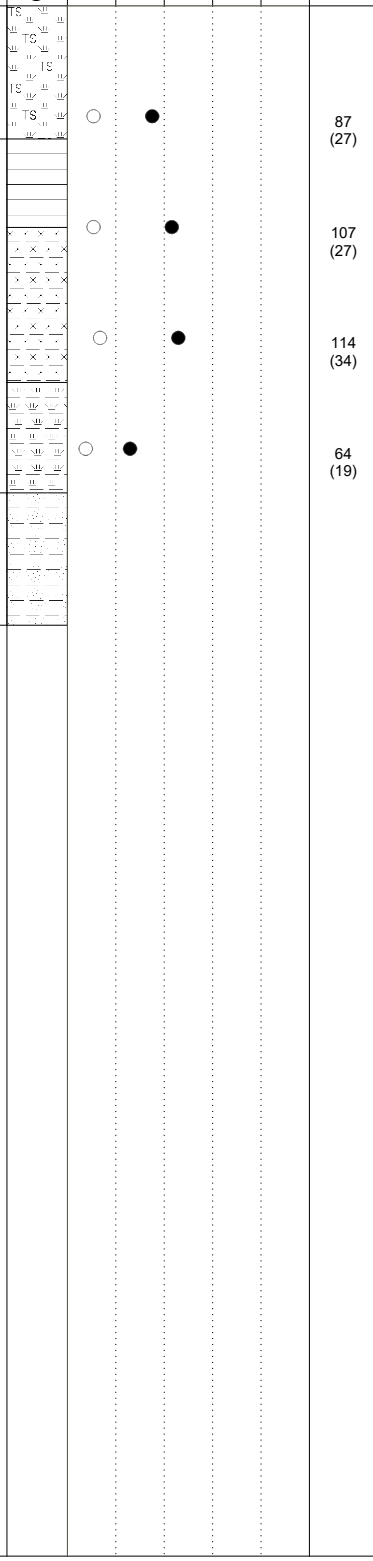
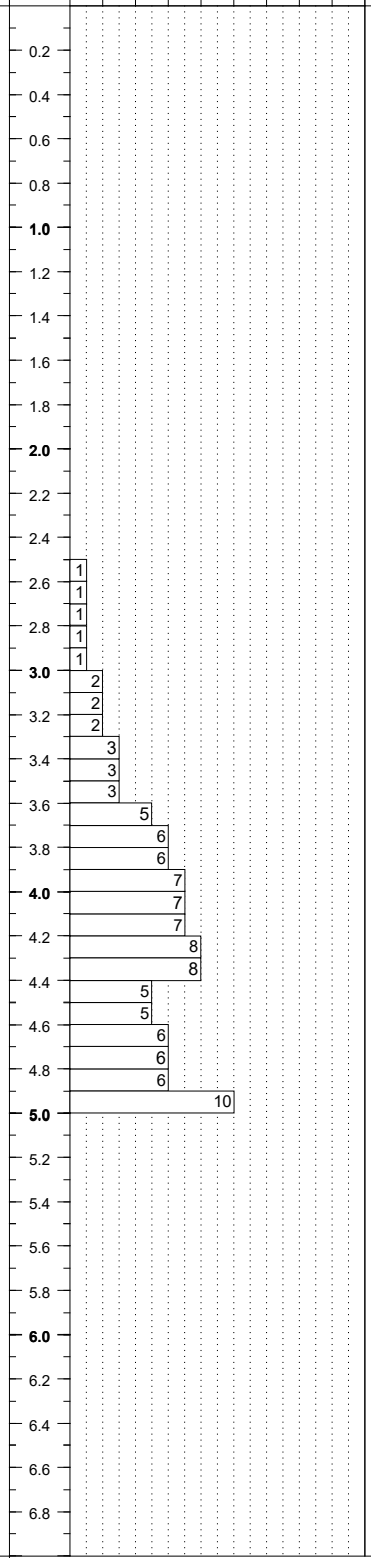
HAND AUGER LOG

Hole No: H6

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO1830	26/01/2021	C. Lee	P. Shorten

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL] SILT, dark brown, stiff, moist, friable	T/S
0.6	CLAY, some silt, light brown streaked orange/dark brown, stiff, moist, moderately plastic [PUKETOKA FORMATION]	Tauranga Group
1.0	SILT, clayey, some sand (fine to medium), brown streaked light brown, very stiff, moist, slightly plastic	
1.4	1.6 m: becomes streaked orange	
1.8	PEAT, black, wet, spongy, fibrous, plastic	
2.0	1.8 m: becomes amorphous, highly plastic	
2.2	SAND (fine to medium), clayey, dark brown/grey, very loose, wet, poorly graded [AWHITU GROUP]	Awhitu Group
2.8	EOH: 2.80 m HOLE COLLAPSE	





Groundwater: ▼ 26/01/2021

Remarks:

1. Groundwater encountered at 1.8m BEGL on 26/01/2021
2. DCP test undertaken from 2.5m to 4.9m BEGL

Datum:

Coordinates:

Fraser Thomas
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HAND AUGER LOG

Hole No: H7

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO703	26/01/2021	M. Carter	P. Shorten

Depth (m)	Description of Strata	Geological Unit
0.0	[TOPSOIL], SILT, dark brown, moist, friable	T/S
0.9	0.9 m: minor fibrous inclusions	
1.0	CLAY, silty, grey/brown streaked orange, firm, moist, highly plastic [PUKETOKA FORMATION]	Tauranga Group
1.2	CLAY, some silt, grey, stiff, moist, highly plastic, contains minor organic rootlets	
1.6	CLAY, silty, some sand (fine to coarse), light grey, stiff, moist, moderately plastic	
1.8	1.8 m: becomes CLAY, silty	
2.2	2.2 m: becomes sandy (fine to coarse), some silt, firm	
3.9	3.9 m: fibrous organic inclusion (40 mm diameter tree root)	
4.0	SAND (fine to coarse), some clay, light grey, loose to dense, wet, poorly graded [AWHITU GROUP]	Awhitu Group
4.4	CLAY, some sand (fine), light grey, firm, wet, highly plastic	
5.0	EOH: 5.00 m TARGET DEPTH	

Undrained Shear Strength (kPa)
Vane readings corrected as per BS 1377
● Shear Vane ○ Residual Shear Vane
50 100 150 200

Depth (m)	Values
0.0	51 (29)
1.0	40 (19)
1.2	61 (16)
1.6	67 (26)
2.0	35 (16)
2.2	45 (32)
2.6	29 (16)
3.0	UTP
3.8	35 (16)

Dynamic Cone Penetrometer
Test Method: NZS 4402:1988, Test 6.5.2
(Blows / 100mm)
2 4 6 8 10 12 14 16

Depth (m)	Blows / 100mm
4.0	2
4.1	5
4.2	9
4.4	1
4.8	2
4.9	2

Groundwater
26/01/2021

Remarks:
1. Groundwater encountered at 2.6m BEGL on 26/01/2021
2. DCP test undertaken from 4.0m to 4.9m BEGL

Datum:

Coordinates:

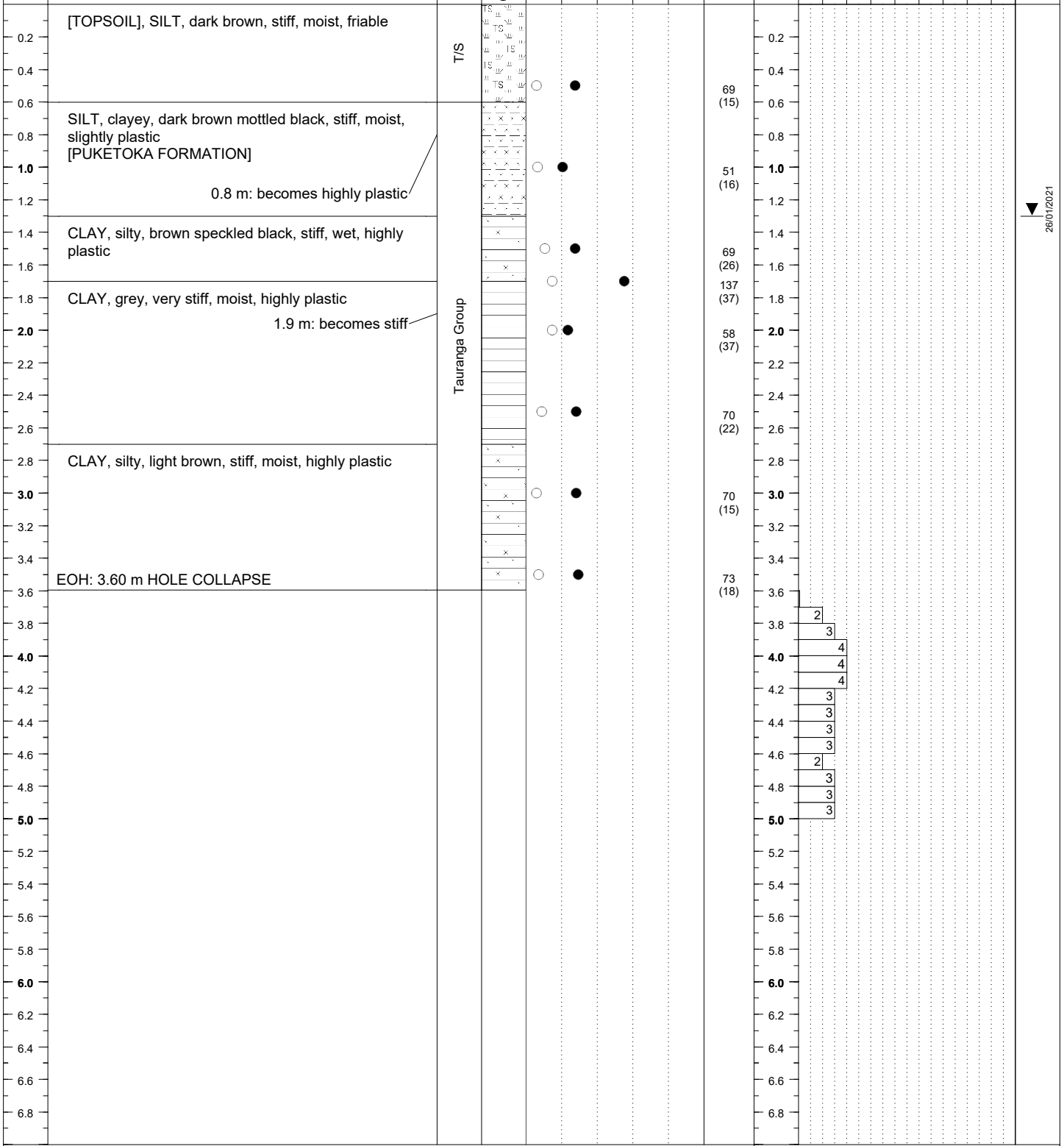
Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

HAND AUGER LOG

Hole No: H8

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO517	26/01/2021	J. Leath	P. Shorten

Depth (m)	Description of Strata	Geological Unit
0.0 – 0.6	[TOPSOIL], SILT, dark brown, stiff, moist, friable	T/S
0.6 – 1.4	SILT, clayey, dark brown mottled black, stiff, moist, slightly plastic [PUKETOKA FORMATION] 0.8 m: becomes highly plastic	Tauranga Group
1.4 – 1.8	CLAY, silty, brown speckled black, stiff, wet, highly plastic	Tauranga Group
1.8 – 2.6	CLAY, grey, very stiff, moist, highly plastic 1.9 m: becomes stiff	Tauranga Group
2.6 – 3.6	CLAY, silty, light brown, stiff, moist, highly plastic	Tauranga Group
3.6	EOH: 3.60 m HOLE COLLAPSE	



Remarks:

1. Groundwater encountered at 1.3m BEGL on 26/01/2021
2. DCP test undertaken from 3.6m to 5.0m BEGL

Datum:

Coordinates:

Fraser Thomas
ENGINEERS • RESOURCE MANAGERS • SURVEYORS

HAND AUGER LOG

Hole No: H9

Project No:	Project:	Shear Vane:	Date Drilled:	Logged By:	Checked By:
64932	Gardon Trust 45a, 92 and 130 Constable Road, Waiuku	GEO517	26/01/2021	J. Leath	P. Shorten

Depth (m)	Description of Strata	Geological Unit	Graphic Log
0.0	[TOPSOIL], SILT, dark brown, moist, friable	T/S	
0.4	CLAY, silty, dark brown, very stiff, moist, slightly plastic [PUKETOKA FORMATION]	Tauranga Group	
0.8	PEAT, black, wet, fibrous, firm, plastic, contains some plant fragments		
2.4	CLAY, brown mottled black, firm, moist, highly plastic		
3.4	EOH: 3.40 m HOLE COLLAPSE		

Undrained Shear Strength (kPa)

Vane readings corrected as per BS 1377

● Shear Vane ○ Residual Shear Vane

Depth (m)	Values
0.4	117 (29)
1.6	51 (15)
2.0	37 (15)
2.6	53 (23)

Dynamic Cone Penetrometer

Test Method: NZS 4402:1988, Test 6.5.2

(Blows / 100mm)

Depth (m)	Blows / 100mm
4.0	2
4.2	4
4.2	4
4.4	5
4.4	5
4.6	8
4.6	8
4.8	6
4.8	5
5.0	5

Groundwater

▼ 26/01/2021

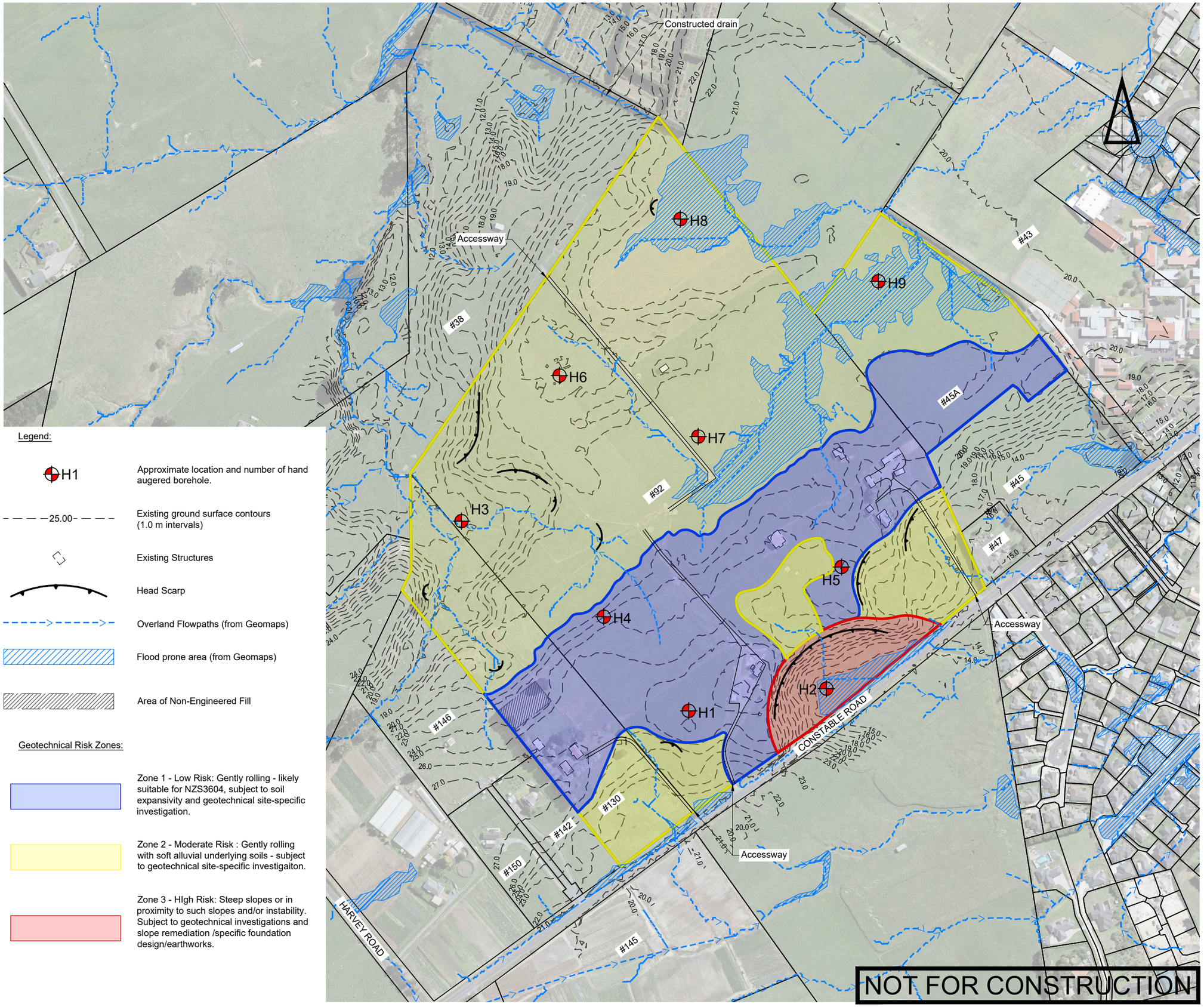
Remarks:

1. Groundwater encountered at 0.8m BEGL on 26/01/2021
2. DCP test undertaken from 3.4m to 4.9m BEGL
3. DCP dropped under own weight from 3.4m to 4.0m BEGL

Datum:

Coordinates:

Drawing
64931-1 Plan Showing Geomorphological Features and Geotechnical Risk Zones



Legend:

- H1 — Approximate location and number of hand augered borehole.
- 25.00 — Existing ground surface contours (1.0 m intervals)
- Existing Structures
- Head Scarp
- Overland Flowpaths (from Geomaps)
- Flood prone area (from Geomaps)
- Area of Non-Engineered Fill

Geotechnical Risk Zones:

- Zone 1 - Low Risk: Gently rolling - likely suitable for NZS3604, subject to soil expansivity and geotechnical site-specific investigation.
- Zone 2 - Moderate Risk : Gently rolling with soft alluvial underlying soils - subject to geotechnical site-specific investigaiton.
- Zone 3 - HIgh Risk: Steep slopes or in proximity to such slopes and/or instability. Subject to geotechnical investigations and slope remediation /specific foundation design/earthworks.

NOT FOR CONSTRUCTION

SURVEYED			APPROVED DATE
DESIGNED	JL	FEB 2021	JPMS
DRAWN	CJR	FEB 2021	FEBRUARY 2021
CHECKED			

REVISION	CHANGES	CHECKED	DATE
A	MINOR CHANGES	SF	06/07/21

NOTES

1. The land contours shown on this plan are based on 2017 LiDAR data.
2. Refer to Fraser Thomas Ltd. Report No. 64932, dated March 2021 for full description of Risk Zones.

CLIENT

GARDON TRUST

PROJECT

45A, 92, 130 CONSTABLE ROAD
WAIUKU
AUCKLAND

TITLE

PLAN SHOWING GEOMORPHOLOGICAL FEATURES AND GEOTECHNICAL RISK ZONES

Fraser Thomas
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STATUS

Construction works shall commence only on receipt of and in accordance with the Council or Council organisation stamped approved drawings, unless otherwise indicated.

SCALE 1:4000 (A3)

DRAWING No 64932/1 REVISION A