



Soil&Rock Consultants

For well-grounded solutions

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Geotechnical Engineering Ltd
T/A Soil & Rock Consultants

Our Ref. 16425

12 August 2016

Bluebarn Consulting Ltd

PO Box 21-525

Henderson

Auckland 0650

Attention: Michael Gordon

Dear Sir,

PRELIMINARY GEOTECHNICAL APPRAISAL 3094 – 3096 GREAT NORTH ROAD, NEW LYNN

1.0 Introduction

As requested, we have undertaken a geotechnical desktop study and geotechnical assessment at the above site to assist with the due diligence process and assessment of development options. At this stage no detailed plans of the property redevelopment were available.

The scope of this assessment, as detailed in our fee estimate dated 26 July 2016, is as follows:

1. Detailed walkover inspection
2. Review of geological maps
3. Drilling of three hand augerholes (5.0m max depth)
4. Review of previous boreholes and augerholes carried out within the site by Soil & Rock Consultants.
5. Review of existing geotechnical reports for nearby sites
6. Review of historical aerial photographs
7. Prepare a Preliminary Geotechnical Assessment report suitable for use for due diligence and assessment of development options.

2.0 Walkover Inspection - Site Description

The Site is located to the south of Great North Road and west of the Clark Street extension and is presently occupied by two commercial (warehouse office and retail) buildings. The property has access directly off Clark Street (extension). The public transport railway line runs adjacent to the southern site boundary and Rewarewa stream flows from south to north along the full extent of the western site boundary. The stream is marked by steep banks thickly vegetated with native plants.

The ground surface ascends from Great North Road gently to the south and has been modified by previous earthworks to form essentially level platforms for the earlier developments. The buildings are surrounded by extensive areas of car parking.

3.0 Geological Maps

According to the Auckland Geological Map, GNS Map, Scale 1:250,000 dated 2013 the site is underlain by Puketoka Formation of the Tauranga Group of Pliocene to Pleistocene age.

The Puketoka Formation soils comprised clays, silts and sands with highly variable lesser fractions of each, frequently saturated at depth. Black, organic clay and peat may also be present. At some locations, surficial volcanic ash deposits, typically less than 1m in thickness, may overlie the deposits.

Puketoka Formation deposits are typically variable in strength ranging from soft to very stiff and are over consolidated or normally consolidated. Saturated sands and fibrous Peat deposits are prone to consolidation settlement under surcharge loads.

During the field investigation soils of the Waitemata group were encountered directly underlying the Puketoka Formation soils.

The soils of the Waitemata Group are Miocene in age and generally regarded as the 'basement' soils around the Auckland area and generally are found from ground surface or underlying volcanic or alluvial deposits.

The Waitemata Group soils are favourable with respect to foundation design and earth working considerations however consideration must be given to the shrink/swell potential of the material, which varies from site-to-site. Shrink/swell effects are seasonal and can result in significant damage to structures however are a normal engineering consideration within these soils.

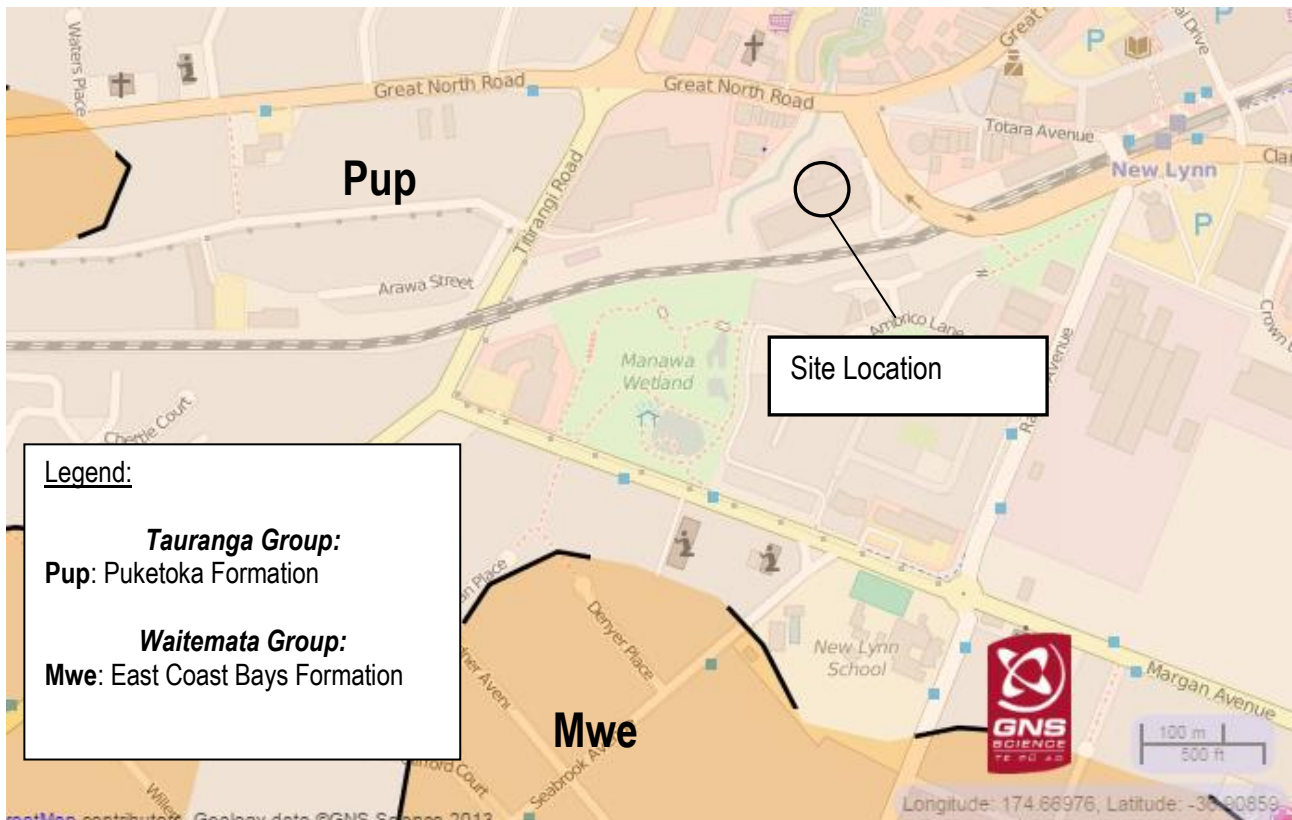


Figure 1 - Adapted from GNS Science – New Zealand Geology Web Map

4.0 Current Investigation

The on-site component of our current scope comprised the drilling of three hand augerholes (AH101 – AH103).

The locations of all field tests were measured in by tape from existing site features and inferred boundaries without survey control and are therefore approximate only. Test locations are shown on the attached Site Plan, Drawing No. 16425/1.

Measurements of the undrained shear strengths were undertaken in the augerholes at intervals of depth by means of a hand held shear vane. The test method was in accordance with the New Zealand Geotechnical Society Guidelines for Hand Held Shear Vane Tests, dated August 2001. The peak vane shear strengths and the remoulded vane shear strength values shown on the attached augerhole logs represent dial readings off the vane, adjusted using the BS 1377 calibration. Correction factors based on calibration tests are shown on the attached logs.

A visual-tactile field classification of the subsoils encountered during drilling was carried out in accordance with "Guidelines for the Field Classification and Description of Soil and Rock for Engineering Purposes", issued by the New Zealand Geotechnical Society Inc. (2005).

The results of the three hand augerholes (2016) are summarised in the Section 8 below, along with result from previous investigation work.

5.0 Previous Geotechnical Reports by Soil & Rock Consultants

Soil & Rock Consultants have carried out a number of geotechnical investigations in the area. The two closest and most relevant are as follows:

- (i) Soil and Rock Consultants, 'Geotechnical Investigation for Rewarewa Walkway Between Great North Road and Hugh Brown Reserve, New Lynn, Job No. 06075, dated 26 May 2006.
- (ii) Soil & Rock Consultants, 'Bank Stability and Risk Assessment at Rewarewa Creek South of Great North Road, Rewarewa Creek, New Lynn, Job No 09233, dated June 2010.

The above reports were carried out for Auckland Council with regard to the bank stability of the Rewarewa Creek. The more relevant of the two reports is that dated June 2010, as a significant number of our augerholes and boreholes were located within the subject site (as shown on the attached Site Plan, Drawing No. 16425/1).

The materials encountered during these investigations are summarised in Section 8 below.

The conclusion of these reports were that many parts of the steep stream banks along the Rewarewa Creek are at risk of instability and soil creep. Within the subject site the areas considered to be at risk of instability didn't extend to the footprints of the existing buildings.

6.0 Previous Reports by Other Consultants

The Auckland Council property files were obtained for two neighbouring properties where recent construction has been carried out. These properties are as follows:

1. 2-6 Titirangi Road, New Lynn. Bunnings Warehouse constructed 2014-2015.
2. 42-50 Totara Road, New Lynn. Retail and Carpark Building constructed 2012.

The following documents were encountered which are considered of geotechnical relevance:

- (i) Tonkin & Taylor Ltd, "Proposed Bunnings Development Corner, Great North Road & Titirangi Road, New Lynn, Preliminary Geotechnical Assessment" Ref No: 27571.001 Rev1, dated October 2010.
- (ii) Tonkin & Taylor Ltd, "Bunnings Warehouse Development, New Lynn, Detailed Design Support, Geotechnical Analysis" Ref No. 27571.3000/A, dated March 2014.
- (iii) Tonkin & Taylor Ltd, "Bunnings Warehouse, Great South Road (sic) and Titirangi Road, New Lynn, Producer Statement – Construction Review (PS4) Pile Driving. BC No. ABA/2014/354" Ref No. 27571.400, dated June 2015.
- (iv) Tonkin & Taylor Ltd, "New Warehouse, Great South Road (sic) and Titirangi Road, New Lynn, Construction Observations & Producer Statement – Construction Review (PS4) Pile Driving. BC No. ABA/2014/354" Ref No. 27571.300, dated May 2015.
- (v) Tonkin & Taylor Ltd, "New Lynn Merchant Quarter, New Lynn, Auckland, Geotechnical Investigation Report" Ref No: 27606, dated December 2010.
- (vi) Tonkin & Taylor Ltd, "New Lynn Merchant Quarter, Building A, Construction Observations & Producer Statement, BC No: ABA/2011/1411" Ref No: 27606.004, dated October 2012.

A brief summary of these documents is provided overleaf.

6.1 Bunnings Warehouse

Investigation:

- The investigation carried out by Tonkin & Taylor (T&T) comprised eight Cone Penetration Tests (CPTs), two machine boreholes and 20 percussion boreholes.
- Non-engineered fill up to 3.3m deep was encountered and included construction debris in places.
- Puketoka Formation alluvial deposits were encountered to depths between 3.0m and 7.0m.
- Weathered Waitemata Group soils were encountered below the Puketoka Formation soils and generally comprised a 1.0m to 2.0m thick layer.
- Waitemata Group rock was encountered underlying the Puketoka Formation and weathered Waitemata Group soils. This was described as weak to extremely weak sandstone and siltstone. The depth to rock was shown to be shallower in the north (closer to Great North Road), and deeper in the south (closer to the stream).
- Groundwater levels were recorded between 1.2m and 5.0m below ground level.

Geotechnical Findings and Recommendations:

- Preliminary foundation recommendations indicated that either shallow foundations (strip or pad footings) or piles would be appropriate for the support of the warehouse.
- The risk of instability was identified on the stream bank at the southern side of the Bunnings site.
- Subsoil drainage was recommended to prevent hydrostatic uplift on the pavement areas.
- The subsoil category for seismic design actions was designated as Class C – Shallow soil site.

Construction

The PS4s (Producer Statement – Construction Review) prepared by T&T show the following:

- The foundations comprised mainly of driven steel UC piles (embedded in the order of 8.5m to 12.0m deep) with a smaller number of bored concrete piles.
- Some soft subgrade areas were encountered during construction. These were undercut and replaced with compacted granular fill underlain by a geotextile fabric.

6.2 New Lynn Merchant Quarter Buildings A & B (47 Totara Avenue)

- The investigation carried out by T&T comprised eight Cone Penetration Tests (CPTs), and five machine boreholes.
- Fill up to 1.1m deep was encountered.
- Puketoka Formation alluvial deposits between 13.2m and 17.8m thick were encountered below the fill.

- Weathered Waitemata Group soils were encountered below the Puketoka Formation soils and generally comprised a 0.4m to 4.4m thick layer.
- Waitemata Group rock was encountered underlying the Puketoka Formation and weathered Waitemata Group soils. This was described as weak to extremely weak sandstone and siltstone. The depth to rock was shown to range between 15.0m and 19.5m below ground level.
- Groundwater was encountered in three of the five boreholes, at depths between 1.3m and 1.7m below ground level.

Geotechnical Findings and Recommendations:

- Preliminary foundation recommendations indicated that a raft type foundation would be suitable for Building A, while piles embedded into the bedrock were required for Building B.
- The subsoil category for seismic design actions was designated as Class C – Shallow soil site.

Construction

The PS4 (Producer Statement – Construction Review) prepared by T&T for Building A shows the following:

- The foundations comprised bored concrete piles embedded between 6m and 10m into Waitemata Group rock.

7.0 Historical Aerial Photographs

Historical aerial photographs were obtained from both Google Earth and Auckland Council's GIS system. The photographs examined are listed in the table below.

Table 1: Aerial Photographs

Date	Source
1940	Auckland Council GIS
1959	Auckland Council GIS
1996	Auckland Council GIS
2010	Auckland Council GIS
8 March 2016	Google Earth



Photograph 1: Aerial photo taken in 1940 indicating no major development and the subject site being used as rural land.



Photograph 2: Aerial photo taken in 1959 indicating the first building erected on the subject site and earthworks possibly in progress for further building platforms. Surrounding developments are also in progress.



Photograph 3: Aerial photo taken in 1996 indicating the main commercial building that still occupies the site today has been fully erected.



Photograph 4: Aerial photo taken in 2010 indicating the site has been fully developed to include extensive pavement areas for car parking and access and access.

Note: Positioning of aerial photographs in relation to other features (such as property boundaries) are not exact on Auckland Council's GIS website, and vary between photographs.



Photograph 5: Aerial photo taken in March 2016 indicating the recent road developments with the Clark Street widening and extension adjacent to the eastern boundary of the subject site.

Comparison of aerial photographs from 1959 through to 2016 reveals the following points considered relevant from a geotechnical perspective:

- No significant change in the alignment or shape of stream beds and gullies.
- Major earthworks at various locations to form building platforms and roads
- The land-use over the time span of the aerial photos has remained predominantly commercial.

8.0 Subsurface Conditions – Subject Site

Table 2 below summarises the subsurface conditions encountered in hand augerholes carried out within the site as part of the current scope. Table 3 summarises subsurface conditions encountered in hand augerholes and machine boreholes carried out within the site as part of previous investigations.

Conclusions and recommendations contained in this report are based on the results of our field investigation and in-situ testing within augerholes at point locations and information from geological maps. The nature and continuity of the subsurface conditions away from the test locations are inferred however actual subsurface conditions could vary from the assumed model. This is particularly so where previous manmade disturbances and placement of non-engineered fill may have occurred in the past, typically associated with landscaping and/or previous construction activities.

Table 2 – Summary of Current Field Investigation

Test Location	Depth Drilled	Depth of Topsoil and/or Fill	Depth to Base of Alluvial Deposits	Depth to Groundwater
All depths measured in metres below present ground level. NE = Not Encountered				
AH 101	4.5	1.1	2.2	NE
AH 102	5.0	0.5	4.3	NE
AH 103	5.0	0.2	2.7	3.0

Table 3 – Summary of 2010 Field Investigation (Job No. 09233)

Test Location	Depth Drilled	Depth of Topsoil and/or Fill	Depth to Base of Alluvial Deposits	Depth to Base of Weathered Waitemata Group Soils	Depth to Waitemata Group Rock	Depth to Groundwater
All depths measured in metres below present ground level. NE = Not Encountered						
AH1	3.1	1.5	>3.1	NE	>3.1	NE
AH2	2.1	0.7	>2.1	NE	>3.1	NE
AH3	3.2	0.2	>3.2	NE	>3.2	NE
AH4	5.0	0.4	>5.0	NE	>5.0	NE
AH5	3.2	0.5	NE	>3.2	>3.2	NE
AH6	2.7	0.5*	NE	>2.7	>2.7	NE
AH7	2.1	0.4	NE	>2.1	>2.1	NE
AH8	3.4	0.1	NE	>3.4	>3.4	2.0
AH9	3.0	0.5*	NE	>3.0	>3.0	NE
AH10	3.3	0.1	NE	>3.3	>3.3	3.1
MB1	10	5.3	NE	7.0	7.0	0.2
MB2	10	4.7	NE	7.4	7.4	5.3

*Colluvium, not fill encountered in upper 0.5m of AH6 and AH9

- Topsoil.** Topsoil was encountered from the ground surface at the locations of hand augerholes AH101, AH103, AH3, AH4, AH7, AH8, AH10, MB1, MB2 and MB3 to depths between 0.1m and 0.4m below present ground level (bpgl). Topsoil is unsuitable for the support of permanent structures (ie building foundations, floor slabs, retaining walls etc)

- **Non-Engineered Fill.** Non-Engineered Fill was encountered from the ground surface at the locations of hand augerholes AH101, AH102, AH1, AH2, AH3 and AH5 to depths between 0.5m and 1.5m below present ground level (bpgl).

In MB1 and MB2 non-engineered fill was encountered to depths of 5.3m and 4.7m respectively.

The non-engineered fill generally consisted of variable amounts of gravels, sands and clays intermixed with topsoil inclusions. Non-Engineered fill is unsuitable for the support of permanent structures (ie building foundations, floor slabs, retaining walls etc).

- **Alluvial Deposits.** Alluvial Deposits were encountered within hand augerholes AH101 to AH103 (2016) and AH1 to AH4 (2009), underlying the topsoil and/or fill. In AH101 to AH103 the alluvial deposits were encountered to the top of the Weathered Waitemata Group soils between 2.2m and 4.4m bpgl. In AH1 to AH4 the alluvial deposits were encountered to the base of the augerholes.

The alluvial soils comprised stiff to hard silts and clays. Vane shear strengths recorded within the cohesive soils ranged from approximately 60kPa to greater than 200kPa and at some test depths the vane was unable to penetrate the soil, indicated as UTP on the attached augerhole logs.

- **Weathered Waitemata Group Soil.** Weathered Waitemata Group soils were encountered within hand augerholes AH101 to AH103 underlying the alluvial deposits, to the termination depths of the augerholes between 4.5m and 5.0m bpgl. Weathered Waitemata Group soils were also encountered within AH5 to AH10 underlying the topsoil and/or fill, to the termination depths of the augerholes.

In MB1 and MB2 weathered Waitemata Group soils were encountered underlying the fill and/or topsoil, to the contact with Waitemata Group Rock at depths of 7.0m and 7.4m.

The weathered Waitemata Group soils typically comprised very stiff to hard silts and clays, with occasional layers of loose to medium dense sands. Vane shear strengths recorded within the cohesive soils ranged from 97kPa to greater than 190kPa. The majority of the soils encountered were non-cohesive and Scala blows per/100mm ranged from 3 to 25 indicating loose to very dense soils.

- **Waitemata Group Rock.** Sandstone and siltstone of the Waitemata Group were encountered in MB1 and MB2 at depths of 7.0m and 7.4m below ground level.

9.0 Geotechnical Discussion & Conclusions

9.1 Presence of Fill

Deep fill deposits (4.7m to 5.3m) were encountered in the machine boreholes at the north-western side of the existing building (between the building and the stream). Such material is not suitable for the support of multi-storey buildings due to variability in both composition and engineering properties.

To accurately establish the extent of the fill, additional boreholes would be required, and could form part of a design-specific geotechnical investigation.

9.2 Land Stability

Our 2010 report identifies the potential for land instability and soil creep on and near the stream banks. We have attached a plan (Drawing No. 09233/4) which shows the area considered to be at risk of instability under high groundwater conditions.

It is recommended that during the concept design stage of any future development, additional stability analysis is undertaken in accordance with the latest Council guidelines, so assessment can be made of how the proposed development would affect, and be affected by land stability considerations.

9.3 Foundations

Shallow Foundations

It is possible that shallow foundations could be used to support future buildings. There would be significant constraints to the use of shallow foundations, which would include proximity to the stream banks (land stability) and whether the building is situated on fill. The primary factor on influencing whether shallow foundations could be used, would be the design loads of the proposed building.

The concentrated loading under columns of multi-level buildings usually exceeds both the bearing capacity and settlement performance of shallow footings. Multi-level buildings on this site will most likely be founded on bored, in-situ cast concrete piles embedded in the Waitemata Group rock.

Pile Foundations

It is probable that at least one of the above factors (slope stability, presence of fill, building loads) would cause pile foundations to be necessary. Given that the buildings recently constructed on nearby sites, as discussed in Section 6, are supported by pile foundations, it is likely that piles will be required on the subject site also.

Piles would likely require embedment into Waitemata Group rock, which was encountered at depths of 7.0m and 7.4m during our 2010 investigation work. The embedment would be dictated by structural design requirements.

Based on comparison of the geotechnical data from the subject site and surrounding sites, it appears that the depth to rock increases towards the east and decreases towards the west. A detailed geotechnical investigation during the design phase would allow the depth and strength characteristics of the rock across the site area to be determined.

9.4 Excavation Considerations

At the time of preparation of this report, no concept designs were available, therefore it is not known whether basement levels may be incorporated into future developments, or the extent of site earthworks.

If basement levels are proposed, it is likely that bulk excavation will encounter the groundwater table. This will have implications on both consenting (groundwater diversion) and construction (weakening of subgrade and additional temporary stability considerations).

Any excavations will require careful consideration of both temporary and permanent stability, however this is exaggerated when groundwater is present or when cuts are located in close proximity to site boundaries, existing structures or steep ground.

9.5 Further Geotechnical Work – Intrusive Investigation

A development specific investigation should be carried out once the preliminary design concept has been decided. This should include:

- 5-6 Machine Boreholes
- 2-4 Cone Penetration Tests (CPTs)
- Laboratory testing (Unconfined Compressive Strength (UCS), Plasticity Index)

- Permeability testing
- Groundwater monitoring
- Hand augerholes and Scala penetrometer testing

The site specific investigation should address the following geotechnical issues:

- Foundation capacity (shallow and deep)
- Foundation settlement characteristics
- Temporary excavation stability
- Groundwater conditions (groundwater drawdown if applicable)
- Pavement design parameters
- Excavatability of soils and rock

9.6 Environmental Assessment

If it is proposed to remove the fill material from the site, a detailed contamination assessment will most likely be required by Council. Even if all fill material is to remain on site, a contamination assessment may be required for Resource Consent application.

10.0 Limitations

This report has been prepared for the sole benefit of our Client, Bluebarn Consulting Ltd, and their client Cambridge Clothing Company Ltd, with respect to the particular brief given to us. The data and/or opinions contained in this report may not be used in other contexts or for any other purpose without our prior review and agreement.

The recommendations given in this report are based on site data from discrete locations. Inferences about the subsoil conditions away from the test locations have been made, but cannot be guaranteed. Variations in ground conditions from those described in this report could exist across the site. A specific geotechnical investigation must be undertaken in relation to any specific development proposal on the site.

We trust this is satisfactory and if you have any queries please contact us at your convenience.

Yours faithfully,

SOIL & ROCK CONSULTANTS

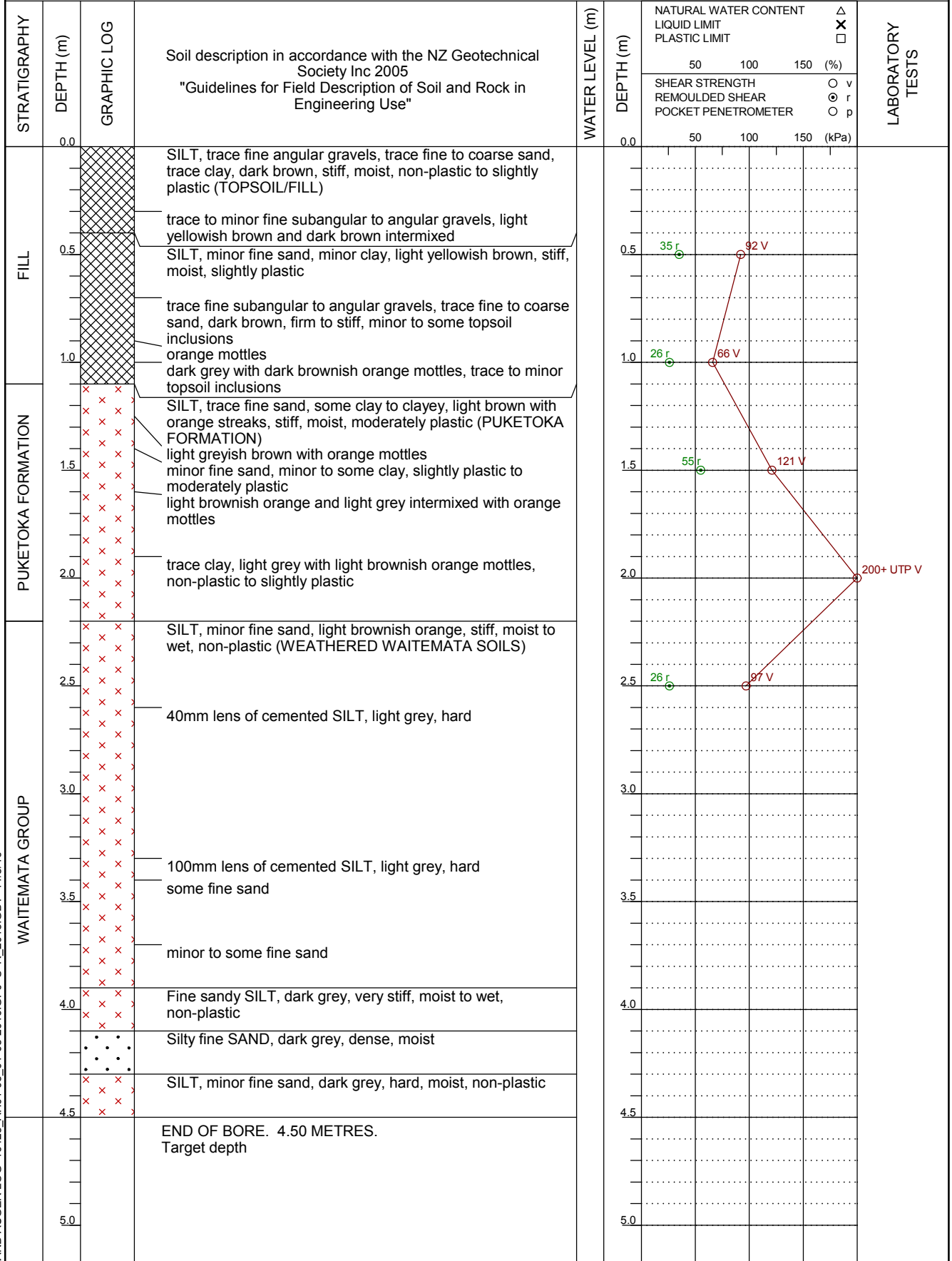


Prepared by: Chris Windross
Engineering Geologist



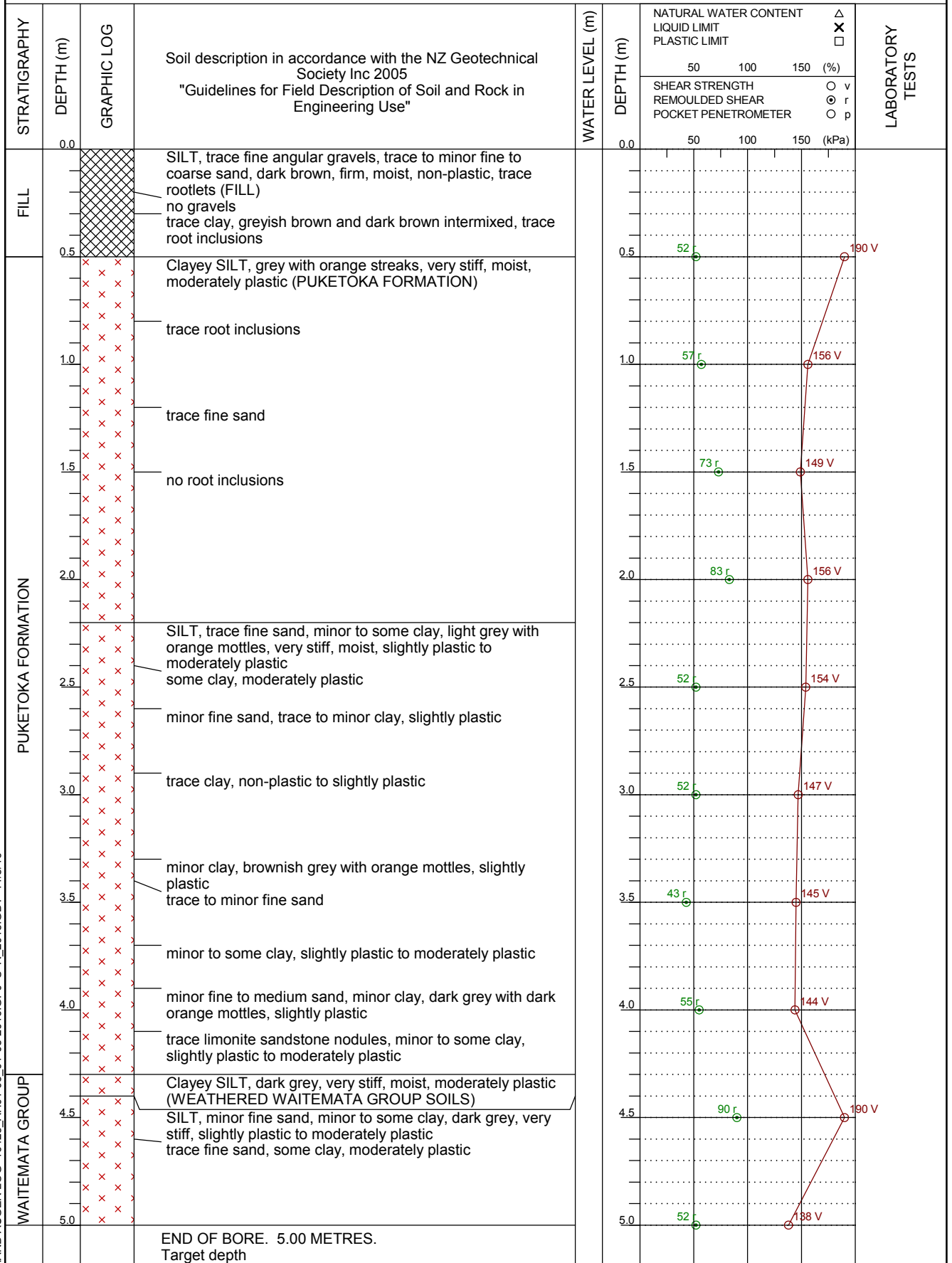
Reviewed by: Damir Soric
Senior Geotechnical Engineer, CPEng

Drill Type: Hand Auger Project No: 16425 Logged By: JW
 Drilled By: JW Coordinates: Shear Vane No - Calibration Date: GEO354 - 24/03/2016
 Date Started: 1/8/16 Ground Elevation: Surface Conditions: Near level, grass
 Date Finished: 1/8/16 Water Level: Groundwater not encountered



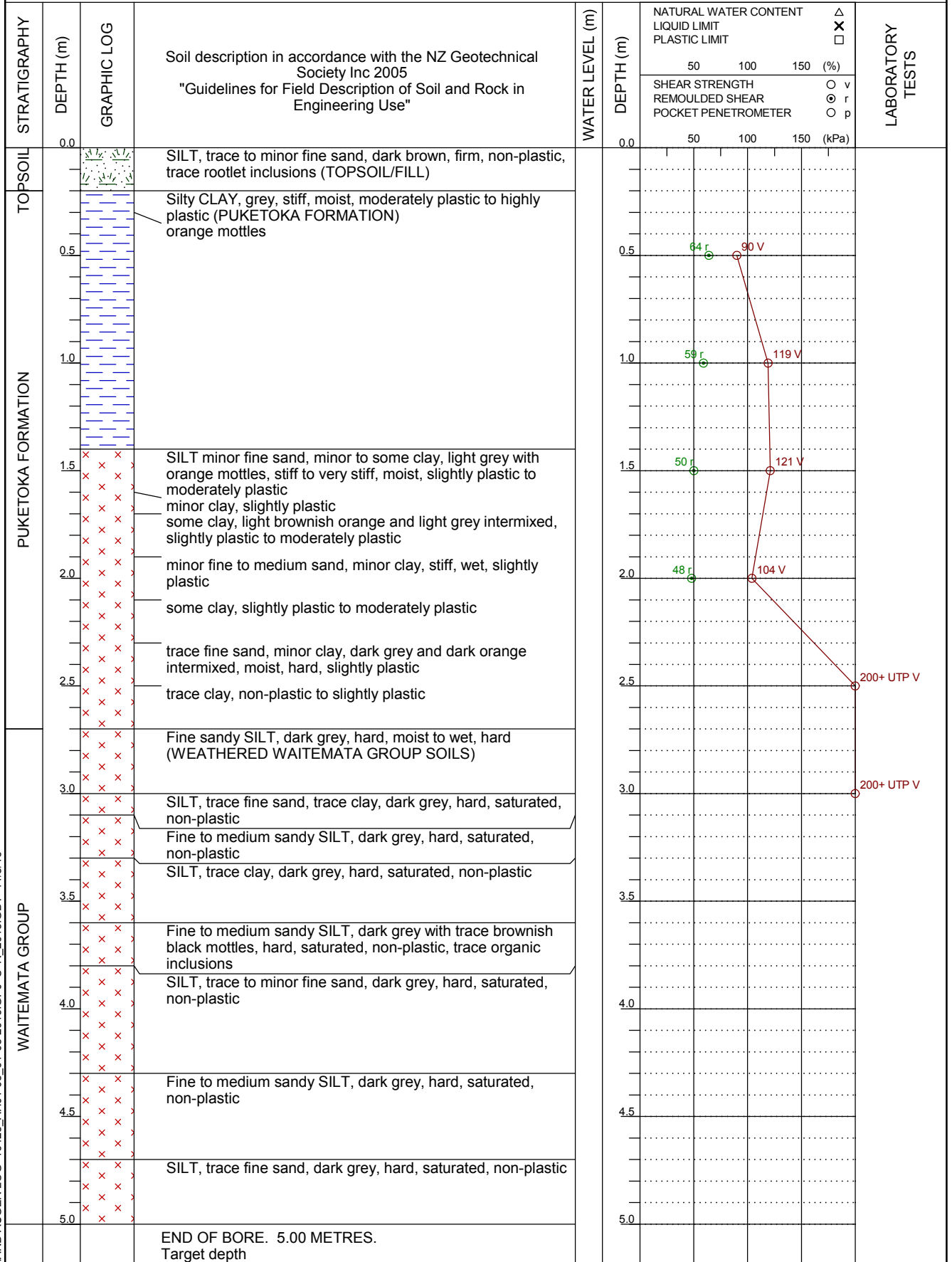
HAND AUGER LOG 16425 AH01-03_01-08-2016.GPJ S+R_2013.GDT 11/8/16

Drill Type: Hand Auger Project No: 16425 Logged By: JW
 Drilled By: JW Coordinates: Shear Vane No - Calibration Date: GEO354 - 24/03/2016
 Date Started: 1/8/16 Ground Elevation: Surface Conditions: Slightly sloping garden
 Date Finished: 1/8/16 Water Level: Groundwater not encountered



HAND AUGER LOG 16425 AH01-03_01-08-2016.GPJ S+R_2013.GDT 11/8/16

Drill Type: Hand Auger	Project No: 16425	Logged By: JW
Drilled By: JW	Coordinates:	Shear Vane No - Calibration Date: GEO354 - 24/03/2016
Date Started: 1/8/16	Ground Elevation:	Surface Conditions: Slightly sloping grass
Date Finished: 1/8/16	Water Level: Groundwater not encountered	



HAND AUGER LOG: 16425-AH01-03_01-08-2016.GPJ S+R_2013.GDT 11/8/16

Job No: 09233 Job Name: Rewarewa Walkway
 Job Suburb: New Lynn

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, grassed

AUGERHOLE LOG AH 1

Page 1

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"	Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●	Remoulded Vane Shear Strength (kPa) □
Intermixed grey, orange, brown SILT, some clay, stiff, moist, trace of gravel, rootlet inclusions [FILL]	X	0				
Dark brown, occasional fine gravel	X	0.5			●	□
Intermixed dark brown, orange	X	1			●	□
Brownish orange SILT, some clay, stiff to very stiff, moist, slightly plastic to moderately plastic [ALLUVIAL DEPOSITS]	+	1.5			●	□
Trace of rootlet inclusions, fine sand	+	2			●	□
Greyish orange	+	2.5				
Brownish grey SILT, some fine sand, trace of clay, very stiff, moist, non to slightly plastic	+	3				UTP
Fine gravel	+	3.1				UTP
Dark grey, streaked orange clayey SILT, very stiff, moist, moderately plastic	+	3.5				
Dark grey, some clay and fine sand	+	4				
End of Augerhole 3.1 metres (too stiff to auger)	+	5				

Observations: Groundwater not encountered 1 Sept 2009

Job No: 09233

Job Name: Rewarewa Walkway
Job Suburb: New Lynn

AUGERHOLE LOG AH 2

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, grassed

Soil description in accordance with the NZ Geotechnical Society Inc 2005
"Guidelines for the Field Description of Soil and Rock in Engineering use"

Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●	Remoulded Vane Shear Strength (kPa) □
	0				
	0.5				
	1.0				
	1.5				
	2.0				
	2.5				
	3.0				
	3.5				
	4.0				
	4.5				
	5.0				

Intermixed dark brown, orange SILT, some clay, stof, moist, moderately plastic, trace of fine rootlets [FILL]

Medium gravel

Brownish orange SILT, minor clay - some clay, stiff, moist, slightly plastic, trace of rootlet inclusions, fine sand [ALLUVIAL DEPOSITS]

Greyish orange, trace of clay, minor fine sand

Orange / grey SILT, trace of fine sand, some clay, very stiff, moist, moderately plastic

Brown, orange, moist to wet

End of Augerhole 2.1 metres (too stiff to auger)

Observations: Groundwater not encountered 1 Sept 2009

Date: 1 September 2009

Shear Vane No: 023

Logged by: HZ

Shear Vane Calib Factor: 1.00

Drilling Method: Hand auger

Date of last calibration: 13 July 2009



Soil & Rock Consultants
CONSULTING GEOTECHNICAL ENGINEERS

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Job No: 09233 Job Name: Rewarewa Walkway
Job Suburb: New Lynn

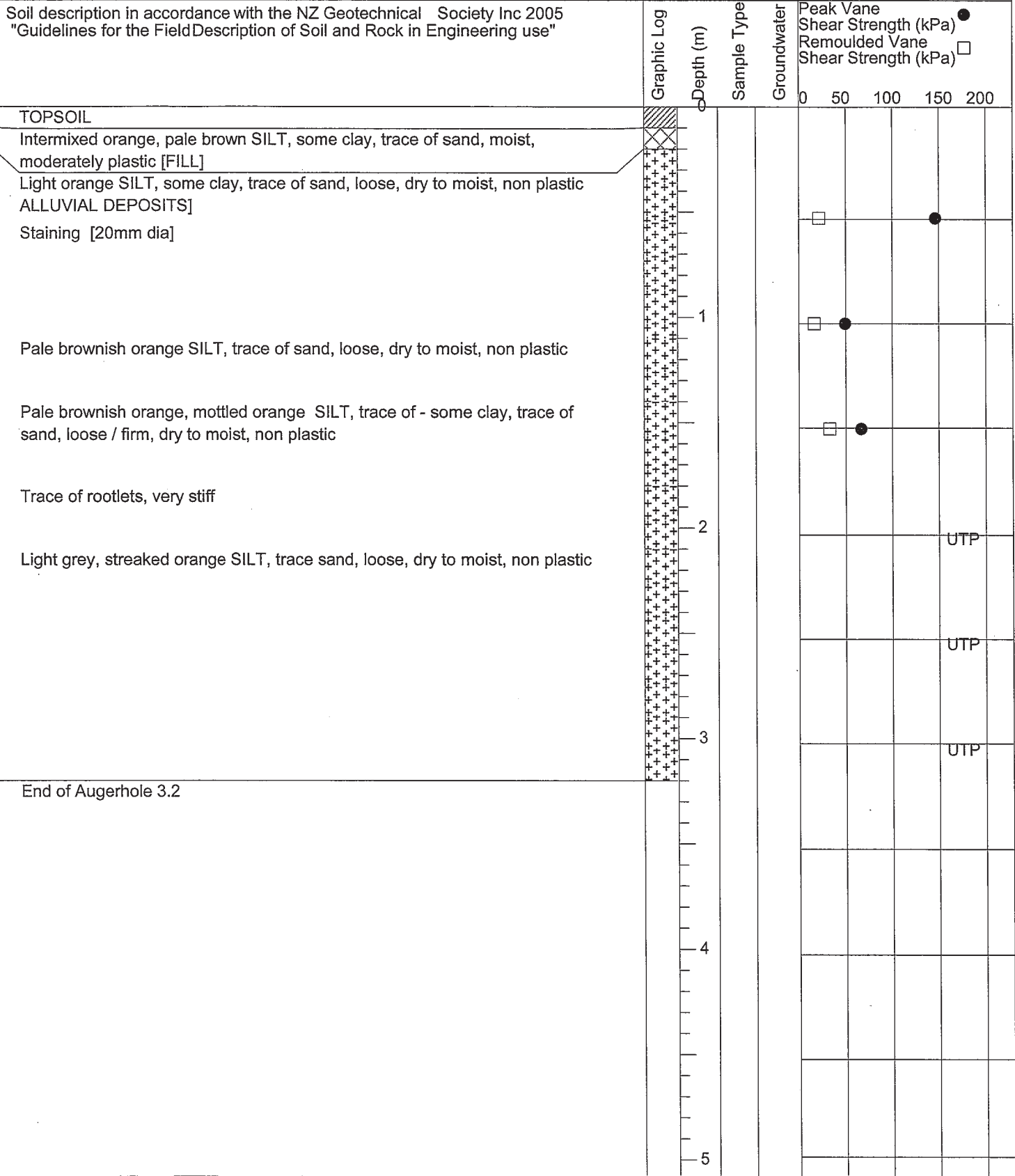
AUGERHOLE LOG AH 3

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Bush, grassed

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"



Observations: Groundwater not encountered 1 Sept 2009

Date: 1 September 2009

Shear Vane No: G765

Logged by:

Shear Vane Calib Factor: 1.404

Drilling Method: Hand auger

Date of last calibration: 14 July 2009



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www.soilandrock.co.nz

Job No: 09233	Job Name: Rewarewa Walkway Job Suburb: New Lynn
Borehole location: See site plan	
Surface Elevation [m]:	Datum:
Surface Conditions: Steep, grassed	

AUGERHOLE LOG AH 4

Page 4

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"	Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●	Remoulded Vane Shear Strength (kPa) □			
		0			0	50	100	150	200
TOPSOIL, Intermixed dark brown Silt	▨	0							
Pale orange, streaked pale brown sandy [uniform] SILT, dry to moist, non plastic [ALLUVIAL DEPOSITS]	+	0.5				50			
	+	1.0			50				
Light brown SILT, trace of to some clay, trace of to some sand, very stiff, dry to moist, non plastic to slightly plastic	+	1.5							
Dry	+	1.5							UTP
Light grey, streaked orange, mottled dark orange clayey SILT, very stiff, dry, slightly plastic	+	2.0							UTP
Dry to moist, stiff	+	2.5							UTP
Light grey, streaked orange SILT, some clay, stiff, moist, moderately plastic	+	3.0							UTP
Light grey SILT, very stiff, moist, non plastic	+	3.5							UTP
	+	4.0							UTP
Dry to moist	+	4.5							UTP
Dry	+	5.0							UTP
End of Augerhole 5.0 metres (target depth)	+	5.0							UTP

Observations: Groundwater not encountered 1 Sept 2009

Job No: 09233 Job Name: Rewarewa Walkway
Job Suburb: New Lynn

AUGERHOLE LOG AH 5

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, Streambank

Soil description in accordance with the NZ Geotechnical Society Inc 2005
"Guidelines for the Field Description of Soil and Rock in Engineering use"

Soil description	Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●					Remoulded Vane Shear Strength (kPa) □											
					0	50	100	150	200	0	50	100	150	200							
Dark brown SILT, minor clay, stiff, moist, slightly plastic [FILL]		0																			
Light brownish orange clayey SILT, stiff, moist, moderately plastic																					
Pale orange SILT, some clay, trace fine sand, very stiff, moist, slightly plastic [WEATHERED WAITEMATA GROUP SOILS]		0.5																			
		1.0																			
Pale grey, light orange SILT, minor clay, very stiff, moist, slightly plastic																					
Light orange, pale grey fine sandy SILT, very stiff, moist, non plastic																					UTP
Light grey sandy SILT, dense, moist, non plastic																					UTP
Light grey, orange SILT, minor clay, very stiff, moist, slightly plastic																					UTP
End of Augerhole 3.2 metres (too stiff to auger)		3.2																			
		4.0																			
		5.0																			

Observations: Groundwater not encountered 1 Sept 2009

Date: 1 September 2009

Shear Vane No: G740

Logged by:

Shear Vane Calib Factor: 1.508

Drilling Method: Hand auger

Date of last calibration: 17 December 2008



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Job No: 09233 Job Name: Rewarewa Walkway
 Job Suburb: New Lynn

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, Streambank

AUGERHOLE LOG AH 6

Page 6

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"	Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●	Remoulded Vane Shear Strength (kPa) □
		0			0	50
		1			100	150
		2			200	
Light brown, dark brown, minor light orange SILT, minor clay, stiff, moist, slightly plastic [COLLUVIUM]	+++++	0				
Light orange SILT, some clay, very stiff, moist, moderately plastic [WEATHERED WAITEMATA GROUP SOILS]	+++++	0.5			150	50
Light orange SILT, minor clay, very stiff, moist, slightly plastic	+++++	1			150	
Light orange, dark orange, frequent limonite banded SILT, minor sand, trace of clay, very stiff, moist, non to slightly plastic	+++++	1.5				UTP
	+++++	2				UTP
	+++++	2.5				UTP
End of Augerhole 2.7 metres (too stiff to auger)	+++++	2.7				
	+++++	3				
	+++++	4				
	+++++	5				

Observations: Groundwater not encountered 1 Sept 2009

Job No: 09233 Job Name: Rewarewa Walkway
Job Suburb: New Lynn

AUGERHOLE LOG AH 7

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, bare

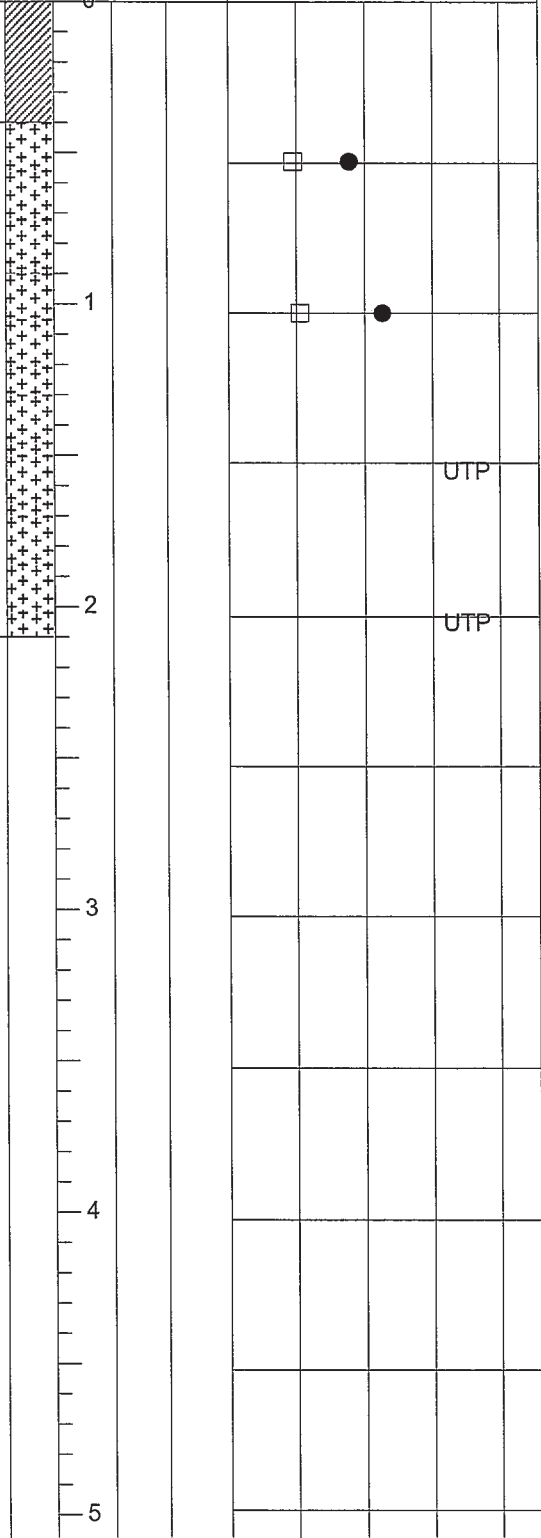
Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"

Graphic Log
Depth (m)
Sample Type
Groundwater
Peak Vane Shear Strength (kPa) ●
Remoulded Vane Shear Strength (kPa) □
0 50 100 150 200

TOPSOIL

Orange SILT, some clay to clayey, stiff to very stiff, moist, moderately plastic, trace of rootlet inclusions, fine sand [WEATHERED WAITEMATA GROUP SOILS]
Greyish orange
Trace of clay, minor fine sand, slightly plastic
Sandy silt [fine], trace of clay, non to slightly plastic
Some fine sand
Brownish orange fine sandy SILT, trace of clay, non to slightly plastic
Brownish orange fine sand, dense, moist, non plastic

End of Augerhole 2.1 metres (too dense to auger)



Observations: Groundwater not encountered 1 Sept 2009

Date: 1 September 2009

Shear Vane No: 023

Logged by: HZ

Shear Vane Calib Factor: 1.00

Drilling Method: Hand auger

Date of last calibration: 13 July 2009



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Job No: 09233

Job Name: Rewarewa Walkway
Job Suburb: New Lynn

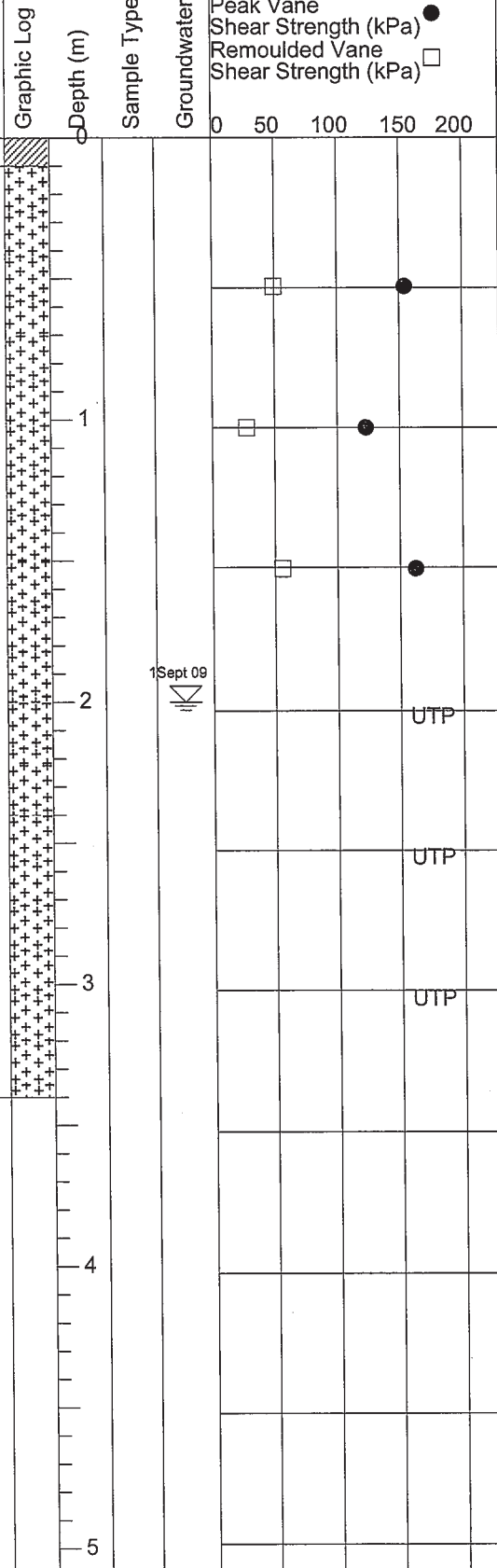
AUGERHOLE LOG AH 8

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, grassed

Soil description in accordance with the NZ Geotechnical Society Inc 2005
"Guidelines for the Field Description of Soil and Rock in Engineering use"



Observations:

Date: 1 September 2009

Shear Vane No: G765

Logged by: TC

Shear Vane Calib Factor: 1.404

Drilling Method: Hand auger

Date of last calibration: 14 July 2009



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Job No: 09233

Job Name: Rewarewa Walkway
Job Suburb: New Lynn

AUGERHOLE LOG AH 9

Borehole location: See site plan

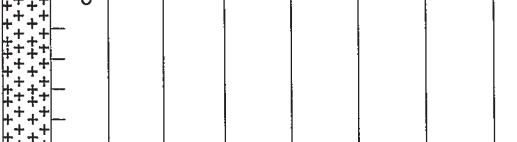
Surface Elevation [m]: Datum:

Surface Conditions: Steep, bare

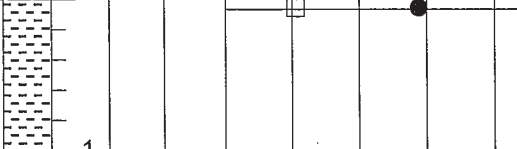
Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"

Graphic Log
Depth (m)
Sample Type
Groundwater
Peak Vane Shear Strength (kPa) ●
Remoulded Vane Shear Strength (kPa) □
0 50 100 150 200

Intermixed light grey, dark brown, orange SILT, some clay, very stiff, moist, moderately plastic, trace of rootlet inclusions, fine sand [COLLUVIUM]

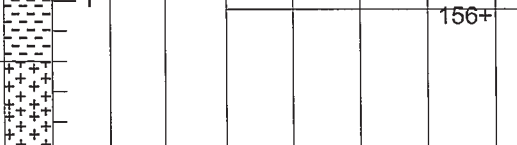


Orange silty CLAY, very stiff, moist, highly plastic [WEATHERED WAITEMATA GROUP SOILS]



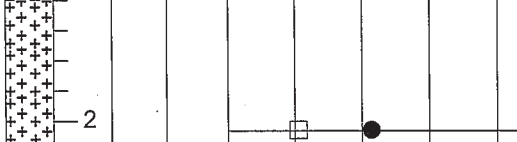
Dark brownish orange

Orange, trace of rootlet inclusions [to 5mm dia]



Orange / grey clayey SILT, very stiff, moist, moderately plastic, trace of fine sand, trace of rootlet inclusions

Some clay

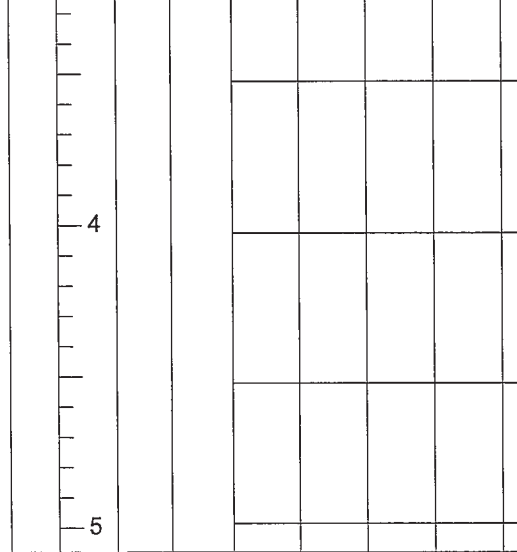


Greyish orange

Greyish orange SILT, minor fine sand, trace of clay, stiff to very stiff, moist, slightly plastic, some fine limonite gravel



End of Augerhole 3.0 metres (too stiff to auger)



Observations: Groundwater not encountered 1 Sept 2009

Date: 1 September 2009

Shear Vane No: 023

Logged by: HZ

Shear Vane Calib Factor: 1.00

Drilling Method: Hand auger

Date of last calibration: 13 July 2009



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AUGERHOLE LOG AH 10

Job No: 09233 Job Name: Rewarewa Walkway
 Job Suburb: New Lynn

Borehole location: See site plan

Surface Elevation [m]: Datum:

Surface Conditions: Steep, grassed

Soil description in accordance with the NZ Geotechnical Society Inc 2005 "Guidelines for the Field Description of Soil and Rock in Engineering use"

Graphic Log	Depth (m)	Sample Type	Groundwater	Peak Vane Shear Strength (kPa) ●					Remoulded Vane Shear Strength (kPa) □											
				0	50	100	150	200	0	50	100	150	200							
TOPSOIL	0 - 0.1																			
Light orange, white SILT, some clay, stiff, dry, non to slightly plastic [WEATHERED WAITEMATA GROUP SOILS]	0.1 - 0.5																			
	0.5 - 1.0																			
	1.0 - 1.5																			
Light brown SILT, trace of clay and sand, very stiff, moist, non plastic	1.5 - 2.0																			
	2.0 - 2.5																			
	2.5 - 3.0																			
Light orange SILT, some clay, very stiff, dry, non plastic	3.0 - 3.5																			
	3.5 - 4.0																			
	4.0 - 4.5																			
End of Augerhole 3.3 metres (too stiff to auger)	4.5 - 5.0																			
	5.0 - 5.5																			
	5.5 - 6.0																			

1 Sept 09

Observations:

Job no: 09233 Job Name: Rewarewa Walkway
New Lynn

BOREHOLE LOG MB 1

Sheet 1 of 1

Borehole Location: See site plan
Surface Elevation: Datum:
Surface Conditions: Level, grassed

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

Geol. Unit	Graphic Log	Depth (m)	Reduced Level (m)	Drilling Method	Sample Condition	Sample Type	Sample recovery (%)	Factored Shear Strength (kPa) Peak/Remoulded	Groundwater	SPT	Water content (%)	Dry Density (kg/m ³)	Other Tests	
FILL	Brown SILT, some clay, firm, wet, sl plastic [TOPSOIL]	0-0.5		OPEN BARREL	Excellent				3 September 2009					
	Grey, brown, mottled yellow silty fine SAND, minor clay, moist, slightly plastic	0.5-1.0												UTP [due gravel]
	Yellow, brown	1.0-1.5												UTP
	Yellow, brown, orange CLAY, some medium sand, trace fine gravel, very stiff, moist, highly plastic	1.5-2.0												90/47
	Brown, yellow, white SILT, some clay, silty clay inclusions, fine to medium gravel, stiff, moist, moderately plastic	2.0-2.5												
	Red, brown fine / coarse scoria SAND, loose, wet	2.5-3.0												UTP
	Yellow white silty CLAY, very stiff, moist, highly plastic	3.0-3.5												
	30 mm Topsoil inclusion	3.5-3.8												
	Brown SILT, some clay, very stiff, moist, sl plastic [BURIED TOPSOIL]	3.8-4.2												120/62
	Yellow, orange, brown mottled silty CLAY, minor Topsoil inclusions, very stiff, moist, moderately plastic	4.2-5.0												210+
WEATHERED WAITEMATA	Brown, orange stained clayey SILT, some fine sand, stiff, moist, moderately plastic	5.0-5.5		TRIPLE TUBE	Excellent									
	Brown SILT, some clay, wood fragments, stiff, moist, slightly plastic	5.5-6.0												71/39
	Brown SILT, some clay to clayey, very stiff, moist, slightly plastic [BURIED TOPSOIL]	6.0-6.5												
	Dark orange silty CLAY, very stiff, moist, highly plastic	6.5-7.0												
	Orange, grey, silty, minor fine sand	7.0-7.5												UTP
	Orange, brown SILT, some clay, fine sand, stiff, wet, slightly plastic	7.5-8.0												UTP
	Dark orange fine SAND, some silt, some clay, very stiff, moist, sl plastic	8.0-8.5												
WAITEMATA GROUP ROCKS	Grey silty CLAY, hard, moist, highly plastic	8.5-9.0		TRIPLE TUBE	Good									
	Grey fine SAND, some silt, minor clay, hard, moist, slightly plastic	9.0-9.5												UTP
	Grey clayey SILT, some fine sand, hard, moist, moderately plastic	9.5-10.0												UTP
	Grey alternating fine weak SANDSTONE / weak MUDSTONE [approx 100 - 150 mm thick]	10.0-10.5												UTP
Grey fine SAND, medium dense, wet	10.5-11.0													
Grey weak SANDSTONE	11.0-11.5													
Weak to very weak	11.5-12.0													
Fracture dipping 70°, rough	12.0-12.5													

E.O.B. 10.0 metres (target depth)

Date started: 1 September 2009
Date finished: 1 September 2009
Driller: DCN Drilling Ltd.
Type of Rig: tractor mounted
Shear Vane No: DR4374
Logged by: DG Checked by:
Shear Vane Calib Factor: 1.49
Date of last calibration: 29 January 2009

Observations:

Cad Ref: 09233 bh 1-3.dwg



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Job no: 09233 Job Name: Rewarewa Walkway
New Lynn

BOREHOLE LOG MB 2

Sheet 1 of 1

Borehole Location: See site plan
Surface Elevation: Datum:
Surface Conditions: Level, grassed

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

Geol. Unit	Graphic Log	Depth (m)	Reduced Level (m)	Drilling Method	Sample Condition	Sample Type	Sample recovery (%)	Factored Shear Strength (kPa) Peak/Remoulded	Groundwater	SPT	Water content (%)	Dry Density (kg/m ³)	Other Tests		
FILL	Brown SILT, some clay, firm, moist, slightly plastic [TOPSOIL]			OPEN BARREL	Good			210+							
	Brown, white mottled silty CLAY, very stiff, moist, highly plastic Orange, brown Yellow Organic stained black and brown Yellow, orange, white Yellow, white silty, some sand, moderately plastic 30 mm dia Topsoil inclusion, stiff Orange, yellow, brown, mottled red, yellow									107/15					
	Orange, white, brown silty CLAY, clayey silt inclusions, very stiff, moist, moderately to highly plastic									110/44					
	Grey, brown clayey SILT, some topsoil, very stiff, moist, mod plastic Orange, brown silty CLAY, some sand, very stiff, moist, moderately to highly plastic Brown, orange / brown, yellow clayey SILT, topsoil inclusions, very stiff, moist, moderately plastic									90/35					
WEATHERED WAITEMATA GROUP SOILS	Brown SILT, some clay, stiff, moist, slightly plastic [BURIED TOPSOIL] Yellow brown silty CLAY, very stiff, moist, highly plastic Mottled orange, white			TRIPLE TUBE	Excellent			81/50							
	Grey clayey SILT, some fine sand, stiff, wet, moderately plastic									110/62					
	Orange, brown silty fine SAND, some clay, very stiff, wet, slightly plastic Grey									107/47					
WAITEMATA GROUP ROCKS	Grey fine SANDSTONE very weak to weak, fracture, vert, rough			TRIPLE TUBE				UTP							
	Grey SILTSTONE, very weak									UTP					
	Grey fine SANDSTONE, weak to very weak									UTP					
	Grey SILTSTONE, very weak Grey fine SANDSTONE, weak									UTP					

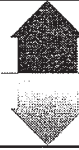
3 September 2009

E.O.B. 10.0 metres (target depth)

Date started: 1 September 2009
Date finished: 1 September 2009
Driller: DCN Drilling Ltd
Type of Rig: tractor mounted
Shear Vane No: DR4374
Logged by: DG Checked by:
Shear Vane Calib Factor: 1.49
Date of last calibration: 29 January 2009


Observations:

Cad Ref: 09233 bh 1-3.dwg





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 **AH101** Approximate Augerhole Locations, Soil and Rock Consultants, 1 August 2016

KEY:

 **MB 1** Approximate Machine Borehole Locations, Soil and Rock Consultants, 1 September 2009

 **AH 1** Approximate Augerhole Locations, Soil and Rock Consultants, 1 September 2009

 **A A'** Approximate Cross Section Locations, Soil and Rock Consultants, 1 September 2009

- NOTES:**
1. Locations of features approximate only.
 2. Location of all buried services to be verified prior to construction
 3. Original sheet size A3
 4. Boundary information on this Site plan adapted from information on Quickmap by Custom Software

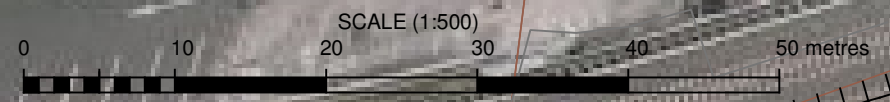
AMENDMENTS		
DATE	REV	DESCRIPTION
02/08/2016	A	

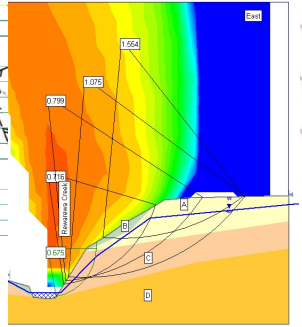
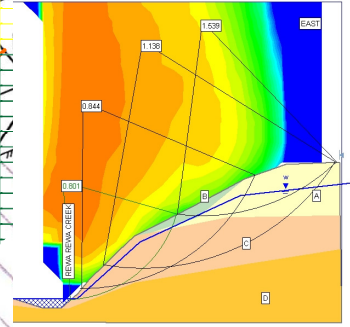
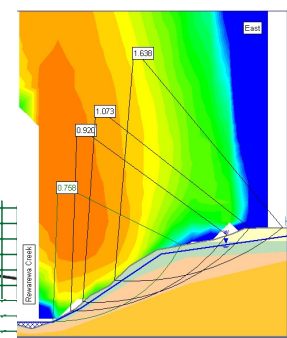
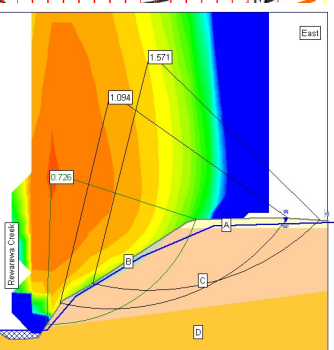
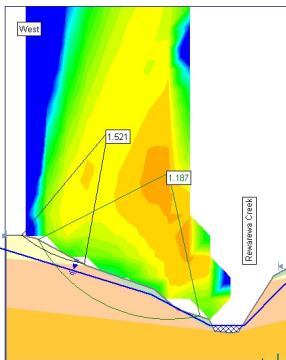
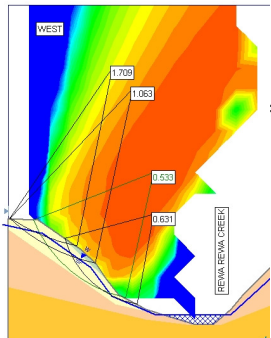
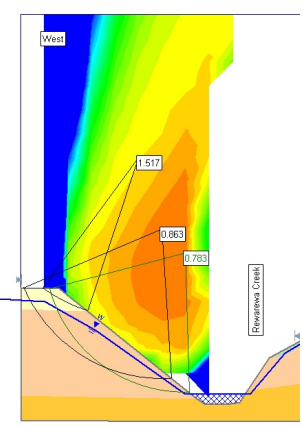
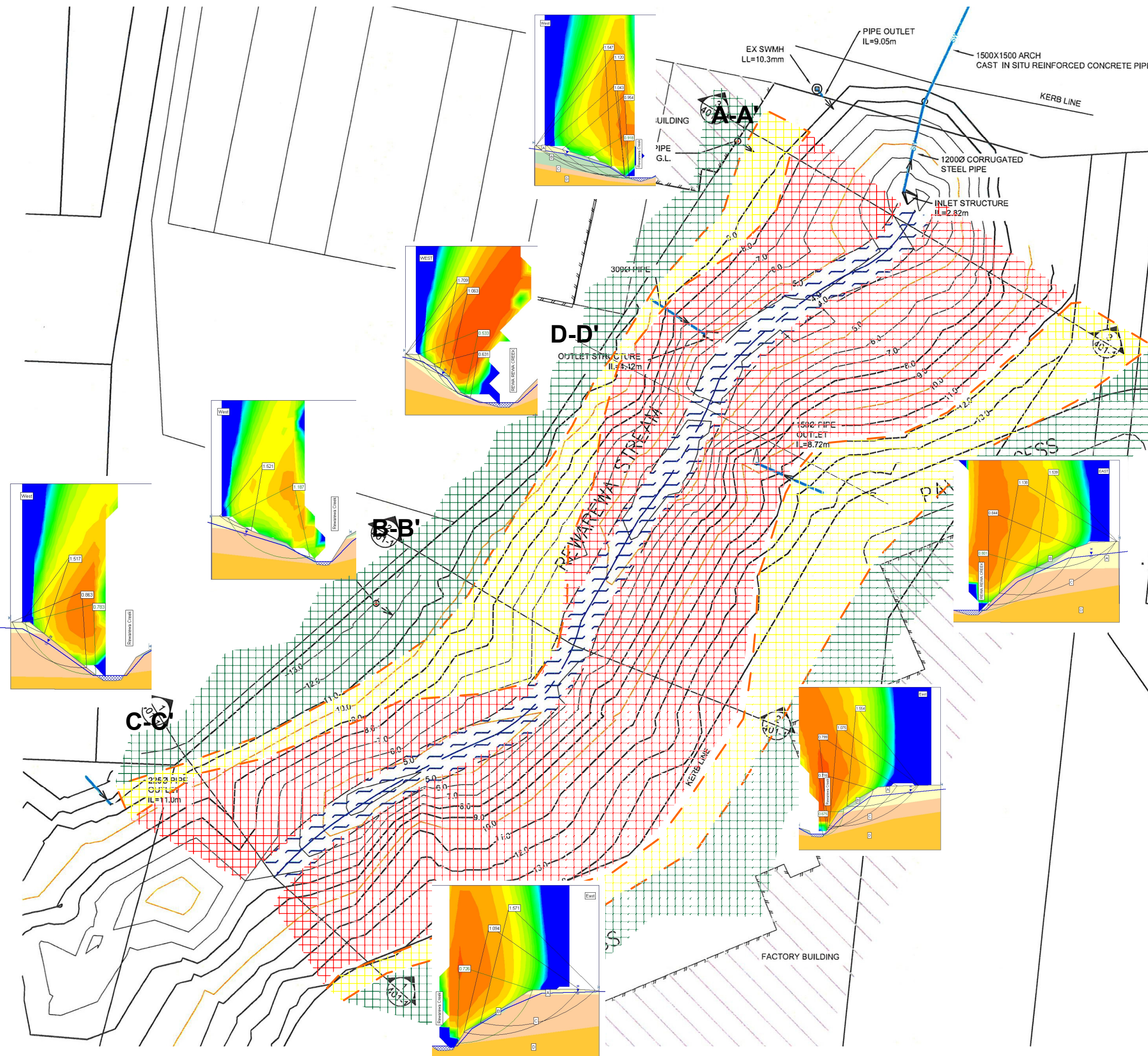
Check all dimensions and levels on site before commencing construction.
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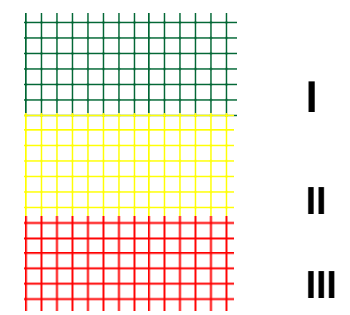
3094-3096 Great North Road
New Lynn
Site plan

16425	DRAWN: CW/JW	DATE: 02/08/2016
SCALES: 1: 500 AT A3	CHECKED:	REV. A
CAD REF: Site plan		





RISK ZONES



REWAREWA CREEK
BANK STABILITY AND RISK ASSESSMENT

HIGH GROUNDWATER LEVEL

Drawing No 09233/4