



Groundwater and Settlement Effects Report

Whenuapai Conveyance - Package 1

Prepared for

Beca Limited

Prepared by

Tonkin & Taylor Ltd

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Table of contents

1	Introduction	1
1.1	General	1
2	Project overview and construction method	1
2.1	Pump station at 23-27 Brigham Creek Road	2
2.2	Gravity main	4
2.3	Rising main	4
3	Site setting and description	5
3.1	Pump station at 23-27 Brigham Creek Road	5
3.2	Gravity main	6
3.3	Rising main	7
4	Ground model	7
4.1	Ground condition	7
4.1.1	Published geology	7
4.1.2	Site investigations	8
4.2	Groundwater	9
4.3	Site geological models	9
4.3.1	Pump station at 23-27 Brigham Creek Road	10
4.3.2	Gravity main	11
4.4	Geotechnical parameters	12
4.4.1	Retention design	12
4.4.2	Soil permeability	13
4.4.3	Soil consolidation	13
5	Geotechnical effect assessment methodology	14
5.1	General overview	14
5.2	Settlement estimation method	14
5.2.1	Mechanical settlement due to excavation	14
5.2.2	Groundwater drawdown and consolidation settlement due to excavations	17
5.2.3	Settlement due to directional drilling (Tamiro Road Stormwater Embankment)	18
5.2.4	Settlement due to pipe hammering (Brigham Creek Road Crossing)	18
5.2.5	Combined consolidation and mechanical settlement effects	19
5.3	Settlement tolerances and zone of influence	19
5.3.1	General	19
5.3.2	Buildings	19
5.3.3	Underground services	21
6	Geotechnical and groundwater effects assessment results	21
6.1	General	21
6.2	Pump station at 23-27 Brigham Creek Road	21
6.2.1	Groundwater drawdown	21
6.2.2	Groundwater drawdown induced settlements	23
6.3	Gravity main	24
6.3.1	Brigham Creek Road trenchless crossing	24
6.3.2	Manhole SSMH11	27
6.3.3	Construction settlement due to micro-tunnelling (SSMH11 to SSMH12)	28
6.4	Rising main	28
6.4.1	Sinton Stream sheet piling for culvert	28
6.4.2	Chamber Construction	28

6.5	Assessment effects on buildings	29
6.6	Assessment of effects on underground services	31
6.7	Assessment of effects on Brigham Creek Road	31
6.8	Assessment of effects on other matters	32
6.8.1	Saline intrusion	32
6.8.2	Neighbouring bores	33
6.8.3	Neighbouring wetlands	33
6.8.4	Base flow to Sinton Stream	33
6.9	Long term effects	34
6.10	Monitoring programme	34
7	Conclusion	34
8	Applicability	36
Appendix A	Site investigation plan and settlement contour plans	
Appendix B	Site investigation data	
Appendix C	Groundwater monitoring results	
Appendix D	SEEP/W outputs and groundwater induced settlement troughs	
Appendix E	Wallap outputs and mechanical settlement troughs	
Appendix F	Construction methodology	
Appendix G	Geological long section from GIR	
Appendix H	Draft GSMCP	

Executive summary

This Groundwater and Settlement Effects Report has been prepared to support an Assessment of Effects on the Environment (AEE), and presents our geotechnical and groundwater effects assessment for the installation of the proposed gravity and rising main pipelines and associated infrastructure including wet well, valve chambers and the storage tanks at the pump station location. The estimated total ground settlements (where assessed) are presented as settlement contours on the project site plan presented in Appendix A.

Based on our technical assessment, we conclude:

Pump Station

- Ground settlement effects arising from pump station and storage tank construction on surrounding structures is assessed to be negligible (0) to very slight risk (1) of damage.

Gravity Main

- Ground settlement effects arising from the construction of the gravity main (shafts, chamber and pipe jack) using open cut and/or direction drill on surrounding structures is assessed to be negligible (0).
- Ground settlement effects arising from the Brigham Creek Road pipe jack upon buried services expected to be low to moderate.
- Maximum total and differential settlements are assessed to be 28 mm and 1V:300H respectively. At this level of total and differential settlement, we assess that the risk of damage to underground services to be low to moderate.

Rising Main

- Ground settlement and groundwater drawdown effects arising from the chamber construction is assessed to be negligible as there are no structures or services within the zone of influence.
- Damming effects associated with the Sinton Stream sheet piling works are assessed to be localised to the stream bank and not expected to significantly impact upon base flows into Sinton Stream.

Groundwater

- The risk of saline intrusion is assessed to be low.
- The impacting upon neighbouring groundwater bores is assessed to be negligible.
- Base flows through Wetland C are unlikely to be materially reduced as excavations for the pump station and the Brigham Creek Road trenchless crossing are downstream of the wetland and the effects of the pump station excavation is proposed to be managed through installation of a temporary sheet pile cut-off wall, groundwater recharge and adaptive management plans.
- Temporary dewatering will occur to Wetland D during the construction of the storage tanks at the proposed pump station. During construction, a Wetland Monitoring and Reinstatement Plan will be implemented as well as recharge across the wetland to minimise effects. Upon completion of construction, Wetland D is proposed to be reinstated.
- We assess that changes to base flow in Sinton Stream arising from the pump station and Brigham Creek Road trenchless crossing construction activity will be low.

Monitoring

We recommend an adaptive groundwater and settlement monitoring programme during construction. In addition, groundwater monitoring bores located within the boreholes BH05A, BH05B, BH06, BH08, BH110, BH111, BH113, BH116, and BH117 (referenced in this assessment) should be monitoring for a minimum period of 6 months prior to commencement of construction to establish baseline levels.

1 Introduction

1.1 General

Beca Limited (Beca) has been engaged by Watercare under the Consultancy Services Panel Framework Agreement, to undertake Feasibility, Design and Consenting for Whenuapai-Redhills Wastewater Servicing Scheme– Package 1 (the Project). Tonkin and Taylor Ltd (T+T) has been engaged as a subconsultant to Beca to provide geotechnical service for this project.

This Geotechnical Effects Report presents the results of our geotechnical effects assessment, regarding the installation approach, and potential settlement effects to surrounding assets and structures, due to the installation of the proposed gravity and rising main pipelines, as well as the wet well, valve chambers and the storage tanks at the pump station location. This report has been written to address the geotechnical and groundwater effects to inform an Assessment of Effects on the Environment prepared by Beca (Beca AEE) in support of resource consent application.

At the time of preparing this report, the project drawings are in their detailed design stage. As such, this report should be reviewed to assess the validity of the results if changes are made to the proposed design drawings which are referenced herein.

This report is based on the T+T Geotechnical Factual Report¹ (GFR), GHD's Geotechnical Interpretative Report² (GIR) and site observations from T+T's site walkover on 28 February 2020. Geotechnical and hydrogeological information presented in the GFR and GIR were used to inform the ground model and analysis to undertake this assessment.

2 Project overview and construction method

The Project aims to provide wastewater servicing capacity for approximately 10,240 dwellings, or 30,720 people, in the Whenuapai catchment. This growth is projected to occur by 2041. The Project includes the following five key components (see **Figure 2.1**):

- 1 A **Pump Station** at a point where the Whenuapai and Redhills Catchments meet at 23-27 Brigham Creek Road, with an emergency overflow outfall to Sinton Stream.
- 2 A **Gravity Main Pipeline** (approximately 700 m long and 375 – 475 mm in diameter) between Whenuapai Village Pump Station on Tamiro Road and the new pump station.
- 3 A **Rising Main** (approximately 1.4 km long and 500 mm in diameter) between the Pump Station and a proposed new break pressure chamber on Mamari Road (the boundary of Package 2)³.
- 4 A **Culvert** (approximately 63 m long including wing wall and rip rap) to provide access for the rising main across Sinton Stream.
- 5 A **Break Pressure Chamber** which connects to the Massey Connector rising main (proposed under Package 2).

The Project extends from the existing Whenuapai Village pump station site in Tamiro Road in the north, across Brigham Creek Road, to Spedding Road in the south.

¹ Tonkin and Taylor Ltd. *Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Package 1. Geotechnical Factual Report*. Dated March 2022. T+T ref. 1014985.

² GHD Ltd. *Whenuapai Redhills Wastewater Package 1. Geotechnical Interpretative Report*. Dated March 2021. Ref. 51/12508391

³ An extension of the rising main is part of 'Package 2' and will be designed to connect to the planned Northern Interceptor Phase 2 tunnel and deliver flows from the Whenuapai Catchment to the Rosedale Wastewater Treatment Plant for treatment. Package 2 is subject to a separate consent application.

Section 2.1 through section 2.3 provide further detail of the proposed infrastructure to be constructed.

A new wastewater pump station is proposed to be installed at 23-27 Brigham Creek Road. The pump station will comprise:

- The construction methodology presented in the Beca AEE proposes that the pump station is to be constructed by open bulk excavation. To reduce groundwater seepage flows from Wetland C into the excavation, temporary sheet piles (sheet pile cut off wall, refer Figure 2.2 below) will be installed around the southern boundary of Wetland C prior to commencement of excavation. The sheet piles are expected to be driven approximately 0.5 m to 1 m into the underlying rock (approximately 6 m below existing ground level) and clutched together. These sheet piles are not anticipated to provide lateral support to the excavation, but rather limit groundwater seepage flows into the excavation.

Construction works will be staged for the inlet manhole, wet wells (pump station), storage tanks, and connecting pipes to limit the extent of excavation open at any given time and limit potential dewatering effects. Excavations for each component is to be carried out in two stages in which a wider, upper excavation is to extend through the soil layers, and a smaller excavation is to be carried out within and to the design depth through into the ECBF bedrock.

For the wet wells, each level of the excavation is to be supported by a double slide rail system to provide safe access, and limit ground deformations associated with mechanical and consolidation settlements. For the storage tanks, the upper excavation area will be battered at approximately 1V:2H, whilst the deeper excavation area will be supported by double slide rails.

Groundwater recharge is expected to be required across Wetland C during construction to maintain suitable hydrological conditions for the wetland. The assessment of effects undertaken is intended to demonstrate that varying levels of recharge across the wetland can be applied to maintain such hydrological conditions and to approximately estimate recharge volumes. Whether recharge is carried out, and the required volume of water provided via recharge, will be dependent on the effectiveness of the sheet pile cut off wall and natural recharge from rainfall, and the Wetland Monitoring and Reinstatement Plan implemented during construction which is developed on recommendations of this assessment and by the Project Ecologist.

Similarly, recharge shall be applied across Wetland D to minimise effects while noting that part of the wetland will be excavated and then reinstated. During construction, an adaptive management approach will be undertaken to minimise effects during construction and enable reinstatement post construction.

The Contractor may choose a different temporary support mechanism from those assessed in the report, as the design is developed, which should be acceptable provided that the chosen support method can be demonstrated to limit groundwater seepage and total ground deformations to the values presented in this report.

Pump station excavations with dewatering are expected to take up to 30 months.

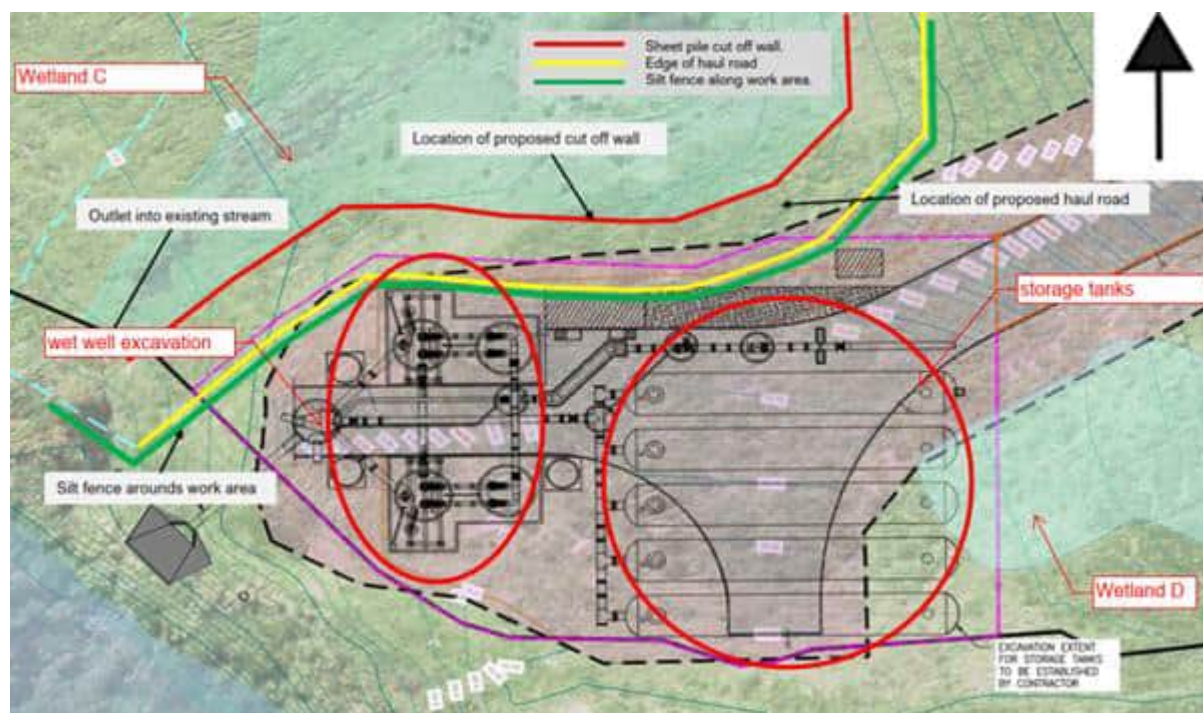


Figure 2.2: Proposed construction methodology plan for the pump station at 23-27 Brigham Creek Road

2.2 Gravity main

A gravity main is proposed from the existing Whenuapai Village pump station to the new pump station at 23-27 Brigham Creek Road comprising:

- Approximately 715 m long 375 mm – 475 mm diameter gravity pipeline with an invert level ranging between approximately 2.4 and 5.5 m below ground level. The pipeline will commence at the existing Whenuapai Village pump station and extend through farmland between 20 and 28 Brigham Creek Road before crossing underneath Brigham Creek Road to terminate at the new pump station.
- 11 No 1540 mm diameter manholes (SSMH-1 through SSMH-11).

The construction methodology proposes:

- Pipe hammering underneath Brigham Creek Road between chambers SSMH3 and SSMH4.
- Trenchless construction between SMH11 and SMH12.
- The remainder of the alignment will be installed by open cut method. Trenches shall be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days, and manhole structures no longer than 30 days.

Temporary support for excavations will be required. Where excavations may be required for longer than 10 days a groundwater dewatering assessment has been undertaken. For the purposes of this assessment, we have considered the following excavation support and seepage control methods:

- SMH11 – trench shields with no seepage controls.
- Brigham Creek Road Drive Shaft – sheet piles with lateral restraint.
- Brigham Creek Road Receiving Shaft – trench shields with no seepage control.

Open cut methods may be required where trenchless methods are proposed in case of an obstruction. If this is the case, the settlement results from the driving and receiving shafts can be adopted to predict the settlement that may arise between these two points if the pipeline shall be trenched.

2.3 Rising main

A rising main is proposed from the new pump station at Brigham Creek Road to the break pressure chamber at 32 Mamari Road comprising:

- Approximately 1492 m long 500 mm diameter riser pipeline with an invert level ranging between approximately 0.5 and 5.9 m below the existing ground level. The pipeline will commence at the pump station and extend along the future extension of Spedding Road, then Spedding Road, and terminate 32 Mamari Road.

The construction methodology proposes:

- That the full length of the rising main is to be installed by open cut method. The pipeline is intended to run underground for its full length except where it passes through a culvert at Sinton Stream. Trenches for the pipeline will be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days.
- To enable culvert construction at Sinton Stream, sheet piles shall be installed to provide ground support over a length of approximately 75 m for a duration of approximately 12 weeks.

- An air valve chamber and connection chamber are proposed at approximately chainage 155 and 235 respectively, north of Sinton Creek. The chambers will require excavations approximately 3.3 m and 2.4 m deep. The excavations are expected to take up to 4 weeks to construct and backfill.

As set out in the Beca AEE, the rising main section of pipeline is being installed by open trenching, which is a permitted activity under Rules E7.4.1(E17) and (E27), and the E7.6.1.10. Therefore, any potential effects associated with groundwater dewatering and diversion for the open trenching have not been considered further in this report. The effects of the Sinton Stream sheet piles and rising main chamber excavations are assessed due their longer period of excavation.

3 Site setting and description

The site is located within Whenuapai, Auckland, and is bounded by Tamiro Road and a residential subdivision to the north, undeveloped subdivided land to the east and west, and Trig Road to the south (refer to Figure 2.1). The following sections provide further detail of the specific areas of assessment.

3.1 Pump station at 23-27 Brigham Creek Road

The pump station site is bounded by Brigham Creek Road to the north, Sinton Stream to the west and south, and the proposed Spedding Road extension to the east.

Two wetlands are identified at the pump station site. Wetland C is located within the northern portion of the site, which is south from Brigham Creek Road. The wetland covers an area of approximately 1,400 m². The ground profile slopes relatively steeply towards Sinton Stream.

Wetland D is located to the east of the proposed storage tanks and extends across the proposed excavation footprint. Similarly, to Wetland C, ground profiles slope towards Sinton stream.

Adjoining land use is predominantly farmland with limited structure surrounding the site, other than Brigham Creek Road to the north and utility services within the roadway corridor.

A plan showing the existing underground services sourced from Auckland Council GeoMaps, before Udig and the detailed design drawings is presented in Figure 3.1 with a list of known public services in presented in Table 3.1.

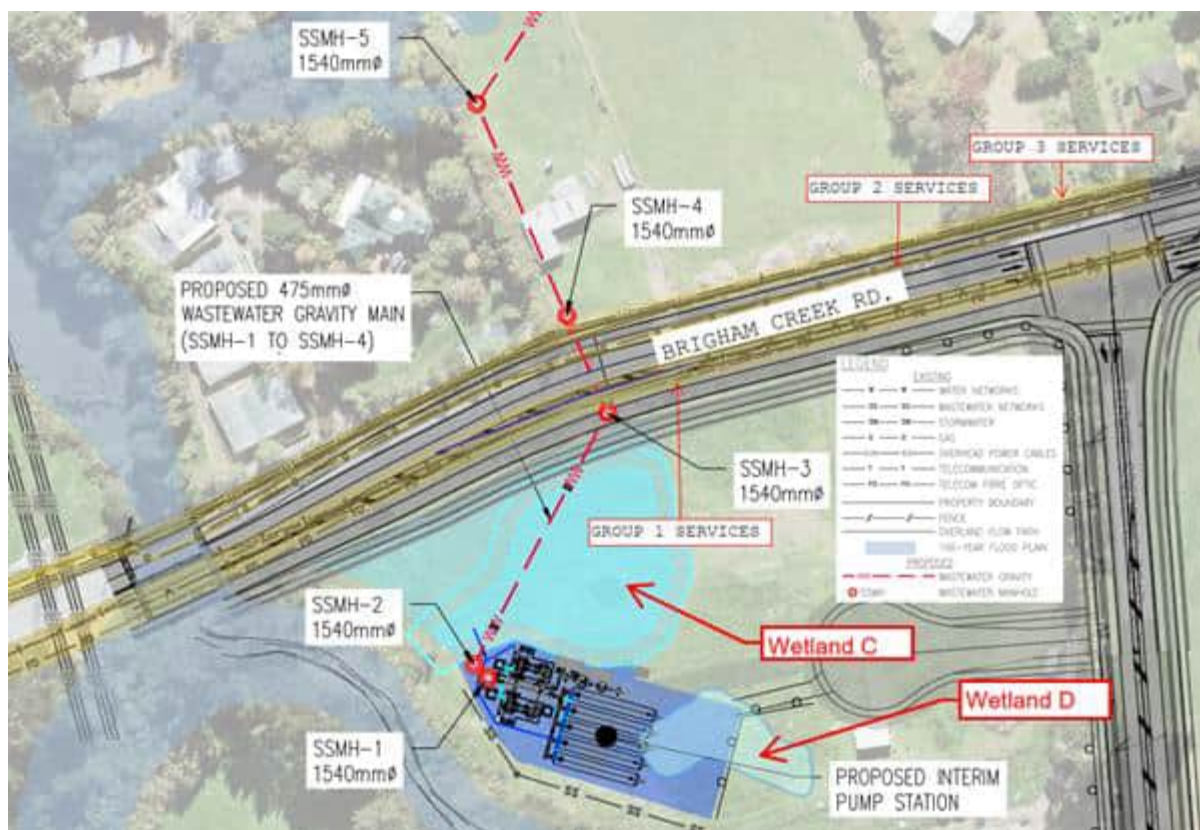


Figure 3.1: Location of existing underground services underneath Brigham Creek Road

Table 3.1: Summary of underground services underneath Brigham Creek Road

Underground service group	Services
Group 1	- Fibre Optic cable – Vodafone New Zealand Ltd, unknown material type - Water pipe local – Watercare Services Limited, 315 mm polyethylene - Telecommunications cable - Vocus Group NZ Limited, 32mmP (96F) - Telecommunication cable – Chorus New Zealand Limited, unknown material
Group 2	Gas line – Vector Limited, MP4 100 mm polyethylene
Group 3	Water pipe local – Watercare Services Limited, 150 mm asbestos-cement

3.2 Gravity main

The alignment crosses private residential properties at the northern end of the alignment between Tamiro Road and Brigham Creek Road. This section is relatively flat and crosses paddocks and farmland with occasional minor gully features. A stormwater detention pond is located immediately to the west of Tamiro Road.

Predominant land use is agriculture and residential with the following properties having structures within 50 m of the proposed alignment:

- 18 Brigham Creek Road (residential dwelling and plastic greenhouses).
- 20-22 Brigham Creek Road (vacant/desert agricultural storage shed) to be removed.

- 23-27 Brigham Creek Road (although it is understood that this building is vacant/deserted).
- 30 Joseph McDonald Drive (residential dwelling).
- 40 Tamiro Road (residential dwelling).
- 42 Tamiro Road (residential dwelling).
- 44 Tamiro Road (residential dwelling).

3.3 Rising main

The section of the rising main alignment from Brigham Creek Road to Spedding Road consists of gently rolling hills and is across farmland with a gully in the centre that forms Sinton Stream. The section of the alignment between Spedding Road and Trig Road extends along the road berm and is generally flat with a small hill at the Trig Road end.

Predominant land use is agriculture and residential with the following properties having structures within 50 m of the proposed alignment:

- 5 Spedding Road (residential dwelling).
- 9 Spedding Road (agriculture storage shed).
- 10 Spedding Road (residential dwelling).
- 11 Spedding Road (agriculture storage shed).
- 13 Spedding Road (residential dwelling).
- 14 Spedding Road (residential dwelling).
- 15-19 Spedding Road (residential dwelling and agricultural storage sheds).

4 Ground model

4.1 Ground condition

4.1.1 Published geology

The published geological map of the area⁴ indicates that the site is underlain by undifferentiated alluvium of the Takaanini Formation (formerly referred to as Tauranga Group) for the northern section of the alignment. Pumiceous deposits of the Takaanini Formation occur near the surface for the remainder of the alignment and alternating sandstone and mudstone deposits of the East Coast Bays Formation (ECBF) is the basement geology for the area. Within the ECBF, layers of Albany Conglomerate have been identified.

The location of the alignment is shown in the context of the regional geology as presented on Figure 4.1 below.

⁴ Kermode, L.O. 1992. Geology of the Auckland Urban Area. 1:50,000. Institute of Geological & Nuclear Sciences.

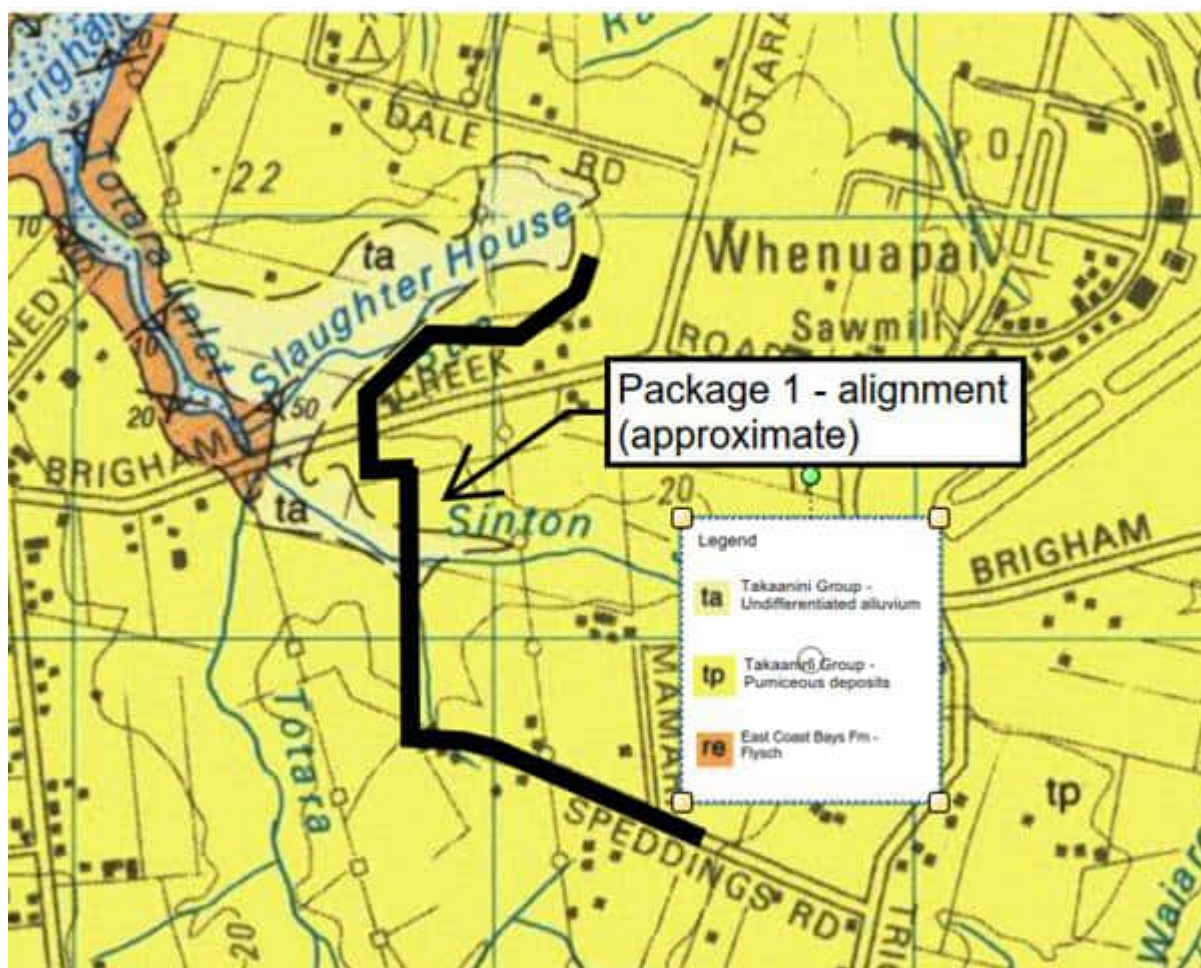


Figure 4.1: Published geology in relation to the project area

4.1.2 Site investigations

T+T carried out geotechnical site investigations and presented them in the March 2022 GFR. A summary of all relevant investigations undertaken for this study are presented below in Table 4.1 and shown on Figure 1 in Appendix A. The T+T GFR provides a comprehensive summary of the investigations and includes copies of borehole logs, CPTs and laboratory test data. Appendix B of this report includes copies of the borehole logs, CPTs and groundwater monitoring data for ease of reference.

Table 4.1: Summary of relevant site investigations

Investigation	Number
Rotary cored machine boreholes (BH)	BH05A, BH05B, BH06, BH07, BH08, BH110, BH111, BH111A, BH113, BH116, BH117
Cone Penetration Tests (CPT)	CPT02, CPT03 CPT04, CPT05, CPT06, CPT07, CPT08, CPT111, CPT112, CPT117, CPT121, CPT126, CPT128, CPT129, CPT131
Geotechnical hand augered boreholes with Scala penetrometer testing (HA)	HA03, HA04, HA05, HA06, HA06, HA07, HA07A, HA08, HA08A, HA107A, HA107B, HA108, HA109, HA110A, HA110B, HA111, HA112, HA113, HA114, HA115, HA116, HA117, HA119
Standpipe piezometer (PZ)	BH05A, BH05B, BH06, BH08, BH110, BH111, BH113, BH116, BH117

4.2 Groundwater

Existing geotechnical data indicates a variable depth to groundwater across the proposed pump station and pipeline alignments. Groundwater along the gravity main is assessed to generally flow to the north towards Slaughterhouse Stream, whereas groundwater at the location of the pump station generally flows west and south towards Sinton Stream.

Nine standpipe piezometers were installed across the project site in November and December 2020, and January 2021. Groundwater levels were measured with a handheld electronic dip meter and level loggers between November 2020 and December 2021.

The groundwater monitoring data indicates that the groundwater level varies between approximately 0.35 mbgl and 5.1 mbgl. Furthermore, the level logger data shows that the groundwater levels fall in the spring and summer and rise in the autumn and winter, with the shallowest groundwater levels occurring in the winter months. There appears to be a relationship between rainfall and groundwater levels where the groundwater is recharged by rainfall.

The GFR and the Whenuapai groundwater level monitoring memo⁵ presents the results from the level logger groundwater monitoring. The GIR provides an analysis of the groundwater data. These documents are provided in Appendix C.

4.3 Site geological models

The site ground models for this effects assessment are based on the geomorphology, published geology, the previously completed project specific investigations and the GIR prepared by GHD.

The subsurface along the project area is interpreted to comprise the following geological units:

- i Topsoil; overlying
- ii Fill; overlying
- iii Takaanini Formation; overlying
- iv Albany Conglomerate; overlying
- v East Coast Bays Formation.

Material descriptions can be generalised as follows:

⁵ Tonkin & Taylor Ltd (2022). *Memo – Whenuapai groundwater level monitoring*. From Troy McAlister to Reginald Barry. T+T ref. 1014985. Dated 10 January 2022

Fill deposits comprising stiff to very stiff clay, generally of medium to high plasticity, and occasionally mixed topsoil organic matter.

Takaanini Formation soils underlying the project area generally comprise silts and clays with varying amounts of sand. The stiffness of these cohesive soils range between firm to very stiff and they are generally highly plastic. Within the northern portion of the site, where the gravity main is located, the silts and clays are interbedded with thin layers (approximately 0.5 m thick) of stiff organic clay and loose to medium dense sand.

Albany Conglomerate rock was only identified in two separate areas along the conveyance. These locations were approximately CH200 along the rising main alignment and CH640 along the gravity main alignment. This unit underlies the Takaanini Formation and is described as completely weathered to highly weathered sandstone or conglomerate. It was recovered as gravel material and is inferred to be weakly cemented.

East Coast Bays Formation material consists of residual soils which are stiff to very stiff silts and medium dense sand. The residual soils are underlain by moderately to slightly weathered rock comprising siltstone and sandstone. Unweathered, weak interbedded siltstone and sandstone underlie these materials and have an average Uniaxial Compressive Strength of 910 kPa. The depth to top of unweathered rock varies along the project area.

4.3.1 Pump station at 23-27 Brigham Creek Road

A representative ground model extending across the pump station/wet wells has been formed based upon the surrounding geotechnical investigations (BH110, BH111, BH117, CPT127, CPT129, HA113, HA116). Around the immediate vicinity of the pump station/ wet wells ECBF rock was encountered in the investigations at shallow depths (approximately -3.5 mRL) compared to investigation to the north of the pump station/wet wells which found ECBF rock at greater depths (approximately -9 mRL).

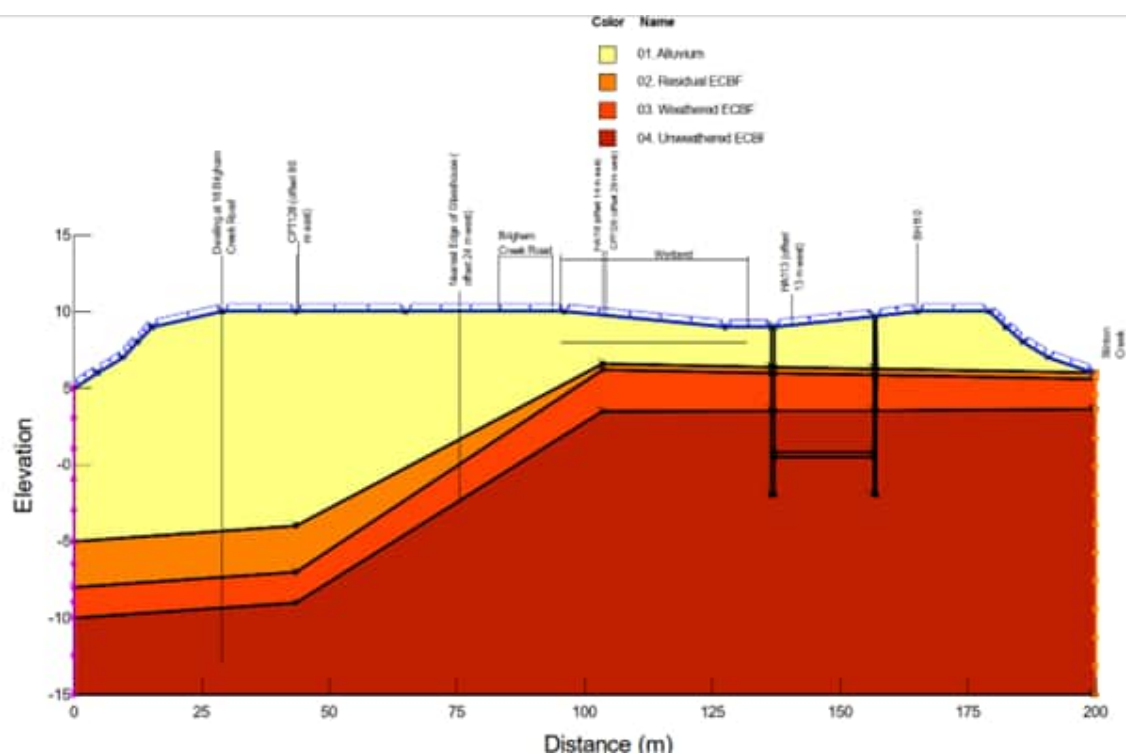
These varying depths to ECBF rock also mean a varying thickness of Takaanini Formation Alluvium across the affected area. As the Takaanini Formation Alluvium is likely to be the more compressible than other materials encountered on site, there is the potential for groundwater induced drawdown settlements to increase with distance back from the edge of the excavation due to the thickening deposits. The ground model has been established to adopt a conservative approach to the thickness of the Takaanini Formation Alluvium under locations of interest, and hence estimation of groundwater drawdown settlement.

It has been assumed that the ECBF rock does not contribute to surface settlements due to the stiffness of this layer at lower strains. Groundwater drawdown induced settlements are considered to only occur within the Takaanini Formation Alluvium, residual ECBF and Weathered ECBF rock.

A ground model representative of the location of the pump station/ wet wells summarised in Table 4.2 below has been adopted for the analysis. A visual representation of the ground model with distance away from the edge of the excavation extending towards 18 Brigham Creek Road is shown in Figure 4.2.

Table 4.2: Ground model adopted for pump station excavations

	Geological unit	Pump station wet wells and storage tanks
Material thickness (m)	Engineered hardfill	0.4
	Takaanini Formation silt and clay	2.1
	ECBF residual soils	1.9
	Weathered ECBF rock	3.5
	Unweathered ECBF rock	22.5 (confirmed within borehole)
Depth to static groundwater level (mbgl)		2 (7.75 mRL)
Depth to elevated groundwater level (mbgl)		0.5 (9.25 mRL)

*Figure 4.2: interpreted geological section from the edge of the wet well excavation to 18 Brigham Creek Road*

4.3.2 Gravity main

Sections for the gravity main have been selected based on, ground conditions, depth of excavation and the proximity of surrounding structures. For the gravity main, the ground models have been separated into the following regions:

- Brigham Creek Road Crossing due to the existing road and utility services. This ground model is based on BH117, CPT128, CPT129, and HA116.
- SMH11 due to its deep excavation (deepest excavation that is north of Brigham Creek Road), and proximity to existing structures. This ground model is based on BH116, CPT117, HA110A, HA110B, and HA111.

A summary of the adopted geological profiles are provided in Table 4.3 and Table 4.4.

Table 4.3: Ground model adopted for gravity main SSMH11

	Geological unit	Gravity main – SSMH11
Material thickness (m)	Non-engineered fill	2.45
	Takaanini Formation silt and clay	13.4
	Albany Conglomerate	4.85 (confirmed)
Depth to static groundwater level (mbgl) () Groundwater elevation		1.73 (12.5 mRL)
Depth to elevated groundwater level (mbgl) () Groundwater elevation		0.5 (13.73 mRL)

Table 4.4: Ground model adopted for the driver and reception shafts excavations at the Brigham Creek Road crossing

	Geological unit	Brigham Creek Road crossing – driver and receiver shafts
Material thickness (m)	Takaanini Formation silt and clay	14.3
	East Coast Bays Formation Residual Soil	3.0
	East Coast Bays Formation Weathered Rock	2.0
Depth to static groundwater level (mbgl)		2 (8.0 mRL)
Depth to elevated groundwater level (mbgl)		0.5 (9.5 mRL)

4.4 Geotechnical parameters

4.4.1 Retention design

Based on the results of geotechnical investigations and testing in this area, and past experience with similar ground conditions, the geotechnical analysis parameters presented in Table 4.5 below are considered appropriate for our assessment of settlement effects.

Table 4.5: Geotechnical analysis parameters for retention analysis

Geological unit	Bulk unit weight, γ (kN/m ³)	Effective cohesion, c' (kPa)	Angle of internal friction, ϕ' (°)	Undrained shear strength, S_u (kPa)	Poisson's ratio	Elastic Modulus, E (MPa)	At rest earth pressure, K_0	Active earth pressure, K_a	Passive earth pressure, K_p
Engineered hardfill	20	0	40	-	0.3	50	0.357	0.189	7.061
Non-engineered fill (cohesive)	18	0	28	50	0.3	10	0.530	0.320	3.485
Takaanini Formation (clay and silt)	17	1	28	50	0.35	10	0.531	0.320	3.485
Takaanini Formation (organics)	16	0	28	50	0.25	5	0.530	0.320	3.485
Takaanini Formation (sands)	18	0	30	-	0.25	12	0.500	0.294	3.878
ECBF residual soil	18	5	30	60	0.35	20	0.500	0.294	3.878
ECBF weathered rock	21	25	35	1000	0.3	85	0.426	0.237	5.153
ECBF unweathered rock	22	100	40	-	0.25	400	0.357	0.189	7.061

4.4.2 Soil permeability

-Subsoil hydraulic conductivity (“permeability”) has been assessed for groundwater analysis. The parameter is based on material descriptions, correlations with CPT results, insitu permeability testing and experience with similar materials in the Auckland area. For the purposes of the assessment of groundwater drawdown and settlements affects for the project, generalised ground models have been adopted. The permeability parameters used in this assessment are presented in Table 4.6.

Table 4.6: Analysis permeabilities

Geological unit	Horizontal permeabilities k_h (m/s)	KV/ k_h	Volumetric water content
Takaanini Formation	8×10^{-7} to 9×10^{-8}	0.1	0.4
Residual ECBF	1×10^{-6} to 1×10^{-8}	0.1	0.5
Weathered ECBF	1×10^{-7} to 1×10^{-8}	0.1	0.1
ECBF Rock	1×10^{-6} to 5×10^{-8}	0.1	0.1
Albany conglomerate	4×10^{-5} to 6×10^{-6}	0.1	0.1

4.4.3 Soil consolidation

The compressibility of the various soil units has been assessed from published correlations with soil strength, laboratory testing, CPT traces and experience with similar materials. Simplified ground models have been adopted for assessing the upper bound consolidation effects for the project. Parameters used in this assessment for various geological units is presented in Table 4.7.

Table 4.7: Consolidation analysis parameters

Geological unit	$M_v (m^2/kN)$
Takaanini Formation	1×10^{-4} to 4×10^{-5}
Residual ECBF	5×10^{-5} to 7×10^{-5}
Weathered ECBF	1×10^{-5} to 2×10^{-5}
ECBF Rock	5×10^{-6} to 8×10^{-6}
Albany conglomerate	1×10^{-4} to 2×10^{-5}

5 Geotechnical effect assessment methodology

5.1 General overview

The geotechnical effects likely associated with the works assessed in this report are:

- Mechanical induced surface ground settlement due to bulk excavations at the pump station, shaft excavations for the Brigham Creek Road trenchless crossing, and chamber, manhole, and pipeline trench excavations for the gravity and rising main.
- Ground surface settlement arising from the temporary groundwater drawdown associated with excavations below the lowest recorded groundwater table.

The proposed construction methodologies for the project are split between open excavation (pump station), trenched excavation, pipe hammer, and directional drilling. Specific comments on each of these methodologies is provided in Section 2 and likely effects in Section 6. These construction methods are well understood and are frequently used across Auckland and New Zealand to construct pipelines for wastewater, stormwater, and water supply networks.

Potential adverse impacts of surface settlement are rarely associated with vertical settlement alone, but rather with tilting or angular distortion (differential settlement). Guidance on angular distortion limits is provided in Section 5.3.

5.2 Settlement estimation method

5.2.1 Mechanical settlement due to excavation

Mechanical settlements have been assessed at the Brigham Creek Road drive shaft using the computer software WALLAP⁶. Open cut excavations supported by sheet piles and lateral bracing elements have been adopted for analyses as this retention system was proposed in the contractor's construction methodology (relevant information summarised in sections below). The CIRIA 760 guide⁷ was used to assess the mechanical settlement (vertical ground settlement) behind the retaining wall excavation as a result of the wall deflections. A ratio between horizontal wall deflection and vertical ground settlement of 0.5 has been adopted.

The sections chosen for mechanical settlement analyses are located within the vicinity of sensitive assets, such as dwellings and existing underground surfaces. Each section adopted a 5 m wide by 10 m long construction surcharge of 15 kPa behind the retaining wall. This surcharge allowed for construction traffic, stockpiling, and materials storage.

⁶ Geosolve (2020). *WALLAP Retaining Wall Analysis Program*.

⁷ CIRIA 760 (2017). *Guidance on embedded retaining wall design*.

To assess mechanical settlement at the Brigham Creek Road receiving shaft and at manhole 11, the empirical method outlined in CIRIA C760⁸ has been used. This journal presents an empirical design chart (Figure 6-15b, duplicated as Figure 5.1 below) which provides an estimate of surface mechanical settlements for retaining walls in stiff cohesive soils. The controlling input parameters are the depth of excavation and the assumed stiffness of the retaining wall. For the purpose of this assessment, a low stiffness wall has been assumed which is applicable based on the expected retaining wall type (trench shields).

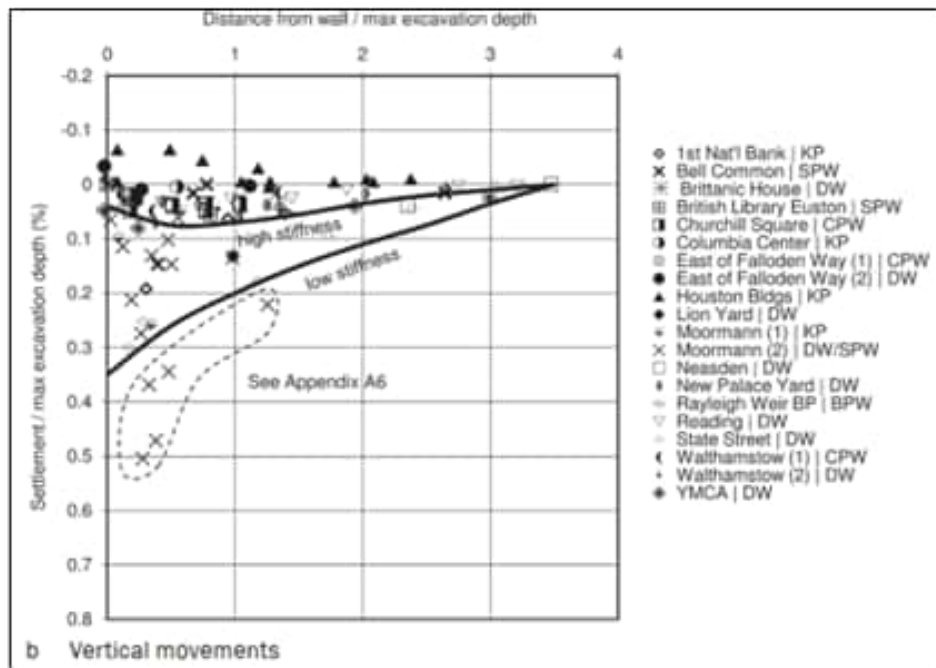


Figure 5.1: Extract of design chart (Figure 6.15b) from CIRIA C760

No mechanical settlement analysis has been undertaken for the Pump Station site because the limit of the proposed excavation is offset from any structures sensitive to settlement by more than five times the depth of excavation in soil. Given the offset, it is assessed that no ground deformation due to mechanical settlement is expected to occur beyond the pump station property and as such no detailed analysis has been undertaken.

5.2.1.1 Structural properties of sheet pile

No structural details on the sheet piles have been provided at the time of this assessment. For the purpose of this assessment and report, and subject to contractor design, the following sheet pile retaining wall parameter assumptions have been adopted for this analysis:

- Sheet pile type adopted is STU-18009, with an effective moment of inertia (I_{eff}) of $3.24 \times 10^{-4} \text{ m}^4/\text{m}$ and Elastic Modulus of 200 GPa.
- Prop type is Freyssi 50010, with a cross-sectional area of $1,257 \text{ mm}^2$, nominal diameter of 40 mm and an Elastic Modulus of 210 GPa.
- The effective moment of inertia is assumed to be 100% of the gross value under construction condition for the sheet piles and props.
- An installation reduction factor has not been considered.

⁸ CIRIA C760, 2018. Guidance on Embedded Retaining Wall Design. London, 455 pp Figure 6.15.

⁹ Sheet Pile NZ Ltd. SP3W and STU1800. <https://sheetpile.co.nz/sp3w-or-stu1800/>

¹⁰ Solentanche Freyssinet (2014). *Anchoring systems for geotechnical engineering*.

5.2.1.2 Assumptions for analysis

The following assumptions have been made as part of this assessment:

- The feasibility of embedding sheet piles into ECBF weathered and unweathered rock has not been considered. From experience, the constructability of driving sheet piles greater than 0.5 m depth into ECBF rock (SPT N greater than 50) may be difficult. However, for the purposes of this assessment the effects of sheet pile retention for excavations have been analysed only.
- Trench excavations and any void between the permanent structure and ground will be backfilled with engineered hardfill back to existing ground surface. Undercut of 0.5 m has been assumed, unless specified in the design drawings^{11, 12, 13}.
- The retaining structures and soil are expected to completely relax through the duration of the works.
- A seismic case was not analysed as the ULS seismic case is not expected to be critical for the short return period of 1/250¹⁴ (based on Importance Level 3 structure, design life less than 6-month period).
- Topsoil is removed and replaced with engineered hardfill prior to any excavation activity at the location of the pump station. These earthworks form part of the “Contractor Area Hub” which will be undertaken prior to construction.
- The deadman anchor is assumed to be rigid and fixed (i.e. will not deform or displace). Depending on the final propping configuration and loads, a cast in-situ beam in lieu of the deadman sheet pile may be required to limit deformations.

5.2.1.3 Construction sequence

The adopted general construction sequence in the WALLAP model is summarised below:

- 1 Install steel sheet pile to design depth.
- 2 For open cut excavations, model the backslope (3H:1V) on the left-hand side (LHS) of the analysis as a triangular surcharge with an equivalent soil type of the backslope material.
- 3 Reset wall displacements to zero.
- 4 Apply a construction surcharge of 15 kPa behind the retaining wall (i.e. LHS).
- 5 Change the groundwater profile on the right-hand side (RHS) of the analysis so it is at least 250 mm below the proposed excavation level.
- 6 Excavate on the RHS to a ground level at least 1 m below proposed prop installation level.
- 7 Install steel prop (row 1) to represent a deadman anchor at appropriate spacing. The spacing varies for different excavations.
- 8 Repeat stages 5 to 7 if another row of props (row 2) is required.
- 9 Fill RHS with at least 0.5 m thick of engineered hardfill, unless the detailed design drawings indicate site concrete.

¹¹ WSP and GHD (2022). *Watercare Services Limited. Whenuapai-Redhills Wastewater Servicing Package 1. Wastewater Pump Station (DPISH). Detailed Design Issue*. Project no. 3-AWD32.00. Dated 14 January 2022.

¹² WSP and GHD (2021). *Watercare Services Limited. Whenuapai-Redhills Wastewater Servicing. Brigham Creek Road, Whenuapai. Interim slaughterhouse PS – Wastewater Rising Main*. Dated July 2022.

¹³ WSP and GHD (2021). *Watercare Services Limited. Whenuapai-Redhills Wastewater Servicing. Brigham Creek Road, Whenuapai. Interim slaughterhouse PS – Wastewater Gravity Pipe*. Dated 15 December 2021.

¹⁴ NZS1170.0 (2002). *Structural design actions. Part 0: General principles*.

- 10 Increase the groundwater level for a high groundwater analysis to the shallowest elevations indicated by the groundwater monitoring data or to ground surface level.

5.2.2 Groundwater drawdown and consolidation settlement due to excavations

Ground surface settlement relating to temporary groundwater drawdown is a consequence of dewatering to maintain a dry excavation. While settlement is the primary geotechnical concern, care must also be taken to minimise the dewatering impacts to the surrounding environment. Of particular concern is the neighbouring wetland C at the pump station site.

The current design philosophy at the pump station is to adopt methods to limit seepage from Wetland C as reasonably as practicable and recharge as required to maintain the hydrogeological condition of the wetland to an acceptable level as determined in the adaptive Ground Settlement Monitoring and Contingency Plan (GSMCP) presented in Appendix G and the adaptive Wetland Monitoring and Reinstatement Plan prepared by Beca¹⁵ for the wetland.

The assessment undertaken is intended to demonstrate a range of potential recharge rates to maintain the wetland to a suitable level. For the purposes of the assessment, this has been taken as a constant head condition of near surface groundwater saturation. It should be appreciated that wetlands can be sensitive to both under and over saturation and there are a number of factors that may affect required recharge rate that are beyond the practical scope of testing and modelling. As such, these elements shall be addressed through adaptive monitoring plans during construction.

For remaining areas of the project, groundwater drawdown analysis has been undertaken adopting the parameters outlined in this report on the basis of the proposed construction methodology.

The effect of the groundwater drawdown and consolidation effects from the excavations works has been modelled through a series of 3-dimensional (3D) SEEP3D models at the pump station and 2-dimensional (2D) Seep/W models within GeoStudio software or hand calculations as presented in CIRIA R113 at the remaining areas of interest. Our results are presented in Appendix D.

The methodology adopted is based upon the depth of excavation below the groundwater level, proximity of neighbouring structures/ infrastructure and construction methodology.

The trench excavations for the gravity main were assumed to have a typical over excavation of 0.5 m below the proposed excavation level. Trench excavations were modelled using hand calculations due to their typical shallow depth. Where trench excavations are deeper, there was not assessed to be a need for a more detailed assessment due to the low density of surrounding structures/ infrastructure that would be affected by the works and short duration that trench is expected to open (generally expected to be less than 10 days).

Where sheet piles have been adopted for seepage control, the sheet pile walls have been modelled with partially sealed clutches. Modelling guidance on equivalent permeabilities and thicknesses of steel sheet piles was taken from ArcelorMittal¹⁶. The base of the shafts are assumed to be sealed with a minimum 300 mm thick layer of concrete (50 mm blinding concrete and 250 mm thick concrete foundation slab) where the pump station bases are left unsealed.

Groundwater drawdown levels in this assessment have been based on observed groundwater levels from the groundwater monitoring programme. Actual groundwater drawdown levels and associated consolidation settlements should be verified again prior to construction once groundwater monitoring and detailed design has been completed. Note that following high rainfall events, groundwater levels may rise to close to or at the ground surface level. In this instance, most of the alignment would have the potential to lower groundwater levels by 2 m or more. However, from a

¹⁵ Whenuapai Wastewater Servicing Package 1: Wetland Monitoring and Reinstatement Plan, Beca Ltd, October 2023

¹⁶ ArcelorMittal (2014): Impervious steel sheet pile walls – Design and practical approach

settlement effects perspective, the controlling factor is the level that groundwater is lowered below the historical low groundwater level, rather than the absolute groundwater lowering. The assessments of settlement effects are therefore based on the lowest observed groundwater level.

Ground settlement resulting from groundwater drawdown occurs over a period of time. The greatest expected settlement due to groundwater drawdown at shafts is considered to occur once excavations are completed prior to the sealing of the base. It is expected that it may take up to 56 days (including 10 days allowance for contingency) to complete dewatering for the Brigham Creek Trenchless crossing excavations and up to 45 days (including 10 days allowance for contingency) for SSMH-11.

For the pump station, the analysis philosophy was to demonstrate that recharging behind the partial seepage cut-off wall would maintain similar hydrological conditions in the wetland as prior to construction. As such, steady state (infinite time) modelling for the pump station was adopted.

The majority of the groundwater drawdown is likely to occur adjacent to the excavation and the effects to diminish away from the excavation. The extent of drawdown influences is determined based on a combination of the Geostudio seepage analysis and comparing the horizontal model extents to simplified hand calculations presented in CIRIA R113 or to identified bodies of water.

Once excavations are sealed, or backfilled, groundwater levels are expected to recover to near observed baseline levels. Once the wastewater network (package 1) is completed, groundwater levels are expected to return to baseline levels across the alignment.

5.2.3 Settlement due to directional drilling (Tamiro Road Stormwater Embankment)

The method of New and O'Reilly (1982) has been used to estimate the maximum magnitude and lateral extent of mechanically induced ground settlement due to construction of the proposed wastewater pipeline and pump station structures.

Tunnelling publications comprising experience from thousands of projects suggest that volume loss varies from zero to 4% depending partly on the ground conditions but primarily from the specific capabilities of the trenchless construction method being used and contractor performance. From experience the expected volume loss within the Auckland Region is approximately 1% or less. For the proposed trenchless pipeline alignment, a conservative estimate of 2.5% volume loss has been adopted for the purposes of assessing geotechnical effects for Resource Consent. Settlement associated with higher volume loss can be reduced with good construction techniques, and mitigation measures that are dependent on the contractor.

The pipeline alignment is expected to be excavated within the Takaanini Formation soils SSMH11 to the Whenuapai Village pump station. For estimating settlements, it is assumed the pipeline is in cohesive soils.

Trenchless construction methods utilise the use of pressure balance or drillings muds to actively support the front face and tunnel until the tunnel opening is lined with the constructed wastewater pipe. These methods also reduce groundwater seepage into the tunnel opening limiting the potential of groundwater drawdown. As such, groundwater drawdown and related associated settlement during trenchless construction works is not expected to be significant, and a detailed assessment of groundwater drawdown is not considered necessary.

5.2.4 Settlement due to pipe hammering (Brigham Creek Road Crossing)

Settlement associated with pipe hammering is covered in the assessment of shaft excavations in Section 6.3.

5.2.5 Combined consolidation and mechanical settlement effects

The total settlement that occurs at the ground surface is a combination of consolidation settlement induced by groundwater drawdown and mechanically induced settlement. The mechanically induced settlement is expected to occur quickly (within days and weeks), compared to the consolidation settlement (within weeks to months) resulting from groundwater drawdown; however, the combination of effects has considered the long term, full occurrence of both types of settlement over a construction period of two years. The method adopted to combine the settlements is the addition of the two calculated amounts at a set horizontal distance and is therefore towards the upper bound of credible settlements. We have undertaken our assessment until settlements have reduce to 5 mm.

5.3 Settlement tolerances and zone of influence

5.3.1 General

The project infrastructure construction has the potential to induce vertical and lateral ground movements that can affect the condition of structures and infrastructure within the zone of influence. For purpose of this assessment, we have considered the zone of influence as the area where total ground settlements associated with the project may be equal to or greater than 5 mm. We have not undertaken an assessment where total ground settlements reduce to less than 5 mm as this level of ground deformation is considered negligible within the context of the receiving environment and within the natural seasonal fluctuation of ground movement.

Settlement guidelines are presented below for the potentially affected structures.

5.3.2 Buildings

The proposed works will be constructed near existing structures, principally private dwellings. In general, a building structure's tolerance to total and differential settlement depends upon the materials used in construction as well as type of foundation system adopted (shallow versus piled), the quality of the structure, and the existing condition of the structure.

The limiting values of total settlement and angular distortion along with damage classification as presented in CIRIA PR30 1996 have been used as guidance for assessment of potential effects on buildings. In addition, the New Zealand Building Code states that designers should limit the probable maximum differential settlement of a building to 1V:240H (25 mm over a 6 m horizontal distance) under serviceability limit state loading, or total settlement to 50 mm unless the structure is specifically designed to resist damage under a greater settlement. While the NZ Building Code applies to these structures, the residential house dwellings are likely to have been designed using acceptable solutions outlined in NZS 3604, which is appropriate for ground with movements less than 25 mm. The ground deformation limits outlined in NZS 3604 are approximately equivalent to Risk Category 2 in CIRIA PR30.

A site walkover was undertaken to assess the existing structures along the proposed gravity main and rising main alignments and at the pump station site. In general, buildings along the proposed alignment comprises one and two storey timber framed homes, and are likely supported on shallow timber piles, pad footings or strip footings. Cladding was observed to typically comprise timber weather boards or metal sheet cladding. We assess these buildings are likely to have some tolerance to ground settlement.

It is important to note that the values presented in the New Zealand Building Code are total amounts of movement over the life of a building. The buildings in the vicinity of the project are existing, with unknown histories; and therefore, may have already been subjected to some movement. To account for historical movement, buildings that are subjected to less than 5 mm vertical settlement and

differential settlement slopes no greater than 1:1000, have been assessed to have a negligible risk to damage and would not need to be further assessed.

For the purposes of this assessment, the settlement criteria in Table 5.1 (which is generally based on the Burland (1995), and Mair et al (1996) classification) has been adopted for our assessment:

Table 5.1: Settlement criteria for properties and buildings

Risk Category	Maximum settlement of building (mm)	Maximum differential settlement	Description of risk	General Category
0	-	-	Negligible: superficial damage unlikely	Aesthetic Damage
1	<10	< 1 in 500	Very Slight: Fine cracks easily treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in exterior visible upon close inspection. Typical crack widths up to 1 mm.	
2	10 to 50	1 in 500 to 1 in 200	Slight: Cracks easily filled. Redecoration probably required. Several slight fractures inside building. Exterior cracks visible, some repainting may be required for weather-tightness. Doors and windows may stick slightly. Typical crack widths up to 5 mm.	
3	50-75	1 in 200 to 1 in 50	Moderate: Cracks may require cutting out and patching. Recurrent cracks can be masked by suitable linings. Brick pointing and possible replacement of a small amount of exterior brickwork may be required. Doors and windows sticking. Utility services may be interrupted. Weather tightness often impaired. Typical crack widths are 5 to 15 mm or several greater than 3 mm	Serviceability Damage
4	> 75	1 in 200 to 1 in 50	Severe: Extensive repair involving removal and replacement of walls especially over door and windows required. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some loss of bearing in beams. Utility services disrupted. Typical crack widths are 15 to 25 mm but also depend on the number of cracks.	
5	> 75	> 1 in 50	Major repair required involving partial or complete reconstruction. Beams lose bearing walls lean badly and required shoring. Windows broken by distortion. Danger of instability. Typical crack widths are greater than 25 mm but depend on the number of cracks	Structural Damage

5.3.3 Underground services

Published literature¹⁷ indicates that the maximum differential settlement for cast iron pipes and brittle services with a diameter of 200 mm or greater is in the order of 1:250. Most of the major services near the proposed works (summarised in Table 3.1) appear to be more flexible materials such as concrete pipe, polyethylene pipes, electrical cables etc. Services running perpendicular to the excavation works are considered to be at the highest risk of damage. In general, where a service is parallel to the excavation works, it may experience horizontal displacement associated with ground loss at the excavation face, as well as similar total settlement but with a gentler settlement slope, i.e. differential settlement.

Settlement tolerance of a service will be dependent on the condition of the current asset and its tolerance to deformation. An allowable differential ground settlement of 1:500 has been conservatively adopted for the services along the proposed excavation works to assess the potential for adverse effects.

6 Geotechnical and groundwater effects assessment results

6.1 General

This section presents the general range of geotechnical effects that we have estimated that could occur from the project's construction activities for the:

- Pump station at 23-27 Brigham Creek Road;
- Gravity main (Brigham Crossing, pipeline trenching and manhole construction);
- Sinton Stream culvert sheets piles; and
- Rising main chambers.

As discussed previously, the rising main pipeline works other than the rising main chambers are understood to meet the permitted activity criteria (refer Beca AEE) and as such have not been assessed in this section.

The estimated total ground settlements (where assessed) are presented as settlement contours on the project site plan presented in Appendix A.

6.2 Pump station at 23-27 Brigham Creek Road

6.2.1 Groundwater drawdown

The following section presents the assessed groundwater drawdown behind the sheet pile seepage cut-off system (wetland side) extending back into the wetland area. Results of our analysis are presented for a steady state condition in the figures below. The analysis assumes recharge back into the wetland environment maintaining a constant head condition of near surface groundwater saturation.

¹⁷ O'Rourke, T D, and C H Trautmann. 1982. Buried pipeline response to tunnel ground movements. In Europipe 82 Conf., Basel, Switzerland, paper 1.

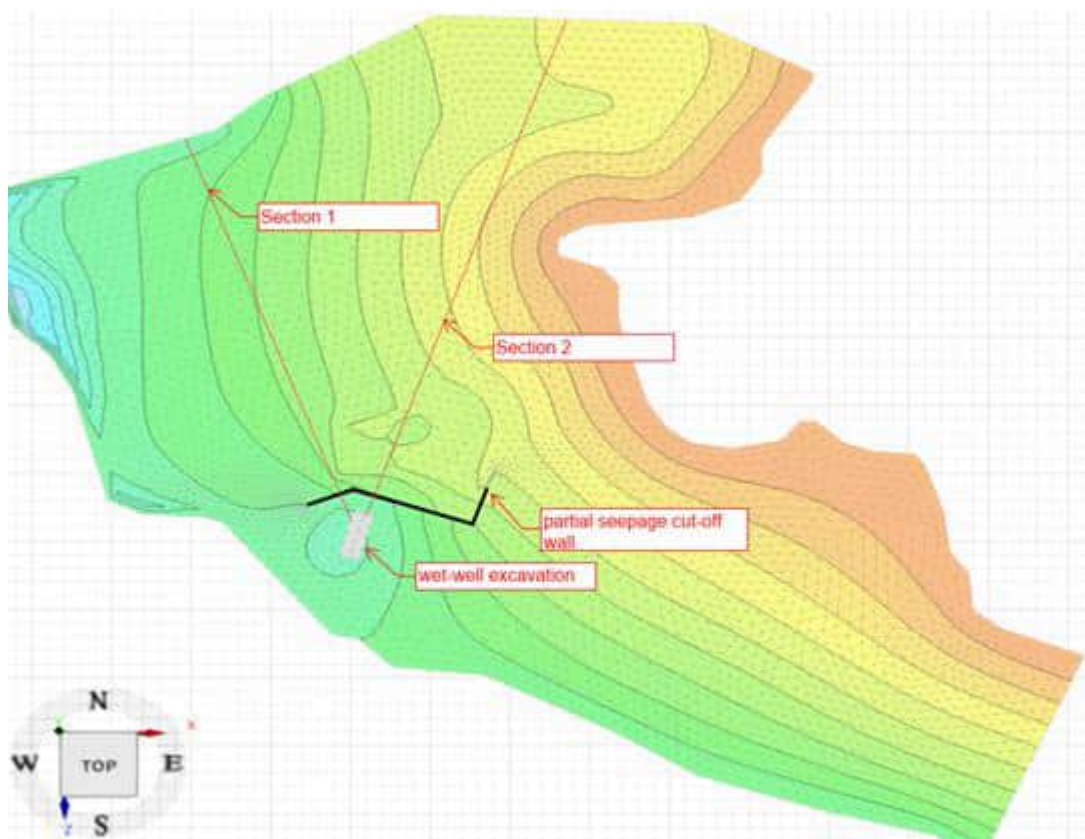


Figure 6.1: Plan view of SEEP3D model and cut sections

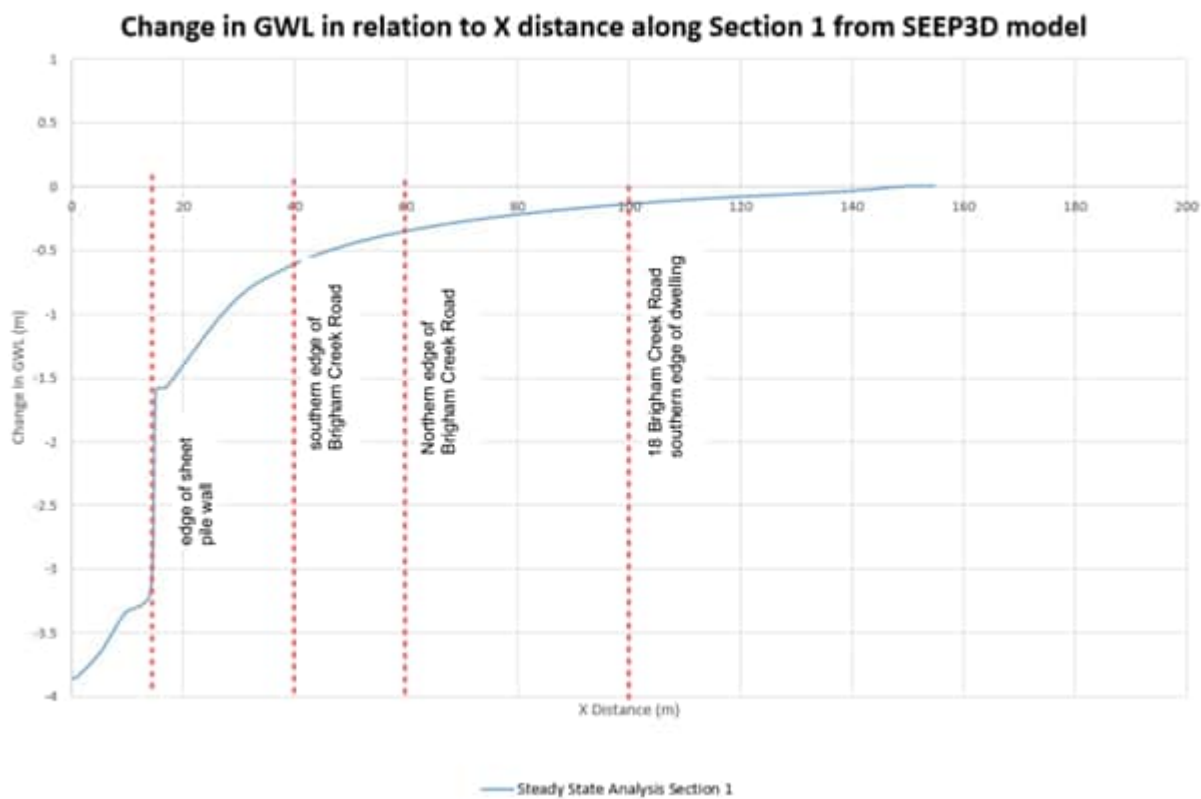


Figure 6.2: Groundwater drawdown along Section 1

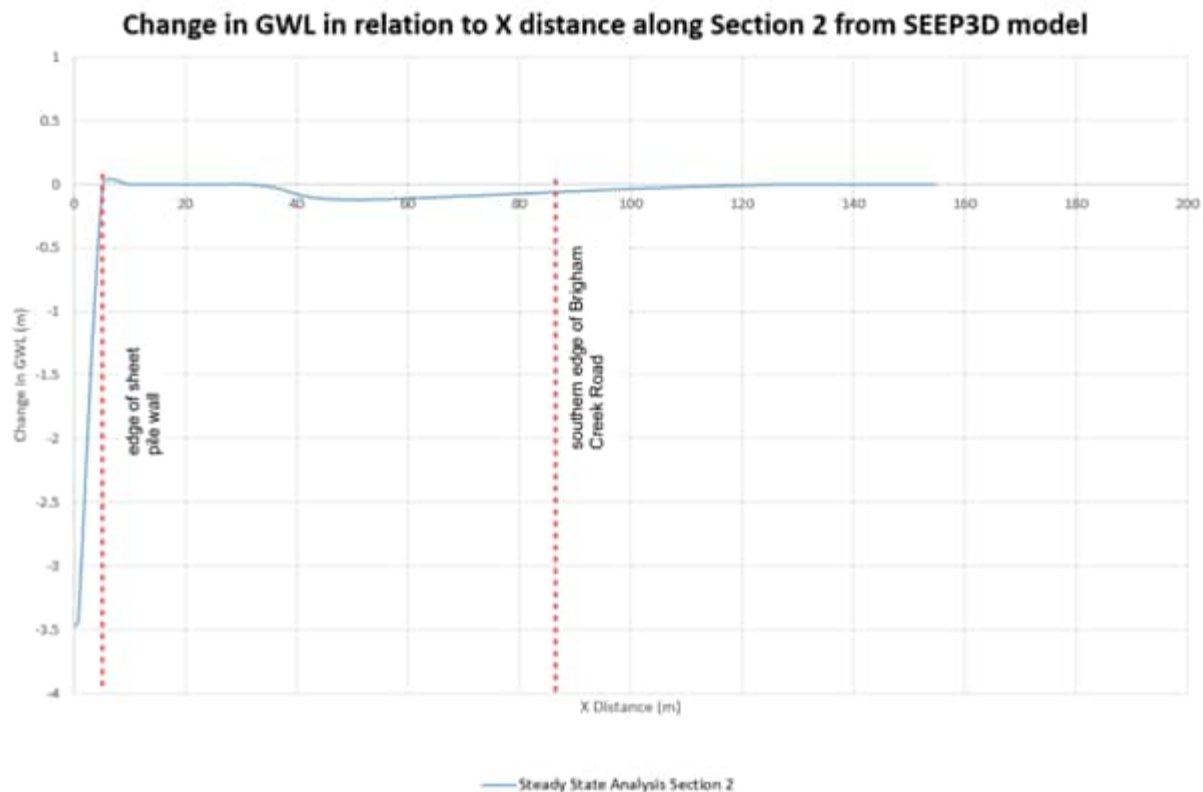


Figure 6.3: Groundwater drawdown along Section 2

6.2.2 Groundwater drawdown induced settlements

Based on our assessed groundwater drawdown, the proposed construction methodology (including installation of sheet pile cut off wall) and adopted ground model, ground settlements are assessed to be 5 mm or less along Section 1 behind the edge of the sheet pile wall (wetland side). These results are presented graphically in Figure 6.4 below.

Settlements along Section 2 are not assessed due to the negligible quantum of groundwater drawdown (less than 0.15 m).

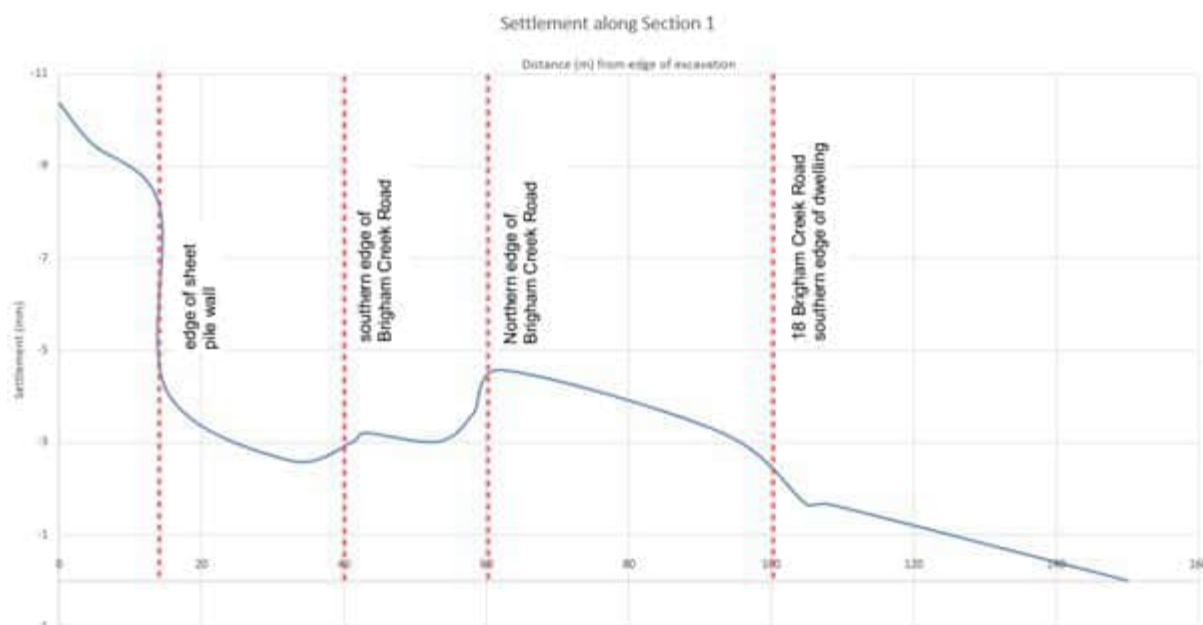


Figure 6.4: Groundwater drawdown induced settlement at the pump station along Section 1

6.3 Gravity main

6.3.1 Brigham Creek Road trenchless crossing

6.3.1.1 Groundwater drawdown induced settlements

We have undertaken an assessment for the Brigham Creek Road crossing adopting the construction methods presented in sections above.

A summary of the results of the groundwater drawdown assessment is presented in Table 6.1. We note that the analysis below assumes no effect from the proposed recharge associated with Wetland C. Effects from recharge are likely to reduce the settlement values predicted in the table below and as such the values presented are considered to be “upper bound” values.

Table 6.1: Groundwater drawdown assessment summary results – Brigham Creek Road crossing shafts

Shaft	Excavation details	Excavation support type	Maximum groundwater drawdown behind retained cut face (m)	Maximum groundwater drawdown settlement behind retained cut face (mm)	Approximate maximum extent of groundwater drawdown (m) ¹
Drive shaft (SSMH-3)	21 m wide with an excavation level of 5.5 mRL including an over excavation of 5.5 mRL.	8.5 m long braced sheet piles with min 4 m embedment	1.0	7	30
Reception shaft (SSMH-4)	10 m wide with an excavation level of 6.0 mRL including an over excavation of 1.0 m.	trench shield	0.9	15	30

Notes: 1. Approximate extent where groundwater drawdown is calculated to be less than 0.1 m.

6.3.1.2 Mechanically induced settlement due to excavation

Table 6.2 presents the maximum expected mechanically induced settlements at the proposed open excavations for the driver and receiver shafts for the Brigham Creek Road crossing. Our analysis has assessed the performance of laterally braced retention systems such as sheet piles with deadman anchors. Table 6.2 presents the expected settlements for the Brigham Creek Road shaft excavations.

Table 6.2: Maximum estimated vertical ground settlement due to mechanical settlement

Location	Excavation depth (m)	Maximum estimated vertical ground settlement due to excavation deformation (mm)
Driver shaft ¹	4.5	20
Receiver shaft ²	4.0	16

Notes:

1. For the driver shaft, lateral bracing has been used in our assessment

The WALLAP outputs are provided in Appendix E.

6.3.1.3 Combined mechanical and groundwater drawdown settlements

The combined effect from both mechanical induced settlement and groundwater drawdown induced settlement for the Brigham Creek Road crossing is presented in **Error! Reference source not found.** below and graphically in Figure 6.5 and Figure 6.6.

Table 6.3: Maximum estimated vertical ground settlement due to excavation at the proposed Brigham Creek Road crossing

Location	Excavation depth (m)	Maximum total estimated vertical ground settlement (mm)
Driver shaft	4.5	23 (allowance for 56 days)
Receiver shaft	4.0	23 (allowance for 56 days)

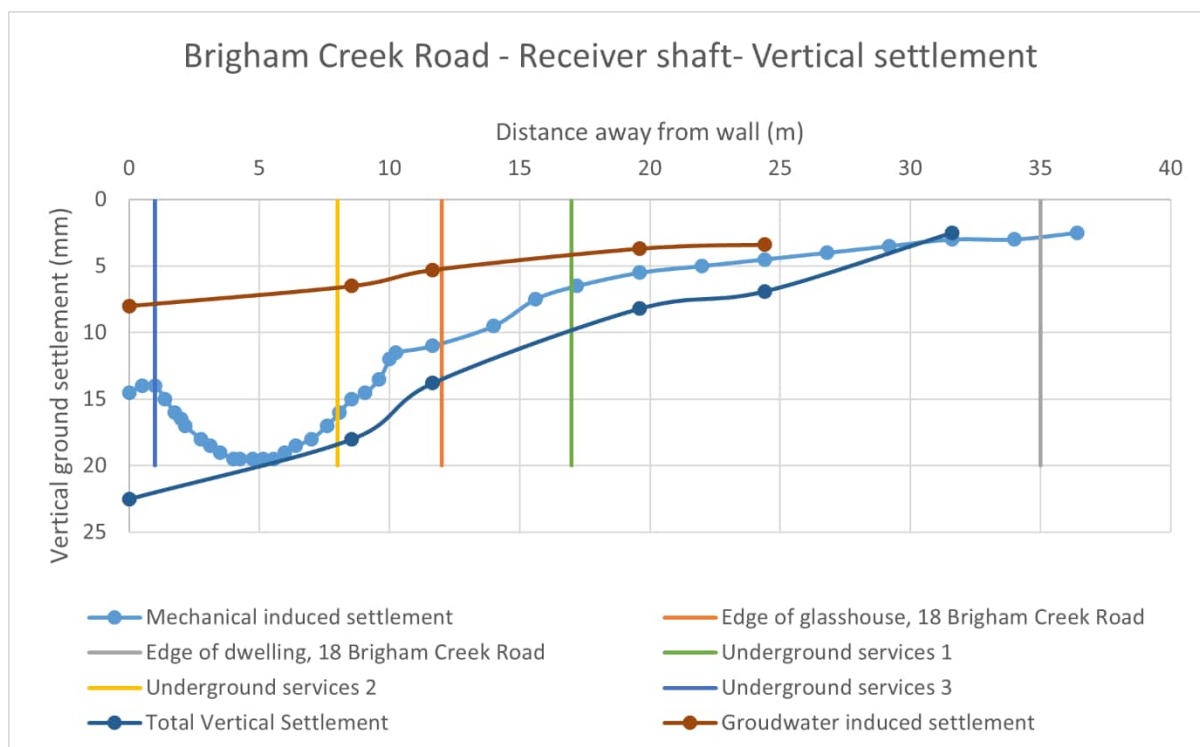


Figure 6.5: Total vertical settlement for the Brigham Creek Road receiver shaft

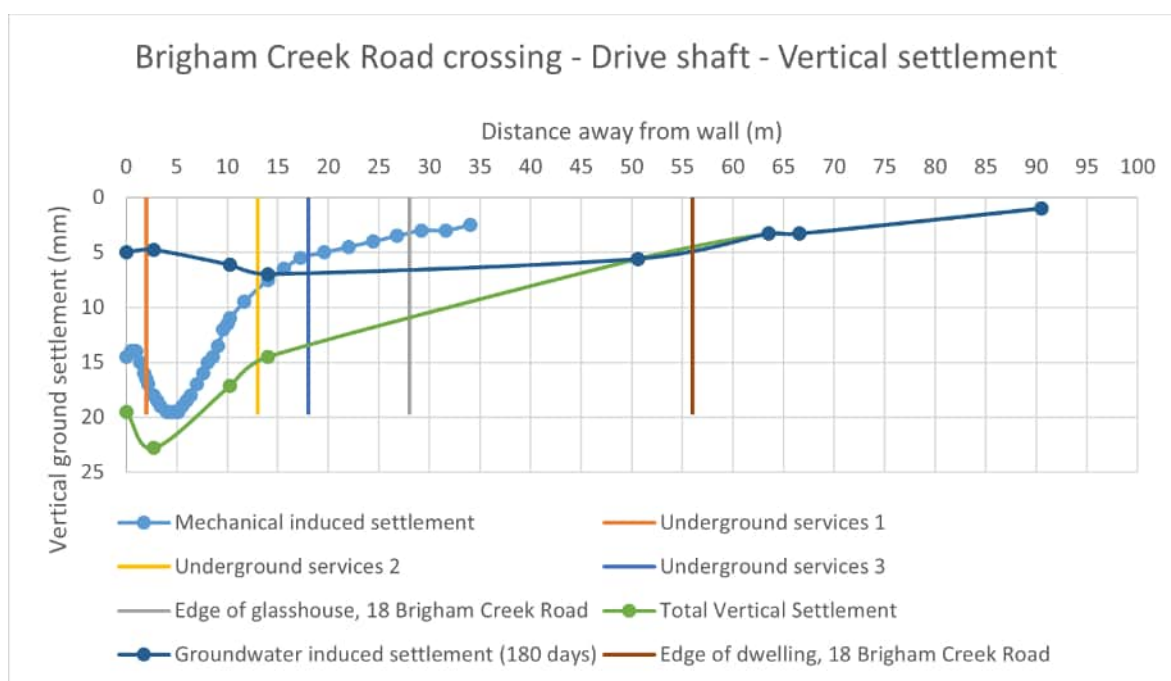


Figure 6.6: Total vertical settlement for the Brigham Creek Road drive shaft

6.3.2 Manhole SSMH11

We have undertaken groundwater drawdown and ground surface settlement analysis for SSMH11. The excavation at SSMH11 is expected to result in the greatest groundwater drawdown and ground settlement effect along the gravity main to the north of Brigham Creek Road due its depth of construction and surrounding ground conditions. We assess that the results from SSMH11 can be conservatively applied to SSMH5 through to SSMH10.

6.3.2.1 Groundwater drawdown induced settlements

A summary of the results of the groundwater drawdown assessment for SSMH11 is presented in Table 6.4.

Table 6.4: Groundwater drawdown assessment summary results – trenched excavations

Location	Excavation details	Excavation support type	Maximum groundwater drawdown behind retained cut face (m)	Maximum groundwater drawdown settlement behind retained cut face (mm)	Radius of influence (m) ¹
Gravity main – SSMH11 - 40, 42 and 44 Tamiro Road	5.1 m bgl (2.5 m below groundwater level)	Trench shield	2.75	19	20

Notes: 1. Radius of influence assessed using CIRIA R113

6.3.2.2 Mechanically induced settlement due to excavation

The maximum expected mechanically induced settlements assessed at SSMH11 are presented in Table 6.5, respectively.

Table 6.5: Estimates of expected mechanically induced settlements along the proposed gravity main

Location	Excavation depth from existing ground level (m)	Maximum estimated vertical ground settlement due to excavation deformation (mm)
Gravity main – SSMH11 - 40, 42, 44 and 46 Tamiro Road	5.1	20

6.3.2.3 Combined mechanical and groundwater settlements

The combined effect from both mechanical induced settlement and groundwater drawdown induced settlement for SSMH11 is presented in Table 6.6 below.

Table 6.6: Maximum estimated vertical ground settlement due to excavation at SSMH11

Location	Maximum estimated vertical ground settlement due to excavation deformation (mm) [ZOI]	Maximum estimated vertical ground settlement due to groundwater drawdown (mm) [ZOI]	Total estimated vertical ground settlement (mm) [ZOI]
Gravity main – SSMH11 - 40, 42 and 44 Tamiro Road	20 [20]	20 [20]	39 [20]

6.3.3 Construction settlement due to micro-tunnelling (SSMH11 to SSMH12)

The pipeline will be excavated within Takaanini Formation, so it can be expected that the annulus will close, either partially or entirely. Closure of the annulus reduces the effectiveness of attempting to fill the annulus and results in ground settlement. The potential ability to achieve a fully or partially grouted annulus is considered to be low to moderate, depending on the size of the annulus and the ability of the bentonite to maintain the annulus prior to being replaced by grout. For the purpose of an effects assessment, it is prudent to assume near-complete annulus closure. Adopting a 0.4 m external diameter pipe with minimum 1 m ground cover, the assessed mechanically induced settlement for 4% volume loss is less than 5 mm.

6.4 Rising main

6.4.1 Sinton Stream sheet piling for culvert

To enable the construction of the Sinton Stream culvert, sheet piles shall be driven into the existing bank to provide slope stability to enable construction. The depth of the sheet piles have not been confirmed but are expected to be up to 5m deep. The sheet piles are expected to intersect groundwater and result in localised diversion for the period that the sheet piles are required (up to 12 weeks). Given the sloping terrain of the bank, the nature of the ground conditions (silt and sand rich mixtures), and the leaky nature of the sheet piles, we assess that damming of groundwater behind the sheets shall be localised in nature. Furthermore, any water dammed behind the sheets is ultimately expected to flow around the sheets into Sinton Stream and thus is not expected to reduce base flows in Sinton Stream.

6.4.2 Chamber Construction

An air valve chamber and connection chamber will be constructed as part of the rising main. The chambers will require excavations approximately 3.3 m and 2.4 m deep respectively. The excavations are expected to take up to 4 weeks to construct and backfill.

The depth of excavation for both chambers is above the lowest groundwater level recorded (summary provided in Table 6.7). As such, groundwater drawdown effects are assessed to not be consequential upon ground settlement or groundwater users.

Mechanical settlement effects are assessed to be limited to a horizontal zone of influence equal to the excavation depth (3.3 m or less). As there are no structures within the zone of influence, a detailed assessment has not been undertaken.

Table 6.7: Summary of groundwater low levels near proposed chamber excavations

Chamber	Nearest monitoring well	Lowest groundwater level required (m bgl)	Approximate excavate depth for chamber (m)
Air valve chamber	BH05B	4.6	3.3
Connection chamber	BH06	3.8	3.4

6.5 Assessment effects on buildings

Total and differential settlements have been assessed for existing buildings along the proposed gravity main. Table 6.8 presents the buildings which have been assessed for potential damage induced by ground settlement associated with the proposed works.

Table 6.8: Summary of building settlements induced from construction works

Location	Horizontal distance from nearest excavation to edge of dwelling (m) from:	Estimated Maximum assessed surface settlement across building (mm)	Estimated Maximum assessed differential settlement across building (mm)	Assessed Settlement Risk Category
18 Brigham Creek Road Dwelling (Gravity main)	SSMH-5: 25 SSMH-4 Receiving shaft: 35	<5	Less than 1V:2000H	0 to 1 – negligible to very slight
44 Tamiro Road (Gravity main)	SSMH11 Drive Shaft: 25 (outside expected zone of influence)	<5	Less than 1V:2000H	0 – negligible
42 Tamiro Road (Gravity main)	SSMH11 Drive Shaft: 30 (outside expected zone of influence)	<5	Less than 1V:2000H	0 – negligible
40 Tamiro Road (Gravity main)	SSMH11 Drive Shaft: 40 (outside expected zone of influence)	<5	Less than 1V:2000H	0 – negligible

6.6 Assessment of effects on underground services

Underground services along Brigham Creek Road are within the zone of influence of the shaft excavations associated with the pipe jack works. Table 6.9 presents the services which have been assessed for potential damage induced by ground settlement associated with the proposed excavations.

Maximum total and differential settlements are assessed to be 28 mm and 1V:300H respectively for the group level 3 services. At this level of total and differential settlement, we assess that the risk of damage to underground services to be low to moderate. As such, the contractor will need to assess appropriate construction controls and mitigation measures to limit effect to the services in consultations with the asset owners.

Maximum total and differential settlements are assessed to be less than 20 mm and 1V:500H respectively for the group level 2 and 1 services. At this level of total and differential settlement, we assess that the risk of damage to underground services to be low

We recommend that the asset owners of the underground services are engaged to manage risks to each service during detailed design to establish suitable controls.

6.7 Assessment of effects on Brigham Creek Road

The predicted total and differential settlement on the Brigham Creek Road pavement are outlined in the contour plan presented in Appendix A. The maximum total and differential settlement is assessed to occur at the pipe jack receiving shaft. The settlement profile is shown in Figure 6.5. The total combined settlement is assessed to be up to 28 mm and have a maximum differential settlement of 1V:300H. We note that the existing roadway has already experienced movement resulting in some surface cracking and deformation. On this basis, it is difficult to assess what effect the additional potential movement may have upon the roadway. We recommend that the asset owner is engaged to assess the effect to the roadway and to establish suitable controls.

Table 6.9: Summary of settlements to underground services included from construction works

Location	Horizontal distance to edge of services (m) from:	Estimated Maximum assessed surface settlement across services (mm)	Estimated Maximum assessed differential settlement across service (mm)	Qualitative Risk Assessment of Damage
Group 1 - Fibre Optic cable – Vodafone New Zealand Ltd, unknown material type - Water pipe local – Watercare Services Limited, 315 mm polyethylene - Telecommunications cable - Vocus Group NZ Limited, 32 mmP (96F) - Telecommunication cable – Chorus New Zealand Limited, unknown material	Pump station: 60 Gravity Main ² : 0 Drive shaft ¹ : 2 Reception shaft ¹ : 20	14	1V:500H	low
Underground services – group 2 Gas line – Vector Limited, MP4 100 mm polyethylene	Pump station: 70 Gravity Main ² : 0 Drive shaft ¹ : 14 Reception shaft ¹ : 9	18	1V:500H	low
Underground services – group 3 Water pipe local – Watercare Services Limited, 150 mm asbestos-cement	Pump station: 74 Gravity Main: 0 Drive shaft ¹ : 18 Reception shaft ¹ : 5	28	1V:300H	Low to moderate

Notes:

1. Refers to the Brigham Creek Road crossing shafts.
2. Proposed Gravity Main crosses over these services

6.8 Assessment of effects on other matters

6.8.1 Saline intrusion

We understand that dewatering will continue for up to 30 months. Our evaluation is that the risk of saline intrusion is low given the proposed construction methodology, the low hydraulic conductivity of the Takaanini Formation, the use of sheet piling, excavations are expected to be above sea level and that groundwater drawdown levels are expected to remain above sea level.

6.8.2 Neighbouring bores

The closest recorded bore to the proposed excavation is bore ID WAT60277201, located approximately 140 m to the northwest of the proposed SSMH-5 excavation. Drawdowns are assessed as very small (less than 0.5 m) at distances greater than 100 m from the excavation edge. On this basis no other piezometers are likely to be affected.

Groundwater drawdown that may occur at neighbouring bores is assessed to be temporary in nature associated with construction excavations. Given the distance of this the bore from the proposed works, it is assessed that dewatering effects are likely to be negligible on the bore.

6.8.3 Neighbouring wetlands

There are two wetlands located within the pump station site. Wetland C is located to the north of the proposed excavations, and Wetland D is located across the eastern portion of proposed excavation (Figure 6.7).

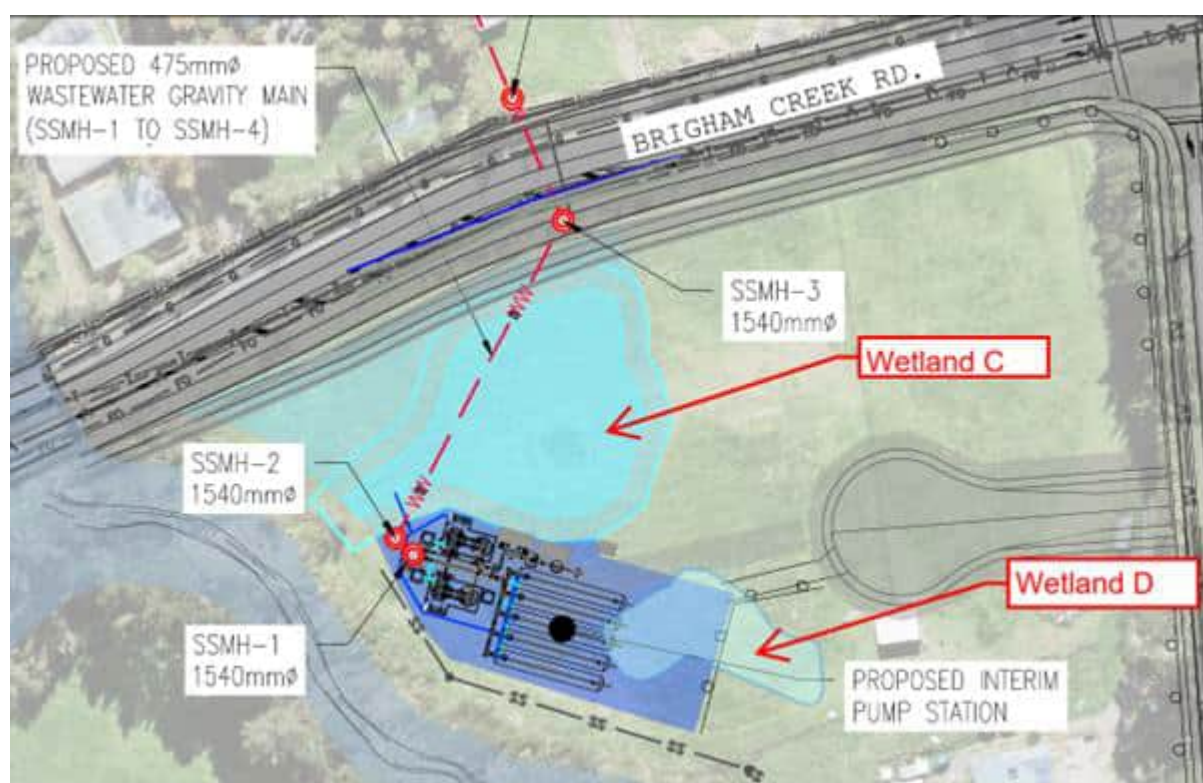


Figure 6.7: Pumpstation site plan showing approximate wetland extend

The proposed construction methodology allows for construction of a temporary sheet pile cut off wall between the excavation and Wetland C, and recharge to the Wetland C is to be undertaken to maintain hydrological conditions within the wetland to acceptable levels. The effects of Wetland C are expected to be monitored through the adaptive GSMCP and Wetland Monitoring and Reinstatement Plan provided as Appendix G of the Beca AEE with the possibility to adjust recharge rates accordingly. The effects of groundwater drawdown are presented in the Ecological Impact Assessment¹⁸, which is provided as Appendix C to the Beca AEE.

¹⁸ Whenuapai Wastewater Servicing Scheme Package 1: Ecological Impact Assessment, Beca, September 2023

We assess that base flows through Wetland C are unlikely to be materially reduced from upstream activities as excavations for the pump station and the Bringham Creek Road trenchless crossing are downstream of the wetland.

The proposed works will result in excavations extending into the mapped area of Wetland D. As a result, temporary dewatering will occur to Wetland D during the construction of the storage tanks at the proposed pump station. During construction, a Wetland Monitoring and Reinstatement Plan shall be implemented as well as recharge across the wetland to minimise effects. Upon completion of construction, Wetland D is proposed to be reinstated.

6.8.4 Base flow to Sinton Stream

During construction, it is expected that groundwater pumped from excavations will be discharged into the local stormwater network which flows into Sinton Stream or directly back into Wetland C and D which then flows into Sinton Stream. Given the proximity of the excavations to the Sinton Stream outlet, the depth of groundwater dewatering, and the proposed recharge activities, we assess that changes to base flow will be low.

6.9 Long term effects

Ongoing long-term groundwater drawdown is considered unlikely as the completed pipeline, manhole and pump station infrastructure should be a closed or watertight system. Groundwater levels are expected to return back to similar levels as prior to construction.

Ground settlement associated with construction is likely to occur in a relatively short period of time. The rate of settlement is expected to be the greatest during construction and reduce once the excavations are complete and backfilled. Ground settlement will stop once groundwater levels return to above their natural historic low.

Any ground settlements that does occur is considered to be non-recoverable and therefore permanent, even when groundwater levels recover.

Backfilling of excavations should not result in long term changes in groundwater flow provided that the backfilling of excavations is carried out in accordance with appropriate geotechnical engineering recommendations, Watercare's Design Principles 07, and the Auckland Council Stormwater Code of Practice.

6.10 Monitoring programme

We recommend an adaptive groundwater and settlement monitoring programme during construction. The requirements of the monitoring programme, including Alert and Alarm levels, will be set out in the Groundwater and Surface Monitoring Contingency Plan (GSMCP). The plan includes groundwater drawdown, surface settlement and building settlement monitoring.

Baseline monitoring of ground surface settlement and building settlement points should be undertaken for a minimum of 6 months prior to commencement of construction to establish seasonal variability.

In addition, groundwater monitoring bores located within the boreholes BH05A, BH05B, BH06, BH08, BH110, BH111, BH113, BH116, and BH117 (referenced in this assessment) should be monitoring for a minimum period of 6 months prior to commencement of construction to establish baseline levels.

7 Conclusion

This Groundwater and Settlement Effects Report has been prepared by T+T to support an Assessment of Effects on the Environment (Beca AEE) for Whenuapai-Redhills Wastewater Servicing Scheme – Package 1.

The estimated total ground settlements (where assessed) are presented as settlement contours on the project site plan presented in Appendix A.

Based on our technical assessment, we conclude:

Pump Station at 23-27 Brigham Creek Road

- Ground settlement effects arising from pump station and storage tank construction on surrounding structures is assessed to be negligible (0) to very slight risk (1) of damage.

Gravity Main

- Ground settlement effects arising from the construction of the gravity main (shafts, chamber and pipe jack) by means of open cut and/or direction drill on surrounding structures is assessed to be negligible (0).
- Ground settlement effects arising from the Brigham Creek Road pipe jack upon buried services expected to be low to moderate.
- Maximum total and differential settlements across Brigham Creek Road are assessed to be 28 mm and 1V:300H respectively. At this level of total and differential settlement, we assess that the risk of damage to underground services to be low to moderate. We recommend that the asset owners are engaged to assess the effect to the roadway and services, and to establish suitable controls during construction.

Rising Main

- Ground settlement and groundwater drawdown effects arising from the chamber construction is assessed to be negligible as there are no structures or services within the zone of influence.
- Damming effects associated with the Sinton Stream sheet piling works are assessed to be localised to the stream bank and not expected to significantly impact upon base flows into Sinton Stream.

Groundwater

- The risk of saline intrusion is assessed to be low.
- The impacting upon neighbouring groundwater bores is assessed to be negligible.
- Base flows through Wetland C are unlikely to be materially reduced as excavations for the pump station and the Brigham Creek Road trenchless crossing are downstream of the wetland and the effects of the pump station excavation shall be managed through installation of a temporary sheet pile cut-off wall, groundwater recharge and adaptive management plans.
- Temporary dewatering will occur to Wetland D during the construction of the storage tanks at the proposed pump station. During construction, a Wetland Monitoring and Reinstatement Plan shall be implemented as well as recharge across the wetland to minimise effects. Upon completion of construction, Wetland D is proposed to be reinstated.
- We assess that changes to base flow in Sinton Stream arising from the pump station and Brigham Creek Road trenchless crossing will be low.

Monitoring

We recommend an adaptive groundwater and settlement monitoring programme during construction that includes monitoring of groundwater drawdown, surface settlement and building settlement monitoring. In addition, groundwater monitoring bores located within the boreholes BH05A, BH05B, BH06, BH08, BH110, BH111, BH113, BH116, and BH117 (referenced in this assessment) should be monitoring for a minimum period of 6 months prior to commencement of construction to establish baseline levels.

8 Applicability

This report has been prepared for the exclusive use of our Beca Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Recommendations and opinions in this report are based on data from discrete investigation locations. The nature and continuity of subsoil away from these locations are inferred but it must be appreciated that actual conditions could vary from the assumed model.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:



Eduard Mandru
Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:



Tim Coote
Project Director

EDMA

\\ttgroup.local\files\aklprojects\1013050\workingmaterial\geotechnical\geotechnical assessment of effects report\1013050 whenuapai package 1 aoe v5 final.docx

Appendix A Site investigation plan and settlement contour plans



LEGEND

EXISTING

- W — W — WATER NETWORKS
- SS — SS — WASTEWATER NETWORKS
- SW — SW — STORMWATER
- G — G — GAS
- E(OH) — E(OH) — OVERHEAD POWER CABLES
- T — T — TELECOMMUNICATION
- FO — FO — TELECOM FIBRE OPTIC
- — — — — PROPERTY BOUNDARY
- // — // — FENCE
- — — — — OVERLAND FLOW PATH
- 100-YEAR FLOOD PLAIN

PROPOSED

- WW — WW — WASTEWATER GRAVITY
- SSMH — SSMH — WASTEWATER MANHOLE

Settlement Contours:

- Approx 5mm settlement contour line
- Approx 10mm settlement contour line
- Approx 15mm settlement contour line
- Approx 20mm settlement contour line
- Approx 5mm settlement contour line if open trench method adopted

Note:

- Settlement contours of greater than 5 mm have not been displayed where there are no structures
- No mechanical settlements have been assessed for the pump station site.
- Settlement contour extents are approximate.

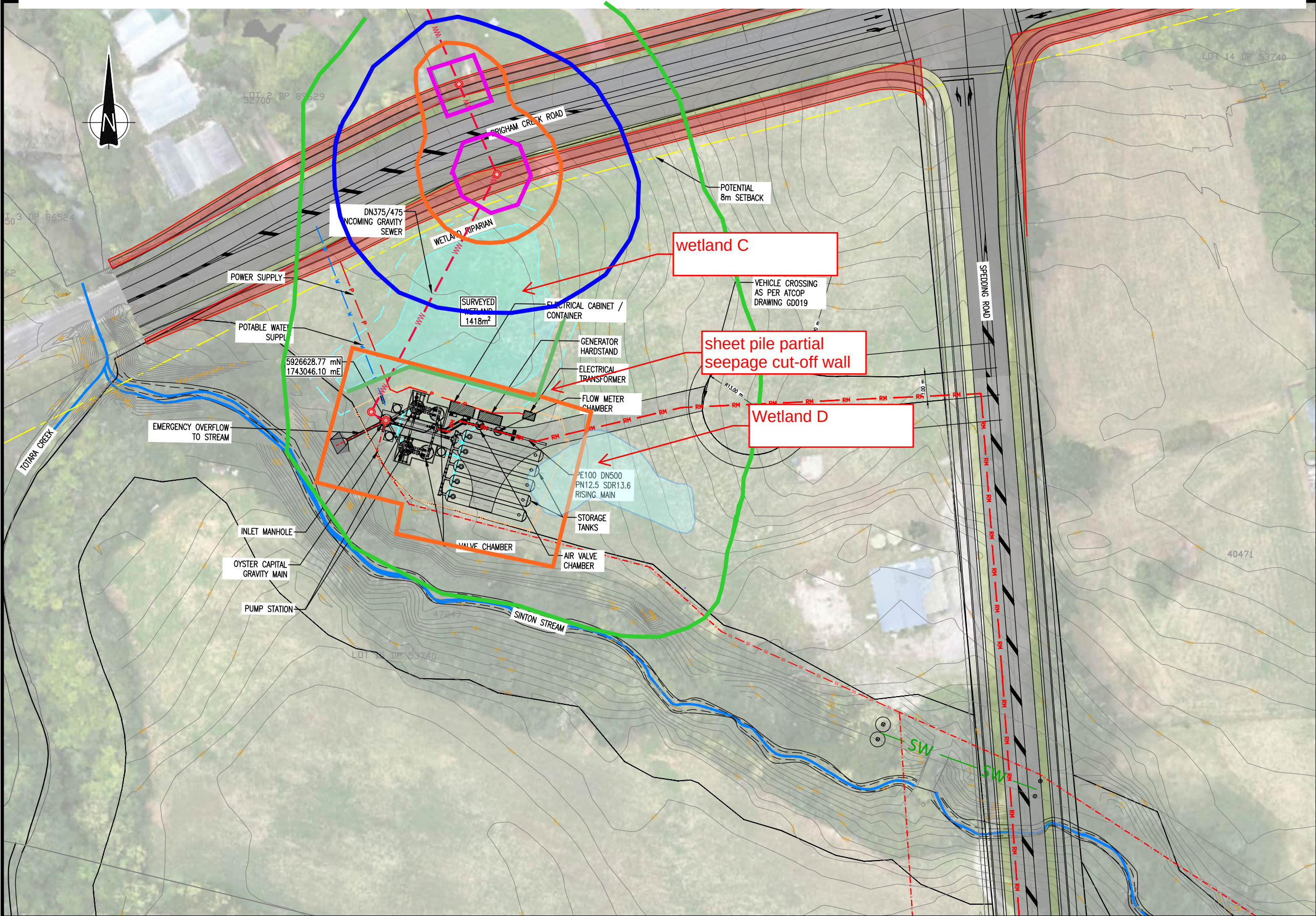
Map Labels:

- EXISTING SSMH 2696093
- EXISTING WHENUAPAI VILLAGE PUMP STATION
- EXISTING SSMH 2695930
- SSMH-11 1540mmØ
- SSMH-10 1540mmØ
- SSMH-9 1540mmØ
- SSMH-8 1540mmØ
- SSMH-7 1540mmØ
- SSMH-6 1540mmØ
- SSMH-5 1540mmØ
- SSMH-4 1540mmØ
- SSMH-3 1540mmØ
- SSMH-2 1540mmØ
- SSMH-1 1540mmØ
- PROPOSED 375mmØ WASTEWATER GRAVITY MAIN (SSMH-4 TO EXISTING SSMH 2696093)
- PROPOSED 475mmØ WASTEWATER GRAVITY MAIN (SSMH-1 TO SSMH-4)
- PROPOSED INTERIM PUMP STATION
- 18 Brigham Creek Road
- 20 Brigham Creek Road to be occupied by WSL and used as laydown
- Pipe hammer construction method proposed between SSMH-3 and SSMH-4
- Wetland C
- sheet pile partial seepage cut-off wall
- Wetland D
- Trenchless construction proposed between SSMH-11 and Existing SSMH 2696093

DETAILED DESIGN
NOT FOR CONSTRUCTION

				DESIGNED	PH	12-21		WHENUAPAI-REDHILLS WASTEWATER SERVICING BRIGHAM CREEK ROAD, WHENUAPAI INTERIM SLAUGHTERHOUSE PS - WASTEWATER GRAVITY MAIN - GENERAL LAYOUT	 	CAD FILE	R0017910.002	DATE	10-12-21
				DES. APPROVED	SW	12-21				ORIGINAL SCALE	A3 1:2000	CONTRACT No.	6484-6934
3	12-21	ISSUED FOR DETAILED DESIGN	J.C.	DRAWN	JC	12-21				REF No.	12508391 3-AWD32		
2	8-21	RE-ISSUED FOR PRELIMINARY DESIGN	J.C.	DWG. APPROVED	DJ	12-21				DWG No.	R0017910.004	ISSUE	3
1	5-21	ISSUED FOR PRELIMINARY DESIGN	J.C.	WSL DESIGN MGMT.			COPYRIGHT - This drawing, the design concept, remain the exclusive property of Watercare Services Limited and may not be used without approval. Copyright reserved.						
ISSUE	DATE	AMENDMENT	BY	APPD.	BY	DATE							
				WSL PROJ. LEAD									

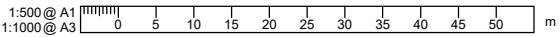
T+T MARK-UP WITH SURFACE GROUND SETTLEMENT CONTOURS ARISING FROM PROPOSED CONSTRUCTION WORKS



LEGEND:

- EXISTING LOT BOUNDARY
- 8.00 EXISTING GROUND LEVEL
- 8.10 EXISTING GROUND LEVEL
- POTENTIAL SETBACK
- RM RISING MAIN
- P POWER SUPPLY
- SECURITY FENCE AND WSL OWNED
- W WATER SUPPLY
- WETLAND BOUNDARY
- STREAM
- WW WASTEWATER GRAVITY SEWER
- SS OYSTER CAPITAL GRAVITY SEWER (TBC)
- Approx 5mm settlement contour line
- Approx 10mm settlement contour line
- Approx 15mm settlement contour line
- Approx 20mm settlement contour line

Note:
1. Settlement contours of greater than 5 mm have not been displayed where there are no structures.
2. No mechanical settlements have been assessed for the pump station site.
3. Settlement contours extents are approximate.



DETAILED DESIGN
NOT FOR CONSTRUCTION

ISSUE	DATE	AMENDMENT	BY	APPD.	DESIGNED	DES. APPROVED	BY	DATE
4	01-22	DETAILED DESIGN ISSUE	SA	MG	SA	MG	BR	03-21
3	10-21	SAFETY IN DESIGN	SA	MK	SA	MK	EW	03-21
2	08-21	RE-ISSUED FOR PRELIMINARY DESIGN	Ev	MK	SA	MK	EW	03-21
1	03-21	PRELIMINARY DESIGN ISSUE	AJ	BR	SA	MK	EW	03-21

Watercare

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WHENUAPAI-REDHILLS WASTEWATER SERVICING PACKAGE 1
WASTEWATER PUMP STATION (DPISH)
OVERALL PLAN



CAD FILE	2013646.003	DATE	14-01-2022
ORIGINAL SCALE	A3 1:500	CONTRACT No.	6484-6934
REF No.	12508391 3-AWD32	DWG No.	2013646.003
ISSUE	4		

Appendix B Site investigation data

BOREHOLE LOG

BOREHOLE No.:

BH05A

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT		DESCRIPTION OF CORE				Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
		SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation												Description & Additional Observations																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
Top		Sandy gravelly SILT, trace organics; brown & grey. Firm, moist, low plasticity; sand, fine to coarse, Quartz, gravel, fine to coarse, subangular, unweathered, Basalt & Concrete; organics, rootlets.						PQTT	46	1 @ 0.10m 1 x Glass Jar 1x plastic Jar																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										</

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Box 1, 0.0-3.0m

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH05A

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	4.95 - 5.35 m: CORE LOSS					6 @ 5.00m 1 x Glass Jar 1x plastic Jar												
	Organic clayey SILT, trace rootlets; dark brown speckled black. Stiff, moist, high plasticity. Organics; amorphous			PQTT	61			5.5										
	6.25 - 6.45 m: CORE LOSS			SPT	55	0/- kPa 1/0 0/1 N=2		6.0					6.00m: Shear Vane failed					
	PEAT (AMORPHOUS), minor sand; dark brown, homogeneous. Firm to stiff, moist; sand, fine.							6.5										
	Organic SILT; dark brown speckled black. Stiff, moist, low plasticity. Organics; amorphous			PQTT	100			7.0										
Albany Conglomerate	PEAT (AMORPHOUS), minor sand; dark brown. Firm to stiff, moist; sand, fine.							7.5										
	7.50m: Very stiff			SPT	116/29	0/1 2/2 3/4 N=11		8.0										
	Completely weathered, grey, SANDSTONE. Extremely Weak, (Recovered as SAND; grey. Medium dense, moist, poorly graded; sand, fine).							8.5										
	8.2 - 9.0 m: CORE LOSS			PQTT	23			9.0										
	9.0 - 9.45 m: Solid Cone SPT			SPT	0	UTP 3/3 5/5 5/6 N=21 Solid		9.5					9.00 - 10.50m: Re-drilled due to core loss					
	Completely weathered, brown-grey, massive, SANDSTONE. Extremely Weak, (Recovered as SAND, minor gravel; brown-grey. Medium dense, moist, poorly graded; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered, Sandstone & Siltstone).																	

Box 2, 3, 0-6.8m

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH05A

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Albany Conglomerate	10.05 - 10.5 m: CORE LOSS			PQTT	57													
	Highly weathered, brown and dark grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Gravelly SAND; brown & dark grey. Medium dense, moist; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered).			SPT	93	UTP 4/4 5/5 7/7 N=24	10.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as GRAVEL; grey. Moist; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone).			PQTT	76		11.0											
	Moderately weathered, grey, SANDSTONE. Extremely Weak, Weakly cemented. SAND; grey. Very dense, moist, poorly graded; sand, fine.						11.5					0						
	11.75 - 12.0 m: CORE LOSS																	
	12.0 - 12.25 m: Solid cone SPT			SPT	100	UTP 5/21 27/23 N>=50	12.0											
	Highly weathered, brown & grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Sandy GRAVEL; brown & grey. Medium dense, moist, poorly graded; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & siltstone; sand, fine to coarse).						12.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (recovered as GRAVEL; grey. Gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone)			PQTT	56		13.0					0						
	Moderately weathered, grey, SANDSTONE. Extremely Weak, very weakly cemented. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).						13.5											
	13.5 - 13.64 m: Solid Cone SPT			SPT	0	15/35 for 65mm N>=50 Solid	13.5											
	Unweathered, grey, SANDSTONE. Extremely Weak, Widely spaced fractures. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).			PQTT	129		14.0					63						
	13.96 - 13.98m: Slightly weathered, grey, SILTSTONE. Extremely Weak. SILT; grey. Hard, moist, low plasticity.						14.5											

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926551.90 mN	DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
	1743191.10 mE	DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
	R.L.: 9.00m		DRILLED BY: McMillan Drilling
DATUM:	NZVD2016		LOGGED BY: ROM CHECKED: CBM



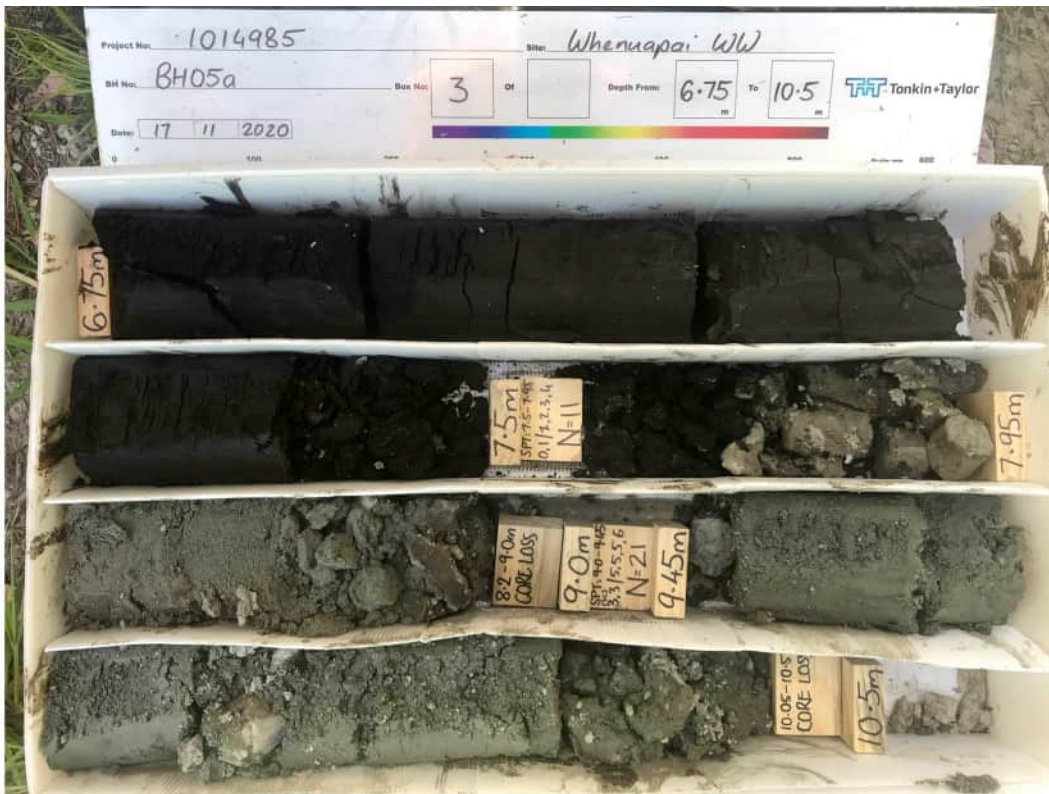
0.00-3.00m



3.00-6.75m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926551.90 mN	DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
	1743191.10 mE	DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
	R.L.: 9.00m	DRILLED BY: McMillan Drilling	LOGGED BY: ROM
DATUM:	NZVD2016		CHECKED: CBM



6.75-10.50m



10.50-13.20m

CORE PHOTOS

BOREHOLE No.: **BH05A**

SHEET: 3 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926551.90 mN (NZTM2000) 1743191.10 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.: 9.00m		DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM: NZVD2016			DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



13.20-15.14m

BOREHOLE LOG

BOREHOLE No.:
BH05B

SHEET: 1 OF 2

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 18/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926553.70 mN
(NZTM2000) 1743191.30 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100	Rock Strength UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%) 25 50 75	Water Level 01/12/2020	Casing	Installation	Core Box No
	Description & Additional Observations																	
	Defect Log									Fracture Spacing (mm) 2000 1600 1200 800 400 200 100 50 20	RQD (%)							
	Wash drilled to 7.0 m BGL. See BH05A for geology details							9	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	

COMMENTS: 50 mm standpipe piezometer with screened interval from 3.5 - 5.5 m.

Hole Depth
7m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	Organic SILT; brown. Hard, moist, non-plastic. 0.30 - 0.40m: Very stiff; [Recovered from next run].			PQTT	40	● UTP												
Tauranga Group	SILT, trace sand; light brown mottled orangish brown. Stiff, moist, low plasticity; sand, fine.			PQTT	140			0.5					0.50m: PID - 0.1 ppm					
	0.6 - 0.75 m: CORE LOSS																	
	SILT, trace sand; light grey mottled orangish brown. Stiff, moist, low plasticity; sand, fine.			PQTT	140			1.0					1.00m: PID - 0.0 ppm					
	Clayey SILT, trace sand; light grey mottled orangish brown. Firm, moist, high plasticity; sand, fine.			PQTT	140			1.5										
	SILT, some clay, trace organics; light grey. Firm, moist, medium plasticity; organics, rootlets.			SPT	100	● 36/5 kPa 0/0 0/1 1/1 N=3		2.0										
	Sandy SILT, trace organics; light grey mottled orangish brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.			PQTT	100			2.5										
East Coast Bays Formation	SILT, some clay and sand; grey. Stiff, moist, medium plasticity; sand, fine.			PQTT	100			3.0										
	SAND; grey. Loose, moist; sand, fine.			SPT	100	● 34/8 kPa 1/0 1/1 1/1 N=4		3.5										
	3.45 - 3.55 m: CORE LOSS																	
	SILT; grey. Stiff, moist, low plasticity.			PQTT	90			4.0										
	Clayey SILT; grey. Stiff, moist, high plasticity.			PQTT	90			4.5										
	Sandy SILT; grey. Stiff, moist; sand, fine.			PQTT	90													
	Silty SAND; grey. Loose, moist; sand, fine.			SPT	100	● 0/- kPa crumble soils 1/1 1/2 1/2 N=6												

COMMENTS: Piezometer installed with screened interval from 3.5 - 5.0 m

Hole Depth
15.12m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
East Coast Bays Formation	[Cont.] Silty SAND; grey. Loose, moist; sand, fine.																	
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as SILT, trace sand; grey. Very Stiff, moist; sand, fine.).			PQTT	100			5.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Sandy SILT; grey. Very Stiff, moist, non-plastic; sand, fine).																	
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Loose, moist; sand, fine).			SPT	100	0/- kPa crumble soils 1/2 1/3 2/3 N=9		6.0										
	6.45 - 6.6 m: CORE LOSE							6.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Sandy SILT; grey. Hard, moist, non-plastic; sand, fine).			PQTT	85			7.0										
	6.90 - 6.95m: Silty SAND; grey. Loosely packed, moist; sand, fine. 6.95 - 7.17m: Very stiff.																	
	7.17 - 7.25m: Very stiff; carbonaceous.																	
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).			SPT	100	0/- kPa crumble soils 2/2 2/3 3/3 N=11		7.5										
	7.40 - 7.50m: Sandy SILT; light grey. Very stiff, moist, non-plastic; sand, fine. 7.50 - 7.95m: Sand, coarse.																	
	7.95 - 8.1 m: CORE LOSS							8.0										
	Highly weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).			PQTT	85			8.5										
	Highly weathered, grey, SILTSTONE. Extremely Weak. (Recovered as Clayey SILT, minor sand; grey. Hard, moist, high plasticity; sand, fine).																	
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Medium dense, moist; sand, fine).																	
	9.00 - 9.20m: Sand, coarse.			SPT	100	0/- kPa crumble soils 2/3 4/5 6/7 N=22		9.0										
	Moderately weathered, grey, SILTSTONE. Extremely Weak. (Recovered as SILT, trace sand; grey. Hard, moist; sand, fine).							9.5										
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine).																	
	9.54 - 9.57m: Highly weathered, grey, SILTSTONE. Extremely Weak, (SILT; grey. Hard, moist, low plasticity).																	

COMMENTS: Piezometer installed with screened interval from 3.5 - 5.0 m

Hole Depth
15.12m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH06

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 19/11/2020

FINISH DATE: 19/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926435.00 mN
(NZTM2000) 1743208.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering Very Weak Weak Moderately Weak Strongly Weak Extremely Weak	Rock Strength Very Weak Weak Moderately Weak Strongly Weak Extremely Weak	Sampling Method Core Recovery (%) 	Testing 	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS									
									Defect Log	Fracture Spacing (mm) 2000 800 400 200 100 50 20	RQD (%)	Description & Additional Observations	Fluid Loss (%) 75 50 25	Water Level	Casing	Installation	Core Box No	
East Coast Bays Formation	[Cont.] Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine).			PQTT	100						81							
	Moderately weathered, grey, SANDSTONE. Extremely Weak, (Recovered as SAND; grey. Dense, moist; sand, medium). - INTERBEDDED WITH - Moderately weathered, grey, SILTSTONE. Extremely Weak.			SPT	100	UTP 9/15 20/26 4 for 10mm N>=50	10.5				0							
	Moderately weathered, grey, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Dense, moist; sand, medium). 10.81 - 11.1 m: CORE LOSS						11.0	X										
	Unweathered, medium grained, SANDSTONE. Very Weak, very weakly cemented. 11.21 - 11.25m: Moderately weathered, SILTSTONE. Extremely Weak. 11.50 - 11.57m: Unweathered, grey, SILTSTONE. Very Weak.			PQTT	75		11.5				75		11.24m: BF, 0° dip, N, CN 11.44 - 11.48m: BF, 0° dip, MN, Sands 11.76m: BF, 0° dip, N, CN 11.88m: DD					
	Unweathered, grey, medium grained, SANDSTONE. Very Weak. 11.78 - 11.84m: Unweathered, grey, SILTSTONE. Very Weak, Carbonaceous. 11.84 - 12.00m: Unweathered, grey, medium grained, SANDSTONE. Very Weak.						12.0	X			0							
	12 - 12.12 m: SOLID SPT			SPT	0	25/25 for 45mm N>=50 Solid	12.5	X										
	12.12 - 12.6 m: CORE LOSS						13.0											
	Unweathered, grey, medium grained, SANDSTONE. Very Weak. 13.18 - 13.26m: Unweathered, grey, SILTSTONE. Very Weak.			PQTT	65		13.5	X			0		12.76 - 12.80m: BF, 0° dip, MN, Sands 12.90 - 12.93m: BF, 0° dip, MN, Sands 13.00 - 13.15m: BZ, 70° dip, N, CN 13.18m: BF, 0° dip, VN, CN 13.21m: DD 13.34m: BF, 0° dip, VN, CN 13.41m: BF, 0° dip, VN, CN					
	13.5 13.65 m: SOLID SPT			SPT	0	16/34 for 55mm N>=50 Solid	14.0	X					13.86m: DD					
	13.63 - 13.8 m: CORE LOSS					-1												
	Unweathered, grey, medium grained, SANDSTONE. Very Weak. 13.80 - 13.84m: Unweathered, grey, SILTSTONE. Very Weak.						14.5						14.09m: BF, 0° dip, N, CN 14.23m: BF, 0° dip, T, CN 14.26m: BF, 0° dip, VN, CN 14.41m: BF, 0° dip, VN, CN 14.57m: BF, 0° dip, T, CN 14.64m: BF, 0° dip, T, CN					
	14.40 - 14.90m: medium to coarse grained SANDSTONE			PQTT	87						73							
	14.90 - 15.00m: Unweathered, grey, medium to coarse grained, SANDSTONE. Extremely Weak, Weakly cemented.												14.79m: BF, 0° dip, T, CN 14.86m: BF, 0° dip, MN, CN					

COMMENTS: Piezeometer installed with screened interval from 3.5 - 5.0 m

Hole Depth	15.12m
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Scale 1:25

Box 4, 8.6-11.5m

30x 5, 11.5-14.3m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000)	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	1743208.20 mE	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	12.60m	LOGGED BY: YCWA	CHECKED: CBM
	NZVD2016		



0.00-2.70m



2.70-5.55m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000) 1743208.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	12.60m	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



5.55-8.60m



8.60-11.48m

CORE PHOTOS

BOREHOLE No.: **BH06**

SHEET: 3 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926435.00 mN (NZTM2000) 1743208.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 19/11/2020
R.L.:	12.60m	DRILL METHOD: RC	HOLE FINISHED: 19/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



11.48-14.26m



14.26-15.12m

BOREHOLE LOG

BOREHOLE No.:
BH07

SHEET: 1 OF 2

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 20/11/2020

FINISH DATE: 20/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926205.30 mN
(NZTM2000) 1743224.80 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 21.80m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	Organic SILT; brown. Stiff, moist, low plasticity; organics, amorphous and rootlets. 0.35 - 0.50m: Light brown mottled orangish brown.			PQTT	100			0.5										
Tauranga Group	Clayey SILT; light grey mottled orangish brownm. Very stiff, moist, high plasticity.			PQTT	100	● 168/67 kPa	21	1.0					0.50m: PID - 0.1 ppm 1.00m: PID - 0.0 ppm					
	1.95 - 2.40m: Stiff.			SPT	66	1/1 1/1 1/2 N=5	20	1.5										
	2.40 - 3.00m: Firm to stiff.			PQTT	100		19	2.0										
	3.0 - 3.5 m: PUSH TUBE			PT	100	● 58/11 kPa Push tube @ 3.00m	18	3.0										
East Coast Bays Formation	Clayey SILT; organish brown. Firm, moist, medium plasticity.			SPT	100	1/0 1/0 1/1 N=3	18	3.5										
	Sandy SILT; grey. Firm, moist, non-plastic; sand, fine.			PQTT	100		17	4.0										
	Clayey SILT; grey. Firm, moist, high plasticity.			PQTT	100	● 40/9 kPa	17	4.5										
	Sandy SILT; grey. Firm, moist, low plasticity; sand, fine.			SPT	100	1/0 1/1 1/1 N=4	17	4.5										

COMMENTS:

Hole Depth
6m

Scale 1:25

Box 1, 0.0-2.6m

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH07

SHEET: 2 OF 2

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 20/11/2020

FINISH DATE: 20/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926205.30 mN
(NZTM2000) 1743224.80 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 21.80m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	[Cont.] Sandy SILT; grey. Firm, moist, low plasticity; sand, fine.																	
	SILT, some clay, minor sand; grey. Stiff, moist, low plasticity; sand, fine.			PQTT	100			5.5										
	6m: END OF INVESTIGATION					● 93/17 kPa		6.0										Box 2, 2.6-5.0m
								6.5										
								7.0										
								7.5										
								8.0										
								8.5										
								9.0										
								9.5										

COMMENTS:

Hole Depth
6m

Scale 1:25

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926205.30 mN (NZTM2000) 1743224.80 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 20/11/2020
R.L.:	21.80m	DRILL METHOD: RC	HOLE FINISHED: 20/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-2.55m



2.55-6.00m

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 1 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Fill	Sandy SILT, trace organics; brown. Firm, moist, low plasticity; sand, fine; organics, rootlets.			PQTT	100	3 @ 0.10m 1 x Glass Jar 1 x Plastic Jar												
	Silty sandy CLAY, trace organics; brown, orange & light grey mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, rootlets.			PQTT	100	1 @ 0.25m 1 x Plastic Jar Corrosivity												
	Sandy SILT; brown mottled orange. Stiff, moist, low plasticity; sand, fine.			PQTT	100	4 @ 0.50m 1 x Glass Jar 1 x Plastic Jar												
	Clayey sandy SILT; brown & orange mottled orange. Stiff, moist, medium plasticity; sand, fine.			PQTT	100	5 @ 1.00m 1 x Glass Jar 1 x Plastic Jar												
	Silty CLAY, trace organics; light grey-grey mottled orange & brown. Stiff, moist, high plasticity; organics, rootlets.			PQTT	100	81/41 kPa 1/1 1/1 1/2 N=5												
	1.95 - 2.05 m: CORE LOSS			PQTT	90	6 @ 2.00m 1 x Glass Jar 1 x Plastic Jar												
	Clayey sandy SILT, trace organics; grey mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, fibrous.			PQTT	90	2 @ 2.30m 1 x Plastic Jar Corrosivity												
	Clayey SILT, minor sand, trace organics; light grey-brown mottled orange. Stiff, moist, medium plasticity; sand, fine; organics, fibrous.			PQTT	90	7 @ 3.00m 1 x Glass Jar 1 x Plastic Jar												
	Sandy SILT, trace organics; light grey-brown mottled orange. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.			PQTT	66	8 @ 4.00m 1 x Glass Jar 1 x Plastic Jar												
	SILT, minor sand, trace organics; light brown mottled orange, speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.			PQTT	66	52/12 kPa 0/1 1/0 1/0 N=4												
Tauranga Group	SILT, minor clay and sand, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.			PQTT	66													
	Sandy SILT, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.			PQTT	66													
	Sandy SILT, trace organics; grey speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous.			PQTT	155													

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 2 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										2000 600 400 200 100 50 20			25 50 75				
Tauranga Group	SILT, minor clay, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; organics, fibrous.			PQTT	100	9 @ 5.00m 1 x Glass Jar 1 x Plastic Jar		5.5										
	6.0 - 6.5 m: Push tube			PT	0	47/19 kPa 1/0 1/1 1/2 N=5		6.0										
	SILT, minor clay, trace organics; brown-grey spotted dark brown. Firm to stiff, moist, low plasticity; organics, fibrous. 6.80 - 6.92m: Grades to: Sandy SILT			SPT	100			6.5										
	SILT, minor sand, trace organics; brown speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous. 7.00m: Grades to: some sand			PQTT	100			7.0										
	Sandy SILT, trace organics; light brown & brown speckled black. Very loose, moist, poorly graded; sand, fine; organics, fibrous.							7.5					7.40 - 7.65m: Core disturbed due to core drop-out and re-drilling					
	SILT, some sand, trace organics; brown mottled light brown speckled black. Firm, moist, low plasticity; sand, fine; organics, fibrous.			SPT	100	0/0 0/1 1/1 N=3		8.0					7.65m: Core run extended to 7.65m due to core drop out of barrel					
	Sandy SILT, trace organics; light brown speckled black. Firm, moist, low plasticity; sand, fine; organics, fibrous.							8.5					8.10 - 9.00m: Core disturbed due to core drop-out and re-drilling					
	Sandy SILT, trace organics; dark brown speckled black. Firm to stiff, moist, low plasticity; sand, fine; organics, fibrous. Sandy SILT, minor organics and clay; brown spotted black. Stiff, moist, low plasticity; sand, fine; organics, fibrous. 9.35m: Grades to: No Sand			SPT	117	59/19 kPa 1/1 2/2 2/2 N=8		9.0										

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH08

SHEET: 3 OF 3

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 23/11/2020

FINISH DATE: 23/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926036.50 mN
(NZTM2000) 1743457.30 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 24.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation								Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	[CONT] Sandy SILT, minor clay and organics; brown spotted black. Stiff, moist, low plasticity; sand, fine; organics, fibrous			POTT 100			10.5										
	Silty SAND, trace organics; light brown-grey spotted black. Loose to medium dense, moist, poorly graded; sand, fine; organics, fibrous. 10.88 - 10.93m: Decomposed wood 10.93m: Brown spotted black			SPT 100	133/31 kPa 1/2 2/2 3/3 N=10	14											Box 4, 8.4-11.0m
	10.95m: END OF INVESTIGATION						11.0										
							11.5										
							12.0										
							12.5										
							13.0										
							13.5										
							14.0										
							14.5										

COMMENTS: Piezometer installed with screened interval from 3.0 to 6.0 m

Hole Depth
10.95m

Scale 1:25

Rev.: A

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926036.50 mN (NZTM2000) 1743457.30 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 23/11/2020
R.L.: 24.60m		DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-2.40m



2.40-5.20m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926036.50 mN (NZTM2000) 1743457.30 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 23/11/2020
R.L.:	24.60m	DRILL METHOD: RC	HOLE FINISHED: 23/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



5.20-8.35m



8.35-10.95m

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 1 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SILT, trace rootlets; brown. Stiff, moist, non-plastic.					1 @ 0.10m			TS									
	SILT, trace sand; light brown mottled orangish brown. Stiff to very stiff, moist, low plasticity; sand, fine. 0.50 - 0.80m: Trace rootlets.			PQTT	100	2 @ 0.50m		0.5	TS				0.50m: PID - 0.6 ppm					
Tauranga Group	Silty CLAY; light brown mottled orangish brown. Very stiff, moist, high plasticity. 0.80 - 0.90m: Trace rootlets.					8 @ 0.80m 3 @ 0.90m		1.0					1.00m: PID - 0.3 ppm					
	1.50 - 2.45m: Light brown.			SPT	84	153/59 kPa 1/1 2/1 3/2 N=8		1.5										
				PQTT	100	5 @ 1.95m		2.0										
				PQTT	100	9 @ 2.30m		2.5										
East Coast Bays Formation	Silty SAND; light brown mottled orangish brown. Loosely packed, saturated; sand, fine.					96/16 kPa		2.5										
	Sandy SILT; grey. Tightly packed, moist; sand, fine.			PQTT	100			3.0										
	3.1 - 3.5 m: PUSH TUBE			PT	100	0/- kPa crumble Push Tube @ 3.10m		3.5										
	Sandy SILT; grey. Hard, moist, non-plastic; sand, fine.			SPT	100	5/10 15/17 18 for 65mm N>=50		3.5										
	3.87 - 4.0 m: CORE LOSS							4.0										
	Moderately weathered, grey, SANDSTONE. Extremely weak. (Recovered as SAND, grey. Very dense, moist; sand fine)			PQTT	79	7 @ 4.00m		4.0										
	Moderately weathered, grey, SILTSTONE. Extremely weak. (Recovered as Sandy SILT, grey. hard, moist, low plasticity; sand fine)			SPT	0	UTP 6/25 20/30 for 45mm N>=50 Solid		4.5										
	4.77 - 4.87 m: CORE LOSS							5										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Box 1, 0.0-2.5m

16/11/2020

07/12/2020

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 2 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength		Sampling Method		Core Recovery (%)		Testing		RL (m)		Depth (m)		Graphic Log		Defect Log		Fracture Spacing (mm)		RQD (%)		Description & Additional Observations		Fluid Loss (%)		Water Level		Casing		Installation		Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																																			
East Coast Bays Formation	Moderately weathered, grey, fine, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine)																																			
	Moderately weathered, grey, SILTSTONE. Very Weak.																																			
	Moderately weathered, grey, fine SANDSTONE. Extremely weak. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	Slightly weathered, grey, SANDSTONE. Extremely weak, very weakly cemented. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	6.93m: Carbonaceous																																			
	Unweathered, grey, SANDSTONE. Very Weak.																																			
	7.5 - 7.63 m: Solid SPT																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	8.00 - 8.15m: Unweathered SILTSTONE. Very Weak.																																			
	8.15 - 8.3 m: CORE LOSS																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.0 - 9.18 m: SOLID SPT																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.30 - 9.40m: Unweathered SILTSTONE. Very Weak.																																			
	9.90 - 9.97m: Unweathered SILTSTONE. Very Weak.																																			

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 3 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	ROCK DEFECTS		Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation										Description & Additional Observations	Fracture Spacing (mm)					
East Coast Bays Formation	Unweathered, grey, medium to coarse, SANDSTONE. Very Weak, Weakly cemented.				PQTT	100							54					
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	0	20/30 for 35mm N>=50 Solid	10.5					0					
	Unweathered, grey, fine, SANDSTONE. Very Weak.				PQTT	100							48					
	11.22 - 11.23m: Unweathered SILTSTONE. Very Weak.																	
	11.35 - 11.53m: SANDSTONE grades fine to medium grained																	
	11.85 - 11.95m: Unweathered SILTSTONE. Very Weak				PQTT	100							21					
	12.0 - 12.09 m: SOILD SPT				SPT	0	32/18 for 15mm N>=50 Solid	12.0					0					
	Unweathered, grey, SILTSTONE. Very Weak. 12.21 - 12.29m: Carbonaceous																	
	12.29 - 12.35m: Carbonaceous																	
	12.63 - 12.64m: SANDSTONE interbed																	
	12.69 - 12.70m: SANDSTONE interbed																	
	Unweathered, grey, fine, SANDSTONE. Very Weak, Weakly cemented.				PQTT	100							55					
	13.37 - 13.46m: Unweathered SILTSTONE. Very Weak.																	
Unweathered, grey mottled light grey, fine to medium grained, SANDSTONE. Weak, Moderately cemented.				SPT	0	32/18 for 20mm N>=50 Solid	13.5					0						
Unweathered, grey, fine, SANDSTONE. Very Weak.																		
14.21 - 14.22m: Unweathered SILTSTONE. Very Weak.				PQTT	75							32						
14.4 - 14.75 m: CORE LOSS																		
Unweathered, grey, SANDSTONE. Very weak																		
Unweathered, grey, SILTSTONE. Very Weak.																		

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m
Scale 1:25

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 4 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										2000 600 200 100 50 20							
	15.0 - 15.11 m: SOLID SPT			SPT	0	23/27 for						0						
	15.11m: END OF INVESTIGATION					35mm N>=50 Solid												
								15.5										
								-6										
								16.0										
								16.5										
								-7										
								17.0										
								17.5										
								-8										
								18.0										
								18.5										
								-9										
								19.0										
								19.5										
								-10										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926611.70 mN (NZTM2000) 1743051.90 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.:	9.60m	DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-2.50m



2.50-5.10m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



5.10-7.10m



7.10-9.61m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926611.70 mN (NZTM2000) 1743051.90 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.:	9.60m	DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



9.61-11.90m



11.90-14.10m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016			DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



14.10-15.11m

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Top	Clayey SILT, some organics; brown. Very stiff, moist, high plasticity; organics, rootlets.						BH111 Sample 1 @ 0.05m												
Tauranga Group	Clayey SILT, trace sand; light brown. Stiff, moist, high plasticity; sand, fine. 0.3 - 1.4 m: CORE LOSS				PQTT	26			0.5										
	Clayey SILT, trace sand; light brown mottled brown. Stiff, moist, high plasticity; sand, fine.				SPT	100	73/31 kPa 1/1 0/1 1/2 N=4		1.5										
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; sand, fine; organics, rootlets.				PQTT	100	BH111 Sample 2 @ 2.00m BH111 Sample 3 @ 2.20m		2.0										
	Sandy SILT; grey mottled orangish brown. Firm, moist, non-plastic; sand, fine.				PQTT	100			2.5										
East Coast Bays Formation	Silty SAND; grey. Medium dense, moist; sand, fine.				SPT	100	BH111 Sample 4 @ 2.80m 2/3 5/6 7/7 N=25		3.0										
	3.45 - 3.7 m: CORE LOSS								3.5										
	Moderately weathered, grey, fine grained, SANDSTONE. Extremely Weak, (Recovered as Silty SAND; grey. Medium dense, moist; sand, fine) 3.90 - 4.05m: Recovered as GRAVEL				PQTT	76	BH111 Sample 5 @ 3.70m BH111 Sample 6 @ 3.90m		4.0										
	Moderately weathered, grey fine grained SANDSTONE; Extremely weak. (Recovered as fine grained SAND; grey. Dense, moist.)				SPT	100	0/- kPa Crumble. 6/5 5/9 15/21 N>=50 Solid		4.5										
	Moderately weathered, grey SILTONE; Extremely weak. (Sandy SILT; grey. Hard, moist, low plasticity; sand, fine.) 4.70 - 4.72m: SILT; light brown. Moist, low plasticity. 4.85m: 2 mm thick SILT; light brown. 4.90 - 4.95m: SAND; grey. Dense, moist; sand, fine.								5										

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation											Description & Additional Observations							
East Coast Bays Formation	4.95 - 5.05 m: CORE LOSS				PQTT	81		4	5.5			65	5.23m: BF, 10° dip, VN, CN 5.27 - 5.28m: BF, 0° dip, MN, light brown veneer						
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak. 5.05 - 5.15m: SAND; grey. Dense, moist; sand, fine. 5.28 - 5.32m: Slightly weathered, grey, SILTSTONE. Very Weak. 5.40m: Carbonaceous																		
	Unweathered, light grey, fine grained SANDSTONE. Weak.				PQTT	12			6.0			0							
	5.56 - 6.0 m: CORE LOSS																		
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak, Carbonaceous [logged after solid SPT testing].				SPT	100	8/15 15/25 10 for 15mm N>=50 Solid					0							
	Slightly weathered, grey, fine, SANDSTONE. Very Weak, (Recovered as GRAVEL).																		
	6.42 - 6.6 m: CORE LOSS																		
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 6.68 - 6.72m: SILTSTONE 6.90 - 6.92m: SILTSTONE				PQTT	84		3	7.0			53	6.60m: BF, 0° dip, N, CN 6.68m: BF, 0° dip, N, CN 6.77m: BF, 0° dip, N, CN 6.87m: BF, 0° dip, N, CN						
	7.20 - 7.26m: SILTSTONE												7.00m: DD 7.20m: DD 7.40m: BF, 0° dip, VN, CN						
	Unweathered, grey, SILTSTONE. Very Weak. - INTERBEDDED WITH - Unweathered, grey, fine, SANDSTONE. Very Weak.				SPT	100	8/12 17/23 10 for 20mm N>=50 Solid			7.5			0						
Unweathered, grey, fine grained SANDSTONE. Very Weak.							2	8.0					8.15m: DD 8.30m: BF, 0° dip, VN, CN 8.42m: BF, 0° dip, VN, CN 8.44m: BF, 0° dip, VN, CN 8.49m: BF, 0° dip, VN, CN 8.53m: DD						
8.32 - 8.33m: SILTSTONE 8.37 - 8.38m: SILTSTONE 8.44 - 8.53m: SILTSTONE 8.53 - 8.90m: Weakly cemented SANDSTONE				PQTT	80				8.5			45							
8.9 - 9.0 m: CORE LOSS							1	9.0											
Unweathered, grey, SANDSTONE. Very Weak, carbonaceous. [logged after solid SPT test].				SPT	95	15/25 35/15 for 10mm N>=50 Solid						0							
9.24 - 9.45 m: CORE LOSS																			
Unweathered, grey, fine grained SANDSTONE. Very Weak.									9.5			31	9.50m: DD 9.68m: DD 9.78m: BF, 0° dip, N, CN 9.83m: DD 9.86m: DD						
9.78 - 9.80m: SILTSTONE 9.86 - 9.97m: SILTSTONE							0												

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
East Coast Bays Formation	[CONT] unweathered, grey, fine grained SANDSTONE. Very Weak. 10.02 - 10.06m: Fine to coarse grained SANDSTONE 10.24 - 10.48m: Fine to coarse grained SANDSTONE				PQTT	83								31						
	10.5 - 10.63 m: Solid SPT				SPT	0	20/27 for 50mm N>=50 Solid		10.5					0						
	10.63 - 11.15 m: CORE LOSS																			
	Unweathered, grey, fine grained SANDSTONE. Very Weak.				PQTT	62								9						
	Unweathered, grey, coarse grained SANDSTONE. Very Weak.																			
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 11.61 - 11.65m: SILTSTONE 11.77 - 11.82m: Coarse grained SANDSTONE																			
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	80	5/14 30/20 for 25mm N>=50 Solid		12.0					0						
	Unweathered, grey, fine grained SANDSTONE. Very Weak.																			
	12.74 - 12.77m: SILTSTONE				PQTT	100									61					
	13.14 - 13.20m: SILTSTONE																			
Unweathered, grey, SILTSTONE. Very Weak.				SPT	100	20/30 for 30mm N>=50 Solid		13.5					0							
Unweathered, grey, fine grained SANDSTONE. Very Weak.																				
14.26 - 14.41m: Weakly cemented				PQTT	73								46							
14.41 - 14.78 m: CORE LOSS																				
Unweathered, grey, fine grained SANDSTONE. Very Weak.																				

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 4 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Rock Defects		Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation			Sampling Method	Core Recovery (%)					
East Coast Bays Formation	[CONT] Unweathered, grey, fine grained SANDSTONE. Very Weak.		SPT	100	20/30 for 45mm N>=50 Solid						
	15.65 - 15.75 m: CORE LOSS		PQTT	84							
	Unweathered, grey, coarse grained SANDSTONE. Very Weak.		PQTT	100							
	16.62 - 16.77 m: CORE LOSS		SPT	100	16/34 for 40mm N>=50 Solid						
	Unweathered, grey, coarse grained SANDSTONE. Weak.		PQTT	76							
	Unweathered, grey, SILTSTONE. Very Weak.										
	17.25 - 17.4 m: CORE LOSS										
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 17.46 - 17.48m: SILTSTONE 17.51 - 17.55m: SILTSTONE 17.67 - 17.86m: SILTSTONE		PQTT	80							
	Unweathered, grey, medium grained SANDSTONE. Very Weak.										
	18.0 - 18.04 m: Solid SPT				7 for 35mm N>=50 Solid Bouncing						
18.04m: END OF INVESTIGATION											

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-3.45m



3.45-6.00m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926614.20 mN (NZTM2000) 1743088.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.: 9.90m		DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



6.00-8.30m



8.30-11.45m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926614.20 mN (NZTM2000) 1743088.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.: 9.90m		DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



11.45-13.60m



13.60-16.50m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



16.50-18.00m

BOREHOLE LOG

BOREHOLE No.:
BH111A

SHEET: 1 OF 1

DRILLED BY: Vincent
LOGGED BY: YCWA
CHECKED: CBM
START DATE: 12/11/2020
FINISH DATE: 12/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743090.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	SILT, minor rootlets; brown. Stiff to very stiff, low plasticity.																	
	Clayey SILT; light brown mottled orangish brown. Stiff, moist, high plasticity. 0.60 - 0.80m: Trace rootlets. Firm.												0.50m: PID - 0.3 ppm 1.00m: PID - 0.5 ppm					
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; organics, fleck; sand, fine.																	
	1.75 - 2.0 m: CORE LOSS																	
	2.0 - 2.5 m: PUSH TUBE																	
	2.5m: END OF BOREHOLE																	

COMMENTS: Drilled 1.5 m from BH111 to recover core in the upper 2.5 m.

Hole Depth
2.5m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH111A**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926614.20 mN (NZTM2000) 1743090.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 12/11/2020
R.L.: 9.90m		DRILL METHOD: RC	HOLE FINISHED: 12/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



0.00-2.50m

Rev : A

BOREHOLE LOG

BOREHOLE No.:
BH113

SHEET: 2 OF 4

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 04/11/2020
FINISH DATE: 05/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																	
	[CONT] SILT, some clay, trace organics; grey-green. Stiff, moist, moderate plasticity; organics, rootlets							7										
	5.50m: Grades: Light brown			PQTT	100			5.5										
	Organic SILT, minor clay, trace organics; brown speckled black. Firm, moist, low plasticity; organics, rootlets																	
	6.0 - 6.5 m: Push Tube			PT	0	96/10 kPa 1 @ 6.00m		6										
	SILT, trace clay, trace organics; grey speckled black. Firm to stiff, moist, low plasticity; organics, carbonaceous.			SPT	100	0/0 0/0 0/1 N=1		6.5										
				PQTT	100			7.0										
				SPT	111	0/- kPa 0/0 1/0 0/1 N=2		7.5										
	Clayey SILT, trace organics; grey-green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.							8.0										
				PQTT	100			8.5										
	9.00 - 9.05m: Brown mottled grey-green, speckled black.			SPT	148	79/30 kPa 0/1 2/0 1/1 N=4		9.0										
	9.50m: Grey-brown speckled black.							9.5										

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Box 2, 4.0-7.3m

Box 3, 7.3-9.8m

BOREHOLE LOG

BOREHOLE No.:
BH113

SHEET: 3 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 04/11/2020

FINISH DATE: 05/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station/Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	[CONT] Clayey SILT, trace organics; grey-green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			PQTT	100		2											
	Clayey SILT, minor sand, trace organics; light green speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets.			SPT	122	78/38 kPa 1/1 1/2 1/3 N=7	10.5											
	SILT, trace organics; grey, brown & light green. Firm, moist, low plasticity; organics, rootlets.						11.0											
	Clayey SILT, trace organics; grey-brown & light green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			PQTT	100		11.5											
	SILT, trace organics; brown, grey-brown & light green. Firm - stiff, moist, low plasticity; organics, rootlets.																	
	Clayey SILT, trace organics; grey-brown & light green speckled black. Stiff, moist, moderate plasticity; organics, rootlets.			SPT	128	44/10 kPa 0/1 3/3 3/3 N=12	12.0											
	Sandy SILT, trace organics; grey & grey-green. Stiff, moist, low plasticity; Sand, fine; organics, wood fragments.						12.5											
				PQTT	100		13.0											
	13.05m: Grey																	
	Silty fine to coarse SAND, trace gravel, trace organics; grey & grey-green. Medium dense, moist, well graded; Gravel, fine to coarse grained, sub-angular Siltstone & Sandstone; organics, wood fragments.			SPT	124	UTP 5/5 6/12 10/12 N=40	13.5											
East Coast Bays Formation	Moderately weathered, grey and grey-green, fine, SANDSTONE. Extremely Weak, bedded, thin. - INTERBEDDED WITH - Moderately weathered, grey and grey-green, SILTSTONE. Extremely Weak, thin, (recovered as Gravelly SAND).			PQTT	100		14.5											
	Moderately weathered, grey SILTSTONE; Extremely weak (Recovered as, Clayey SILT, some sand; grey. Hard, moist, low plasticity).																	
	Slightly weathered, grey, SANDSTONE; EW																	

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Box 4, 9.8-12.5m

Box 5, 12.5-14.9m

BOREHOLE LOG

BOREHOLE No.:
BH113

SHEET: 4 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 04/11/2020

FINISH DATE: 05/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926965.50 mN
(NZTM2000) 1743286.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 12.20m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS					Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
East Coast Bays Formation	15.0 - 5.37 m: Core Loss				SPT	0	2/5 10/17 24 for 75mm N>=50 Solid	-3					0							
	Slightly weathered, grey SILTSTONE; Very weak				PQTT	100		-4					36		15.66m: BF, 12° dip, VN, CN					
	15.65m: Very weak														15.85 - 15.87m: BZ 15.90m: BF, 18° dip, VN, CN 15.98m: BF, 15° dip, VN, CN					
	16.5 - 16.91m: Solid cone SPT				SPT	0	2/4 6/8 23/13 for 35mm N>=50 Solid	-5					0		16.10 - 16.19m: BZ 16.25 - 16.32m: BZ 16.35m: BF, 12° dip, VN, CN					
	Unweathered, grey, SILTSTONE. Weak, laminated. - INTERBEDDED WITH - Unweathered, grey, SANDSTONE. Weak.				PQTT	100		-6					28		17.15m: BF, 15° dip, VN, CN 17.26m: BF, 0° dip, VN, CN 17.30m: BF, 15° dip, VN, CN 17.45m: BF, 13° dip 17.49m: BF, 12° dip, VN, Brown veneer					
	18.0 - 18.28 m: Solid cone SPT				SPT	0	12/25 30/20 for 50mm N>=50 Solid	-7					0		17.51 - 18.00m: BZ 17.55m: J, 55° dip, N 17.60m: J, 55° dip, VN 17.88m: J, 55° dip, VN					
								-7												

Box 6, 14.9-17.4m

Box 7, 17.4-18.3m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 4.0 m. SPT calibration undertaken between 13.5 - 18.0 m.

Hole Depth
20m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926965.50 mN (NZTM2000) 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-4.00m



4.00-7.30m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



7.30-9.75m



9.75-12.45m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926965.50 mN (NZTM2000) 1743286.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.: 12.20m		DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: ROM
			CHECKED: CBM



12.45-14.90m



14.90-17.40m

CORE PHOTOS

BOREHOLE No.: **BH113**

SHEET: 4 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926965.50 mN 1743286.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 04/11/2020
R.L.:	12.20m	DRILL METHOD: RC	HOLE FINISHED: 05/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



17.40-18.28m

BOREHOLE LOG

BOREHOLE No.:
BH116

SHEET: 1 OF 4

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 02/11/2020

FINISH DATE: 03/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
Fill	SILT, some sand, minor clay, trace gravel, trace organics; Dark brown. Stiff, moist, moderate plasticity; Sand, fine grained; Gravel, fine grained, angular; organics, rootlets [FILL]				PQTT	56	1 @ 0.10m	13	0.5					0.10m: PID - 0.1ppm		18/11/2020				
	Silty CLAY; some sand, trace gravel; trace organics; Brown mottled orange and dark brown. Very stiff, moist, high plasticity; Sand, fine to coarse grained; Gravel; fine grained, angular Basalt; organics, rootlets [FILL].																			0.50m: PID - 0.0ppm
Tauranga Group	Silty CLAY, some sand, trace organics; grey-brown mottled orange, speckled white. Very stiff, moist, high plasticity; Sand, fine grained; Gravel, fine grained, angular; organics, rootlets. 0.85 - 1.5 m: CORE LOSS				SPT	77	3 @ 1.00m	12	1.5					1.00m: PID - 0.0ppm		03/11/2020				
	Sandy SILT, trace organics; grey mottled orange & brown. Stiff, moist, low plasticity; Sand, fine grained; organics, rootlets.																			2.00m: PID - 0.2ppm
	Grades to: Silty fine grained SAND, trace organics; grey mottled orange & brown. Loose, moist, poorly graded; Sand, fine; organics, rootlets 2.80m: Grades: grey				PQTT	138	7 @ 3.00m	11	2.5											
	3.05 - 3.45 m: CORE LOSS																			SPT
	3.45 - 3.95 m: PUSH TUBE				PT	0	8 @ 4.00m	9	4.0											
	Silty CLAY, minor sand; green-grey. Very stiff, moist, high plasticity; Sand, fine.																			PQTT
	Organic Silty CLAY, trace organics; dark brown speckled black, Firm, moist, high plasticity; organics, carbonaceous 4.5 - 5.0 m: PUSH TUBE				PT	0														

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH116

SHEET: 2 OF 4

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 02/11/2020
FINISH DATE: 03/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering W1 W2 W3 W4 W5 W6	Rock Strength R1 R2 R3 R4 R5 R6	Sampling Method Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%) FL1 FL2	Water Level	Casing	Installation	Core Box No
									Defect Log	Fracture Spacing (mm) 2000 800 400 200 100 50	RQD (%)	Description & Additional Observations					
Tauranga Group	[CONT] Organic Silty CLAY, trace organics; dark brown speckled black, Firm, moist, high plasticity; organics, carbonaceous			SPT	140	9 @ 5.00m 0/0 0/0 1/1 N=2						5.00 - 5.45m: Core extended					
	Silty CLAY, trace organics; grey speckled black. Stiff, moist, high plasticity; organics, rootlets			PQTT	100												
	6.00m: Grades: green speckled black			SPT	106	0/- kPa 1/1 1/1 0/1 N=3											
	6.90m: Grades: brown speckled black			PQTT	100												
	Grades to: Clayey SILT; grey-green. Firm to stiff, moist, moderate plasticity.			SPT	100	69/31 kPa 0/0 1/0 1/1 N=3											
	Grades to: SILT; grey. Soft to firm, moist, low plasticity, slightly sensitive.																
	Grades to: Clayey SILT; grey-green. Stiff, moist, moderate plasticity, slightly sensitive.			PQTT	60												
	Grades to: SILT, minor clay; brown. Firm to stiff, moist, low plasticity, slightly sensitive.																
	Silty CLAY, grey-green. Stiff, moist, high plasticity.			SPT	133	53/9 kPa 1/1 1/1 1/2 N=5						9.00m: Shear vane indicates material is sensitive. Minimal sensitivity recognized during tactile remoulding					
	SILT; grey-brown & grey-green. Soft to firm, moist, low plasticity, slightly sensitive.																
	SILT, minor clay; grey-green & brown-grey. Firm to stiff, moist, low plasticity, slightly sensitive.																

Box 2, 2.9-6.8m

Box 3, 6.8-9.5m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH116

SHEET: 3 OF 4

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 02/11/2020
FINISH DATE: 03/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

R.L. GROUND: 13.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

DIRECTION:
ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength		Sampling Method		Core Recovery (%)		Testing		RL (m)		Depth (m)		Graphic Log		Defect Log		Fracture Spacing (mm)		RQD (%)		Description & Additional Observations		Fluid Loss (%)		Water Level		Casing		Installation		Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																																			
Tauranga Group	Silty CLAY, grey-green. Stiff, moist, high plasticity.						PQTT		100																											
	Sandy CLAY, some silt, trace organics. Grey-green speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, carbonaceous						SPT		142		98/32 kPa 1/1 2/1 2/3 N=8																									
							PQTT		100																											
							SPT		128		85/31 kPa 0/1 2/1 2/2 N=7																									
Albany Conglomerate	12.6 - 13.5 m: CORE LOSS						PQTT		100																											
	Completely weathered, grey speckled black, SANDSTONE. Extremely Weak, (Recovered as Fine SAND, some silt, trace carbonaceous material; grey speckled black. Medium dense, moist, poorly graded)						SPT		115		119/57 kPa 2/2 3/4 3/4 N=14																									
	14.70m: Sand, fine to medium grained 14.85m: SILTSTONE coarse gravel-sized clasts x2						PQTT		100																											
	Completely weathered, grey-green, SANDSTONE. Extremely Weak, (Recovered as Gravelly SAND).																																			

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH116

SHEET: 4 OF 4

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 02/11/2020
FINISH DATE: 03/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926934.40 mN
(NZTM2000) 1743342.70 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 13.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation																	
Albany Conglomerate	[CONT] Completely weathered, grey-green, SANDSTONE. Extremely weak (Recovered as Gravelly SAND)				SPT	100	4/3 6/12 13/20 for 40mm N>=50												
	Slightly weathered, grey fine to medium grained SANDSTONE; Very weak				PQTT	100			15.5					15.42 - 15.53m: J, 35° dip, VN, CN 15.50m: BF, 6° dip, VN, CN 15.57m: BF, 6° dip, VN, CN 15.63m: BF, 15° dip, VN, CN 15.63 - 15.75m: J, VN, CN 15.74 - 15.84m: BZ, CN					
	15.92 - 15.94m: Slightly weathered, grey SILTSTONE; Extremely weak 16.00 - 16.50m: Recovered as: Gravelly SAND due to core drop-out and re-drilling.								16.0			12							
	16.5 - 16.88 m: Solid cone SPT				SPT	0	8/14 18/16 16 for 75mm N>=50 Solid		16.5			0		16.00 - 16.50m: Core disturbed due to drilling process (fell out of barrel)					
	Slightly weathered, grey, SANDSTONE. Very Weak, moderately thick, (60%). - INTERBEDDED WITH - Slightly weathered, grey, SILTSTONE. Very Weak, thin, (40%).				PQTT	84			17.0			36		16.88m: BF, 6° dip, VN, CN 16.94m: BF, 6° dip, VN, CN 16.95m: BF, 4° dip, VN, CN 16.97m: BF, 12° dip, VN, CN 17.11m: BF, 25° dip, VN, CN 17.11 - 17.28m: J, 45° dip, VN, CN 17.15m: BF, 4° dip, VN, CN 17.28m: BF, 10° dip, VN, CN 17.49m: BF, 10° dip, VN, CN					
	17.83 - 18.0 m: CORE LOSS								17.5					17.80m: DD					
	18.0 - 18.23 m: Solid cone SPT				SPT	0	11/22 45/5 for 5mm N>=50 Solid		18.0			0							
	18.23m: END OF INVESTIGATION																		

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 2.0 - 5.0 m.

Hole Depth
18.23m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926934.40 mN 1743342.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.:	13.60m	DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-2.90m



2.90-6.75m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926934.40 mN (NZTM2000) 1743342.70 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.: 13.60m		DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



6.75-9.45m



9.45-11.85m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926934.40 mN (NZTM2000) 1743342.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 02/11/2020
R.L.:	13.60m	DRILL METHOD: RC	HOLE FINISHED: 03/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



11.85-15.42m



15.42-18.23m

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 1 OF 5

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 06/11/2020
FINISH DATE: 09/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

DIRECTION:
ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	Sandy SILT, trace organics; dark brown. Firm, saturated, low plasticity; Sand, fine; organics, rootlets [TOPSOIL].					2 @ 0.10m			TS									
	Sandy SILT, some clay, trace organics; Brown mottled orange. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets 0.55m: Brown mottled orange speckled white			PQTT	52	3 @ 0.50m		0.5										
Tauranga Group	0.78 - 1.5m: Core Loss							1.0										
	Silty fine grained SAND, minor organics; brown-grey. Medium dense, moist, poorly graded; organics, wood.			SPT	84	1/3 4/5 5/5 N=19		1.5										
	Clayey SILT, minor sand, trace organics; grey-brown speckled black. Stiff, moist, moderate plasticity; Sand, fine; organics, rootlets			PQTT	64	4 @ 2.00m		2.0										
	2.63 - 3.0m: Core Loss							2.5										
	Organic SILT, some clay, trace organics; dark grey - brown. Stiff, moist, low plasticity; organics, wood.			SPT	100	5 @ 3.00m 1/1 1/1 N=4		3.0										
	Grades to: Organic Clayey SILT, trace organics; dark grey-brown. Stiff, moist, low plasticity; organics, wood.			PQTT	83	6 @ 4.00m		4.0										
	4.5 - 5.0m: PUSH TUBE			PT	0	1 @ 4.50m		4.5										

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH117

SHEET: 2 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	Organic Clayey SILT; dark grey-brown. Stiff, moist, low plasticity; organics, wood. 5.20m: grey-brown, mottled brown speckled black			SPT	100	7 @ 5.00m 0/0 1/1 2/1 N=5		5.5										
				PQTT	100			5										
				SPT	133	0/0 1/1 1/1 N=4		6.0										
	Sandy organic SILT; dark brown speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous							6.5										
	6.85m: Sand inclusions (5%); dark brown, speckled black spotted grey							7.0										
	7.10m: Grades: grey-brown			PQTT	100			7.5										
	Sandy SILT, trace organics; light grey-green, speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous			SPT	100	0/0 2/1 2/2 N=7		8.0										
	8.10m: Grades: grey-brown, mottled brown, speckled black							8.5										
	8.90 - 9.00m: Fine to medium grained SAND; grey. Medium dense, moist, poorly graded.							9.0										
	Sandy SILT, trace organics; grey speckled black. Stiff, moist, low plasticity; Sand, fine; organics, fibrous 9.28 - 9.29m: Wood (10mm) 9.34 - 9.35m: Wood (10mm)			SPT	100	1/2 2/3 4/3 N=12		9.5										
	Fine to coarse SAND, minor silt, trace organics; grey. Medium dense, moist, poorly graded; organics, wood.																	
	Sandy SILT, some clay, trace organics; grey speckled black. Stiff, moist, low plasticity; sand, fine; organics, fibrous.																	

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Box 2, 3, 5-7, 1m

Box 3, 7, 1-9, 8m

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 3 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 10.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	Fine SAND, some silt, trace organics; grey & brown. Loose, moist, poorly graded; organics, wood				PQTT	100													
	Fine SAND, some silt, some organics; grey. Loose, moist, poorly graded; organics, wood 9.75 - 9.80m: Wood				SPT	113	1/2 1/2 2/2 N=7		10.5										
	Clayey SILT, trace organics; light green. Stiff, moist, moderate plasticity; organics, fibrous. 10.34 - 10.39m: Wood																		
	Sandy SILT, some clay, trace organics; light grey-green. Stiff, moist, low plasticity; organics, fibrous. 10.40m: brown																		
	Silty SAND, trace organics; brown mottled grey. Medium dense, moist, poorly graded; sand, fine; organics, fibrous. 11.03 - 11.07m: Wood				PQTT	80													
	Silty SAND, some clay, trace organics; brown. Medium dense, moist, poorly graded; sand, fine; organics, wood.				SPT	108	1/2 3/4 4/4 N=15		12.0										
	SAND, some silt, trace organics; grey. Medium dense, moist, poorly graded; sand, fine; organics, wood.																		
	Grades to: Sandy SILT, minor clay, trace organics; grey. Very stiff, moist, low plasticity; Sand, fine; organics, wood				PQTT	90													
	13.50m: Grey & brown, speckled black				SPT	124	1/1 2/2 3/3 N=10		13.5										
	13.90m: Grey																		
	Sandy SILT, some clay, trace organics. Grey & brown speckled black. Very stiff, moist, low plasticity; Sand, fine; organics, carbonaceous.				PQTT	100													

Box 4, 9.8-12.5m

Box 5, 12.6-15.0m

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Box 4, 9.8-12.6m

Box 5, 12.6-15.0m

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 4 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

R.L. GROUND: 10.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

DIRECTION:

ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	Sandy SILT, some clay, trace carbonaceous. Grey & brown speckled black. Very stiff, moist, low plasticity; Sand, fine			SPT	144	2/2 3/3 3/5 N=14						0						
	Fine to medium grained SAND, some silt, trace carbonaceous; light green & brown. Medium dense, moist, poorly graded			PQTT	85			15.5				0						
	16.35 - 16.5m: Core Loss																	
	Sandy SILT, some clay, trace carbonaceous light green. Stiff, moist, low plasticity; Sand, fine			SPT	128	2/3 2/4 3/4 N=13						0						
	Fine SAND, some silt, trace carbonaceous; light green - grey. Loosely packed, moist, poorly graded																	
	17.30m: minor silt.																	
	17.60m: some silt																	
	18.10 - 18.14m: Wood (40mm)																	
	Slight weathered, brown, fine grained SANDSTONE; Very weak			SPT	100	6/6 4/4 4/6 N=18						0						
	Highly weathered, grey-green speckled white, coarse, SANDSTONE. Extremely Weak, (Recovered as fine to coarse SAND, minor gravel; grey-green speckled white, red, brown & green. Medium dense, moist, poorly graded).																	
18.75 - 19.5m: Core Loss																		
	Highly weathered, grey-green speckled white, red, brown & green, coarse, SANDSTONE. Extremely Weak, (Recovered as Fine to coarse SAND, minor gravel; grey-green speckled white, red, brown & green. Very dense, moist, poorly graded).			SPT	77	4/4 5/7 21/18 for 50mm N>=50						0						

Box 6, 15.0-17.8m

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Box 6, 15.0-17.8m

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 5 OF 5

DRILLED BY: Mackenzie

LOGGED BY: ROM

CHECKED: CBM

START DATE: 06/11/2020

FINISH DATE: 09/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

R.L. GROUND: 10.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

DIRECTION:

ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT		DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation		Description & Additional Observations																		
East Coast Bays Formation	Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)				PQTT	42			-10	20.5		Defect Log	Fracture Spacing (mm)	RQD (%)						
	20.38 - 21.0 m: Core Loss																			
		Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)				SPT	100		17/33 for 30mm N>=50		21.0				0					
	21.15m: END OF INVESTIGATION																		Box 7, 17.8-21.2m	

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.75m



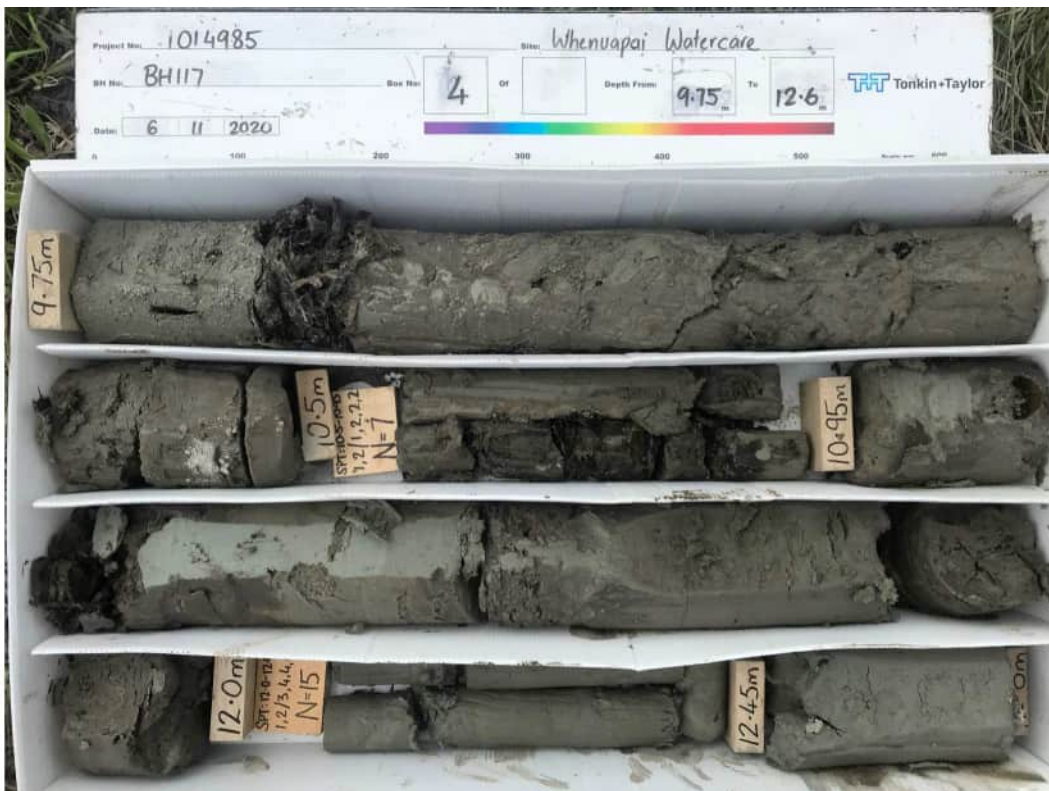
3.75-7.05m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926691.00 mN (NZTM2000) 1743092.70 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.: 10.90m		DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: ROM
			CHECKED: CBM



7.05-9.75m



9.75-12.60m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



12.60-15.00m



15.00-17.80m

CORE PHOTOS

BOREHOLE No.: **BH117**

SHEET: 4 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926691.00 mN 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



17.80-21.15m

BOREHOLE LOG

BOREHOLE No.:

BH05A

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT		DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
												Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations						
SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																					
Top	Sandy gravelly SILT, trace organics; brown & grey. Firm, moist, low plasticity; sand, fine to coarse, Quartz, gravel, fine to coarse, subangular, unweathered, Basalt & Concrete; organics, rootlets.					PQTT	46	1 @ 0.10m 1 x Glass Jar 1x plastic Jar													
Tauranga Group	Silty CLAY, minor sand, trace organics; light brown mottled orange and dark brown, speckled black, homogeneous. Stiff, moist, high plasticity; sand, fine; organics, rootlets.							7 @ 0.35m 1 x plastic jar (Corrosivity)		0.5											
	0.35 - 0.75m: CORE LOSS																				
	Silty CLAY, minor sand, trace organics; light brown mottled orange & dark brown, speckled black, homogeneous. Stiff, moist, high plasticity; sand, fine; organics, rootlets.							0/- kPa													
	Sandy SILT, some clay; light brown mottled orange & dark brown speckled white and black, homogeneous. Stiff, moist, high plasticity; sand, fine.					SPT	86	2 @ 1.00m 1 x Glass Jar 1x plastic jar		1.0											
	Silty CLAY, minor sand, trace organics; light brown mottled orange & dark brown speckled black & white, homogeneous. Stiff, moist; sand, fine; organics, rootlets.																				
	Sandy SILT, trace organics; brown spotted black, homogeneous. Stiff, moist, low plasticity; sand, fine; organics, rootlets.					PQTT	124	93/44 kPa 0/1 1/0 1/1 N=3		1.5											
	SILT, some sand, minor clay, trace organics; light brown mottled orange, homogeneous. Stiff, moist, low plasticity; sand, fine; organics, rootlets.							3 @ 2.00m 1 x Glass Jar 1x plastic Jar 1 x Split 1 x Duplicate		2.0											
	SILT, minor clay, trace organics; light green - grey, speckled black. Firm to stiff, moist, low plasticity; organics, fibrous.					SPT	100			2.5											
	2.00 - 2.17m: Grey-brown mottled brown, speckled black																				
	SILT, trace clay; grey-brown mottled brown, speckled black. Firm to stiff, moist, low plasticity.							8 @ 2.90m 1 x plastic jar (Corrosivity)		3.0											
	3.0 - 3.5 m: Push Tube					PQTT	0	4 @ 3.00m 1 x Glass Jar 1x plastic Jar													
	SILT, trace clay; grey-brown mottled brown, speckled black. Firm, moist, low plasticity.					PT	173	28/9 kPa 0/0 0/1 1/1 N=3		3.5											
	SILT, trace organics; brown speckled black. Firm, moist, low plasticity; organics, fibrous.																				
	3.85m: grades light brown																				
	SILT, minor sand, trace organics and clay; light green, speckled black. Firm, moist, medium plasticity; sand, fine; organics, fibrous.					PQTT	100	5 @ 4.00m 1 x Glass Jar 1x plastic Jar		4.0											
	4.03m: Light brown mottled brown, speckled black																				
	Sandy SILT, trace organics; light brown mottled brown, speckled black. Stiff, moist, low plasticity; sand, fine; organics, fibrous.								19/4 kPa Core disturbed by drilling		4.5										
	Silty SAND; green speckled black, homogeneous. Medium dense, moist, poorly graded; sand, fine.					SPT	100	2/3 3/3 3/4 N=13													
	SAND, minor silt; light brown speckled black. Medium dense, moist, poorly graded; sand, fine.																				

01/12/2020

Box 1, 0.0-3.0m

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH05A

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	4.95 - 5.35 m: CORE LOSS						6 @ 5.00m 1 x Glass Jar 1 x plastic Jar												
	Organic clayey SILT, trace rootlets; dark brown speckled black. Stiff, moist, high plasticity. Organics; amorphous				PQTT	61			5.5										
	6.25 - 6.45 m: CORE LOSS				SPT	55	0/- kPa 1/0 0/1 N=2		6.0					6.00m: Shear Vane failed					
	PEAT (AMORPHOUS), minor sand; dark brown, homogeneous. Firm to stiff, moist; sand, fine.								6.5										
	Organic SILT; dark brown speckled black. Stiff, moist, low plasticity. Organics; amorphous				PQTT	100			7.0										
Albany Conglomerate	PEAT (AMORPHOUS), minor sand; dark brown. Firm to stiff, moist; sand, fine.								7.5										
	7.50m: Very stiff				SPT	116/29 kPa	0/1 2/2 3/4 N=11		7.5										
	Completely weathered, grey, SANDSTONE. Extremely Weak, (Recovered as SAND; grey. Medium dense, moist, poorly graded; sand, fine).				SPT	106			8.0										
	8.2 - 9.0 m: CORE LOSS				PQTT	23			8.5										
	9.0 - 9.45 m: Solid Cone SPT				SPT	0	UTP 3/3 5/5 5/6 N=21 Solid		9.0					9.00 - 10.50m: Re-drilled due to core loss					
	Completely weathered, brown-grey, massive, SANDSTONE. Extremely Weak, (Recovered as SAND, minor gravel; brown-grey. Medium dense, moist, poorly graded; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered, Sandstone & Siltstone).								9.5										

Box 2, 3.0-6.8m

Box 2, 3, 0-6.8m

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH05A

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 17/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926551.90 mN
(NZTM2000) 1743191.10 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.00m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Albany Conglomerate	10.05 - 10.5 m: CORE LOSS			PQTT	57													
	Highly weathered, brown and dark grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Gravelly SAND; brown & dark grey. Medium dense, moist; sand, fine to coarse; gravel, fine to coarse, subangular, unweathered).			SPT	93	UTP 4/4 5/5 7/7 N=24	10.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as GRAVEL; grey. Moist; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone).			PQTT	76		11.0											
	Moderately weathered, grey, SANDSTONE. Extremely Weak, Weakly cemented. SAND; grey. Very dense, moist, poorly graded; sand, fine.						11.5					0						
	11.75 - 12.0 m: CORE LOSS																	
	12.0 - 12.25 m: Solid cone SPT			SPT	100	UTP 5/21 27/23 N>=50	12.0											
	Highly weathered, brown & grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (Recovered as Sandy GRAVEL; brown & grey. Medium dense, moist, poorly graded; gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & siltstone; sand, fine to coarse).						12.5											
	Highly weathered, grey, CONGLOMERATE. Extremely Weak, Very weakly cemented (recovered as GRAVEL; grey. Gravel, fine to coarse, subrounded to subangular, unweathered, Sandstone & Siltstone)			PQTT	56		13.0					0						
	Moderately weathered, grey, SANDSTONE. Extremely Weak, very weakly cemented. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).						13.5											
	13.5 - 13.64 m: Solid Cone SPT			SPT	0	15/35 for 65mm N>=50 Solid	13.5											
	Unweathered, grey, SANDSTONE. Extremely Weak, Widely spaced fractures. (Recovered as SAND; grey. Very dense, moist, poorly graded; sand, fine).			PQTT	129		14.0					63						
	13.96 - 13.98m: Slightly weathered, grey, SILTSTONE. Extremely Weak. SILT; grey. Hard, moist, low plasticity.						14.5											

COMMENTS: Piezometer installed with screened interval from 8.5 - 11.5 m.

Hole Depth
15.15m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926551.90 mN (NZTM2000) 1743191.10 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.: 9.00m		DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: ROM
			CHECKED: CBM



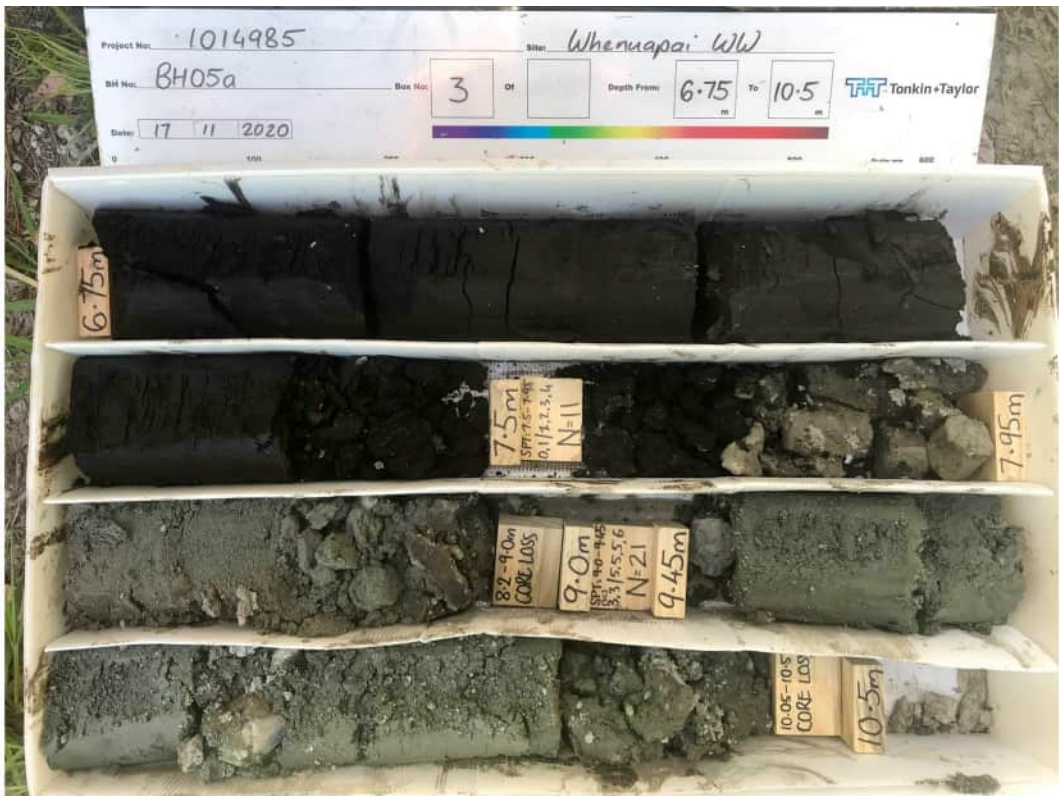
0.00-3.00m



3.00-6.75m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926551.90 mN (NZTM2000) 1743191.10 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.: 9.00m		DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



6.75-10.50m



10.50-13.20m

CORE PHOTOS

BOREHOLE No.: **BH05A**

SHEET: 3 OF 3

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926551.90 mN 1743191.10 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 17/11/2020
R.L.:	9.00m	DRILL METHOD: RC	HOLE FINISHED: 18/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



13.20-15.14m

BOREHOLE LOG

BOREHOLE No.:
BH05B

SHEET: 1 OF 2

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 18/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926553.70 mN
(NZTM2000) 1743191.30 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100	UNW W1 W2 W3 W4 W5 W6 W7 W8 W9 W10 W11 W12 W13 W14 W15 W16 W17 W18 W19 W20 W21 W22 W23 W24 W25 W26 W27 W28 W29 W30 W31 W32 W33 W34 W35 W36 W37 W38 W39 W40 W41 W42 W43 W44 W45 W46 W47 W48 W49 W50 W51 W52 W53 W54 W55 W56 W57 W58 W59 W60 W61 W62 W63 W64 W65 W66 W67 W68 W69 W70 W71 W72 W73 W74 W75 W76 W77 W78 W79 W80 W81 W82 W83 W84 W85 W86 W87 W88 W89 W90 W91 W92 W93 W94 W95 W96 W97 W98 W99 W100															
	Wash drilled to 7.0 m BGL. See BH05A for geology details																	

COMMENTS: 50 mm standpipe piezometer with screened interval from 3.5 - 5.5 m.

Hole Depth
7m

Scale 1:25

BOREHOLE LOG

BOREHOLE No.:
BH05B

SHEET: 2 OF 2

DRILLED BY: Vincent

LOGGED BY: ROM

CHECKED: CBM

START DATE: 18/11/2020

FINISH DATE: 18/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926553.70 mN
(NZTM2000) 1743191.30 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.20m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UNW W C S CS MS MWS CWS									2000 600 200 100 50 20			25 50 75				
	Wash drilled to 7.0 m BGL. See BH05A for geology details			W	0			4 5.5 6.0 6.5 7.0										
	7m: END OF INVESTIGATION							2 7.5 8.0 8.5 9.0 9.5										

COMMENTS: 50 mm standpipe piezometer with screened interval from 3.5 - 5.5 m.

Hole Depth
7m

Scale 1:25



Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:

BH110

SHEET: 1 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
TSoil	SILT, trace rootlets; brown. Stiff, moist, non-plastic.					1 @ 0.10m												
	SILT, trace sand; light brown mottled orangish brown. Stiff to very stiff, moist, low plasticity; sand, fine. 0.50 - 0.80m: Trace rootlets.			PQTT	100	2 @ 0.50m		0.5					0.50m: PID - 0.6 ppm					
	Silty CLAY; light brown mottled orangish brown. Very stiff, moist, high plasticity. 0.80 - 0.90m: Trace rootlets.					8 @ 0.80m 3 @ 0.90m		1.0					1.00m: PID - 0.3 ppm					
Tauranga Group	1.50 - 2.45m: Light brown.					4 @ 1.25m 153/59 kPa / 1 2/1 3/2 N=8		1.5										
				SPT	84	5 @ 1.95m		2.0										
				PQTT	100	9 @ 2.30m 96/16 kPa		2.5										
East Coast Bays Formation	Silty SAND; light brown mottled orangish brown. Loosely packed, saturated; sand, fine.							2.5										
	Sandy SILT; grey. Tightly packed, moist; sand, fine.			PQTT	100	6 @ 2.90m 0/- kPa crumble		3.0										
	3.1 - 3.5 m: PUSH TUBE			PT	100	Push Tube @ 3.10m		3.5										
	Sandy SILT; grey. Hard, moist, non-plastic; sand, fine.			SPT	100	5/10 15/17 18 for 65mm N>=50		3.5										
	3.87 - 4.0 m: CORE LOSS							4.0										
	Moderately weathered, grey, SANDSTONE. Extremely weak. (Recovered as SAND, grey. Very dense, moist; sand fine)			PQTT	79	7 @ 4.00m		4.0										
	Moderately weathered, grey, SILTSTONE. Extremely weak. (Recovered as Sandy SILT, grey. hard, moist, low plasticity; sand fine)			SPT	0	UTP 6/25 20/30 for 45mm N>=50 Solid		4.5										
	4.77 - 4.87 m: CORE LOSS							4.5										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Box 1, 0.0-2.5m

16/11/2020

07/12/2020

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 2 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering		Rock Strength		Sampling Method		Core Recovery (%)		Testing		RL (m)		Depth (m)		Graphic Log		Defect Log		Fracture Spacing (mm)		RQD (%)		Description & Additional Observations		Fluid Loss (%)		Water Level		Casing		Installation		Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation																																			
East Coast Bays Formation	Moderately weathered, grey, fine, SANDSTONE. Extremely Weak. (Recovered as SAND; grey. Tightly packed, moist; sand, fine)																																			
	Moderately weathered, grey, SILTSTONE. Very Weak.																																			
	Moderately weathered, grey, fine SANDSTONE. Extremely weak. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	Slightly weathered, grey, SANDSTONE. Extremely weak, very weakly cemented. (Recovered as Silty SAND, grey. Very dense, moist; sand fine)																																			
	6.93m: Carbonaceous																																			
	Unweathered, grey, SANDSTONE. Very Weak.																																			
	7.5 - 7.63 m: Solid SPT																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	8.00 - 8.15m: Unweathered SILTSTONE. Very Weak.																																			
	8.15 - 8.3 m: CORE LOSS																																			
	Unweathered, grey, fine to coarse, SANDSTONE. Very Weak.																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.0 - 9.18 m: SOLID SPT																																			
	Unweathered, grey, fine, SANDSTONE. Very Weak.																																			
	9.30 - 9.40m: Unweathered SILTSTONE. Very Weak.																																			
	9.90 - 9.97m: Unweathered SILTSTONE. Very Weak.																																			

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 3 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.60m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	ROCK DEFECTS		Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation										Description & Additional Observations							
East Coast Bays Formation	Unweathered, grey, medium to coarse, SANDSTONE. Very Weak, Weakly cemented.				PQTT	100							10.13m: BF, 0° dip, VN, CN 10.22m: BF, 0° dip, N, CN 10.30m: BF, 0° dip, VN, CN 10.37m: BF, 0° dip, VN, CN						
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	0	20/30 for 35mm N>=50 Solid	10.5				54							
	Unweathered, grey, fine, SANDSTONE. Very Weak.				PQTT	100						48	10.74 - 10.77m: BF, 30° dip, N, CN 10.84m: BF, 0° dip, N, CN 10.94m: DD 11.09m: DD 11.22m: BF, 0° dip, VN, CN 11.29m: BF, 0° dip, VN, CN 11.36m: BF, 20° dip, VN, CN						
	11.22 - 11.23m: Unweathered SILTSTONE. Very Weak.																		
	11.35 - 11.53m: SANDSTONE grades fine to medium grained																		
	11.85 - 11.95m: Unweathered SILTSTONE. Very Weak				PQTT	100						21	11.53 - 11.57m: BF, 0° dip, MN, Sands 11.65 - 11.73m: BZ, VN, CN 11.79m: BF, 0° dip, VN, CN 11.85m: DD						
	12.0 - 12.09 m: SOILD SPT				SPT	0	32/18 for 15mm N>=50 Solid	12.0				0	12.19m: BF, 0° dip, VN, CN 12.23m: DD 12.29m: BF, 10° dip, VN, CN						
	Unweathered, grey, SANDSTONE. Very Weak.																		
	Unweathered, grey, SILTSTONE. Very Weak. 12.21 - 12.29m: Carbonaceous																		
	12.29 - 12.35m: Carbonaceous 12.63 - 12.64m: SANDSTONE interbed 12.69 - 12.70m: SANDSTONE interbed																		
	Unweathered, grey, fine, SANDSTONE. Very Weak, Weakly cemented.					PQTT	100						55	12.48m: BF, 0° dip, VN, CN 12.59m: BF, 0° dip, N, Sandstone gravels 12.64m: BF, 10° dip, N, CN 12.68m: BF, 0° dip, VN, CN 12.70m: DD 12.75m: DD 12.99m: DD 13.17m: BF, 0° dip, VN, CN 13.29m: BF, 0° dip, VN, CN					
	13.37 - 13.46m: Unweathered SILTSTONE. Very Weak.																		
					SPT	0	32/18 for 20mm N>=50 Solid	13.5				0	13.63m: BF, 10° dip, N, CN 13.74m: BF, 0° dip, MN, CN 13.77m: BF, 0° dip, N, CN 13.88m: BF, 0° dip, MN, CN 14.10m: DD 14.16m: BF, 0° dip, N, CN 14.25 - 14.29m: BF, VN, CN						
	Unweathered, grey mottled light grey, fine to medium grained, SANDSTONE. Weak, Moderately cemented.																		
	Unweathered, grey, fine, SANDSTONE. Very Weak. 14.21 - 14.22m: Unweathered SILTSTONE. Very Weak.				PQTT	75						32							
	14.4 - 14.75 m: CORE LOSS																		
	Unweathered, grey, SANDSTONE. Very weak																		
	Unweathered, grey, SILTSTONE. Very Weak.																		

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

Rev.: A



BOREHOLE LOG

BOREHOLE No.:
BH110

SHEET: 4 OF 4

DRILLED BY: Mackenzie, Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 13/11/2020

FINISH DATE: 16/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926611.70 mN
(NZTM2000) 1743051.90 mE

R.L. GROUND: 9.60m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station\Surveyed

DIRECTION:

ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										2000 600 200 100 50 20							
	15.0 - 15.11 m: SOLID SPT			SPT	0	23/27 for						0						
	15.11m: END OF INVESTIGATION					35mm N>=50 Solid												
								15.5										
								-6										
								16.0										
								16.5										
								-7										
								17.0										
								17.5										
								-8										
								18.0										
								18.5										
								-9										
								19.0										
								19.5										
								-10										

COMMENTS: Piezometer installed with screened interval from 8.0 - 11.0 m

Hole Depth
15.11m

Scale 1:25

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



0.00-2.50m



2.50-5.10m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926611.70 mN (NZTM2000) 1743051.90 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.: 9.60m		DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



5.10-7.10m



7.10-9.61m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926611.70 mN (NZTM2000) 1743051.90 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.:	9.60m	DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



9.61-11.90m



11.90-14.10m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926611.70 mN 1743051.90 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 13/11/2020
R.L.:	9.60m	DRILL METHOD: RC	HOLE FINISHED: 16/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



14.10-15.11m

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 1 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT		DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Description & Additional Observations	Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
Top		SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Defect Log	Fracture Spacing (mm)	RQD (%)							
Tauranga Group	Clayey SILT, some organics; brown. Very stiff, moist, high plasticity; organics, rootlets.							BH111 Sample 1 @ 0.05m													
	Clayey SILT, trace sand; light brown. Stiff, moist, high plasticity; sand, fine. 0.3 - 1.4 m: CORE LOSS					PQTT	26														
	Clayey SILT, trace sand; light brown mottled brown. Stiff, moist, high plasticity; sand, fine.					SPT	100	73/31 kPa 1/1 0/1 1/2 N=4													
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; sand, fine; organics, rootlets.					PQTT	100	BH111 Sample 2 @ 2.00m BH111 Sample 3 @ 2.20m													
East Coast Bays Formation	Sandy SILT; grey mottled orangish brown. Firm, moist, non-plastic; sand, fine.					PQTT	100														
	Silty SAND; grey. Medium dense, moist; sand, fine.					SPT	100	BH111 Sample 4 @ 2.80m 2/3 5/6 7/7 N=25													
	3.45 - 3.7 m: CORE LOSS																				
	Moderately weathered, grey, fine grained, SANDSTONE. Extremely Weak, (Recovered as Silty SAND; grey. Medium dense, moist; sand, fine) 3.90 - 4.05m: Recovered as GRAVEL					PQTT	76	BH111 Sample 5 @ 3.70m BH111 Sample 6 @ 3.90m													
	Moderately weathered, grey fine grained SANDSTONE; Extremely weak. (Recovered as fine grained SAND; grey. Dense, moist.)																				
	Moderately weathered, grey SILTONE; Extremely weak. (Sandy SILT; grey. Hard, moist, low plasticity; sand, fine.) 4.70 - 4.72m: SILT; light brown. Moist, low plasticity. 4.85m: 2 mm thick SILT; light brown. 4.90 - 4.95m: SAND; grey. Dense, moist; sand, fine.					SPT	100	0/- kPa Crumble. 6/5 5/9 15/21 N>=50 Solid													

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 2 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method		Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No	
	SOIL: Classification, colour, consistency / density, moisture, plasticity				PQTT	SPT						Fracture Spacing (mm)	RQD (%)	Description & Additional Observations							
	ROCK: Weathering, colour, fabric, name, strength, cementation																				
East Coast Bays Formation	4.95 - 5.05 m: CORE LOSS				PQTT	81								65	5.23m: BF, 10° dip, VN, CN 5.27 - 5.28m: BF, 0° dip, MN, light brown veneer						
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak. 5.05 - 5.15m: SAND; grey. Dense, moist; sand, fine. 5.28 - 5.32m: Slightly weathered, grey, SILTSTONE. Very Weak. 5.40m: Carbonaceous																				
	Unweathered, light grey, fine grained SANDSTONE. Weak.				PQTT	12								0							
	5.56 - 6.0 m: CORE LOSS																				
	Slightly weathered, grey, fine grained SANDSTONE. Very Weak, Carbonaceous [logged after solid SPT testing].				SPT	100	8/15 15/25 10 for 15mm N>=50 Solid							0							
	Slightly weathered, grey, fine, SANDSTONE. Very Weak, (Recovered as GRAVEL).																				
	6.42 - 6.6 m: CORE LOSS																				
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 6.68 - 6.72m: SILTSTONE 6.90 - 6.92m: SILTSTONE				PQTT	84								53	6.60m: BF, 0° dip, N, CN 6.68m: BF, 0° dip, N, CN 6.77m: BF, 0° dip, N, CN 6.87m: BF, 0° dip, N, CN						
	7.20 - 7.26m: SILTSTONE															7.00m: DD 7.20m: DD 7.40m: BF, 0° dip, VN, CN					
	Unweathered, grey, SILTSTONE. Very Weak. - INTERBEDDED WITH - Unweathered, grey, fine, SANDSTONE. Very Weak.				SPT	100	8/12 17/23 10 for 20mm N>=50 Solid							0							
	Unweathered, grey, fine grained SANDSTONE. Very Weak.															8.15m: DD 8.30m: BF, 0° dip, VN, CN 8.42m: BF, 0° dip, VN, CN 8.44m: BF, 0° dip, VN, CN 8.49m: BF, 0° dip, VN, CN 8.53m: DD					
	8.32 - 8.33m: SILTSTONE 8.37 - 8.38m: SILTSTONE 8.44 - 8.53m: SILTSTONE 8.53 - 8.90m: Weakly cemented SANDSTONE				PQTT	80								45							
	8.9 - 9.0 m: CORE LOSS																				
	Unweathered, grey, SANDSTONE. Very Weak, carbonaceous. [logged after solid SPT test].				SPT	95	15/25 35/15 for 10mm N>=50 Solid							0							
	9.24 - 9.45 m: CORE LOSS																				
	Unweathered, grey, fine grained SANDSTONE. Very Weak.													31	9.50m: DD 9.68m: DD 9.78m: BF, 0° dip, N, CN 9.83m: DD 9.86m: DD						
	9.78 - 9.80m: SILTSTONE 9.86 - 9.97m: SILTSTONE																				

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:

BH111

SHEET: 3 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:
ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	[CONT] unweathered, grey, fine grained SANDSTONE. Very Weak. 10.02 - 10.06m: Fine to coarse grained SANDSTONE 10.24 - 10.48m: Fine to coarse grained SANDSTONE				PQTT	83							31	10.02m: BF, 0° dip, VN, CN 10.06 - 10.11m: BF, 0° dip, N, CG (grey silt) 10.15m: DD 10.21m: BF, 0° dip, N, CN 10.24m: BF, 0° dip, N, CN 10.38m: DD 10.44m: DD					
	10.5 - 10.63 m: Solid SPT				SPT	0	20/27 for 50mm N>=50 Solid		10.5				0						
	10.63 - 11.15 m: CORE LOSS																		
	Unweathered, grey, fine grained SANDSTONE. Very Weak.				PQTT	62							9	11.22m: BF, 0° dip, N, CN 11.28m: BF, 0° dip, N, CN 11.36m: BF, 0° dip, N, CN 11.45m: DD 11.50m: DD 11.59m: DD					
	Unweathered, grey, coarse grained SANDSTONE. Very Weak.																		
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 11.61 - 11.65m: SILTSTONE 11.77 - 11.82m: Coarse grained SANDSTONE														11.73m: DD 11.77m: BF, 0° dip, N, CN 11.82m: DD 11.88m: DD				
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	80	5/14 30/20 for 25mm N>=50 Solid		12.0				0						
	Unweathered, grey, fine grained SANDSTONE. Very Weak.														12.46m: DD				
	12.74 - 12.77m: SILTSTONE				PQTT	100							61	12.63 - 12.73m: BZ, 70° dip, VN, CN 12.87m: DD					
	13.14 - 13.20m: SILTSTONE														13.14m: DD 13.27m: DD 13.32m: BF, 0° dip, N, CN 13.42m: DD				
	Unweathered, grey, SILTSTONE. Very Weak.				SPT	100	20/30 for 30mm N>=50 Solid		13.5				0		13.76m: DD 13.85m: DD				
	Unweathered, grey, fine grained SANDSTONE. Very Weak.														14.02m: DD 14.10m: DD 14.15m: DD				
14.26 - 14.41m: Weakly cemented				PQTT	73							46							
14.41 - 14.78 m: CORE LOSS																			
Unweathered, grey, fine grained SANDSTONE. Very Weak.														14.88m: DD					

Box 4, 8.3-11.5m

Box 5, 11.5-13.6m

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

Rev.: A

BOREHOLE LOG

BOREHOLE No.:
BH111

SHEET: 4 OF 4

DRILLED BY: Vincent

LOGGED BY: YCWA

CHECKED: CBM

START DATE: 10/11/2020

FINISH DATE: 11/11/2020

CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI

JOB No.: 1014985.0000

LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743088.20 mE

DIRECTION:

ANGLE FROM HORIZ.: -90°

R.L. GROUND: 9.90m

R.L. COLLAR:

DATUM: NZVD2016

SURVEY: Total Station/Surveyed

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS			Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation										Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	[CONT] Unweathered, grey, fine grained SANDSTONE. Very Weak.		SPT	100	PQTT	84	20/30 for 45mm N>=50 Solid	15.5	15.5	15.5	2000 1000 500 200 100 50 20	0	15.27m: DD 15.35m: DD 15.40m: DD	25 50 75				
	15.65 - 15.75 m: CORE LOSS																	
	Unweathered, grey, coarse grained SANDSTONE. Very Weak.		SPT	100	PQTT	76	17.0	17.0	66	16.93m: DD 17.10m: DD 17.16m: DD								
	16.62 - 16.77 m: CORE LOSS										PQTT	80	17.5	17.5	44	17.60m: BF, 0° dip, N, CN		
	Unweathered, grey, coarse grained SANDSTONE. Weak.		SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m								
	Unweathered, grey, SILTSTONE. Very Weak.										SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m
	17.25 - 17.4 m: CORE LOSS		SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m								
	Unweathered, grey, fine grained SANDSTONE. Very Weak. 17.46 - 17.48m: SILTSTONE 17.51 - 17.55m: SILTSTONE 17.67 - 17.86m: SILTSTONE										SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m
	Unweathered, grey, medium grained SANDSTONE. Very Weak.		SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m								
	18.0 - 18.04 m: Solid SPT										SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m
18.04m: END OF INVESTIGATION		SPT	100	PQTT	80	18.0	18.0	0	18.00m: SPT calibration undertaken between 10.5 - 18.0m									

COMMENTS: 50 mm standpipe piezometer installed with screened interval from 3.0 - 5.0 m.

Hole Depth
18.04m

Scale 1:25

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



0.00-3.45m



3.45-6.00m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926614.20 mN (NZTM2000) 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016	LOGGED BY: YCWA	CHECKED: CBM



6.00-8.30m



8.30-11.45m

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926614.20 mN (NZTM2000) 1743088.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.: 9.90m		DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM: NZVD2016		LOGGED BY: YCWA	CHECKED: CBM



11.45-13.60m



13.60-16.50m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926614.20 mN 1743088.20 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 10/11/2020
R.L.:	9.90m	DRILL METHOD: RC	HOLE FINISHED: 11/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



16.50-18.00m

BOREHOLE LOG

BOREHOLE No.:
BH111A

SHEET: 1 OF 1

DRILLED BY: Vincent
LOGGED BY: YCWA
CHECKED: CBM
START DATE: 12/11/2020
FINISH DATE: 12/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926614.20 mN
(NZTM2000) 1743090.20 mE

R.L. GROUND: 9.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

DIRECTION:
ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
										Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
Tauranga Group	SILT, minor rootlets; brown. Stiff to very stiff, low plasticity.																	
	Clayey SILT; light brown mottled orangish brown. Stiff, moist, high plasticity. 0.60 - 0.80m: Trace rootlets. Firm.												0.50m: PID - 0.3 ppm 1.00m: PID - 0.5 ppm					
	Clayey SILT, minor organics, trace sand; brown. Firm, moist, high plasticity; organics, fleck; sand, fine.																	
	1.75 - 2.0 m: CORE LOSS																	
	2.0 - 2.5 m: PUSH TUBE																	
	2.5m: END OF BOREHOLE																	

COMMENTS: Drilled 1.5 m from BH111 to recover core in the upper 2.5 m.

Hole Depth
2.5m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **BH111A**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926614.20 mN (NZTM2000) 1743090.20 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 12/11/2020
R.L.: 9.90m		DRILL METHOD: RC	HOLE FINISHED: 12/11/2020
DATUM: NZVD2016			DRILLED BY: McMillan Drilling
			LOGGED BY: YCWA CHECKED: CBM



0.00-2.50m

BOREHOLE LOG

BOREHOLE No.:
BH117

SHEET: 5 OF 5

DRILLED BY: Mackenzie
LOGGED BY: ROM
CHECKED: CBM
START DATE: 06/11/2020
FINISH DATE: 09/11/2020
CONTRACTOR: McMillan Drilling

PROJECT: Watercare Whenuapai-Redhill GI
JOB No.: 1014985.0000
LOCATION: Whenuapai

CO-ORDINATES: 5926691.00 mN
(NZTM2000) 1743092.70 mE

R.L. GROUND: 10.90m
R.L. COLLAR:
DATUM: NZVD2016
SURVEY: Total
Station\Surveyed

DIRECTION:
ANGLE FROM HORIZ.: -90°

GEOLOGICAL UNIT	DESCRIPTION OF CORE		Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS				Fluid Loss (%)	Water Level	Casing	Installation	Core Box No
	SOIL: Classification, colour, consistency / density, moisture, plasticity	ROCK: Weathering, colour, fabric, name, strength, cementation									Defect Log	Fracture Spacing (mm)	RQD (%)	Description & Additional Observations					
East Coast Bays Formation	Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)																		
	20.38 - 21.0 m: Core Loss				PQTT	42			20.5				0						
	Moderately weathered, grey, fine SANDSTONE; Extremely weak, weakly cemented (Recovered as Fine grained SAND, trace silt; grey. Very dense, moist, poorly graded)				SPT	100	17/33 for 30mm N>=50		21.0				0					Box 7, 17.8-21.2m	
	21.15m: END OF INVESTIGATION								21.5										
									-11										
									22.0										
									22.5										
									-12										
									23.0										
									23.5										
									-13										
									24.0										
									24.5										
									-14										

COMMENTS: 50 mm standpipe piezometer with screened interval from 2.0 - 4.0 m.

Hole Depth
21.15m

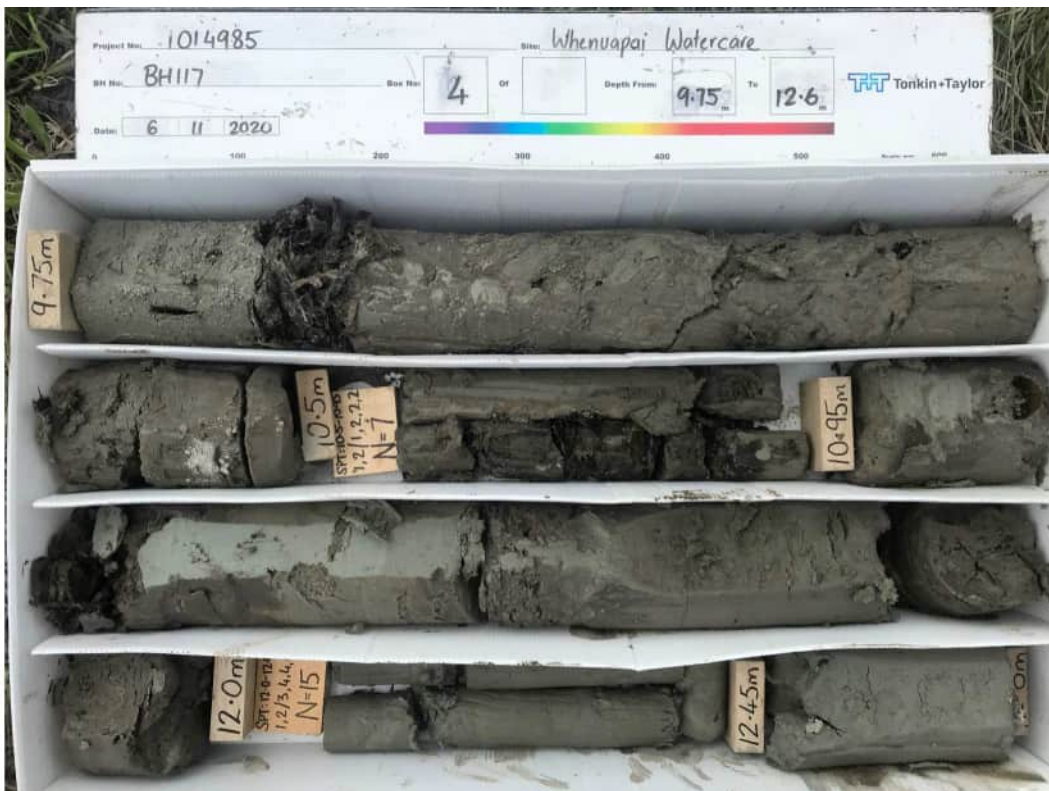
Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926691.00 mN (NZTM2000) 1743092.70 mE		DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.: 10.90m		DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM: NZVD2016		DRILLED BY: McMillan Drilling	LOGGED BY: ROM
			CHECKED: CBM



7.05-9.75m



9.75-12.60m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES:	5926691.00 mN (NZTM2000) 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



12.60-15.00m



15.00-17.80m

CORE PHOTOS

BOREHOLE No.: **BH117**

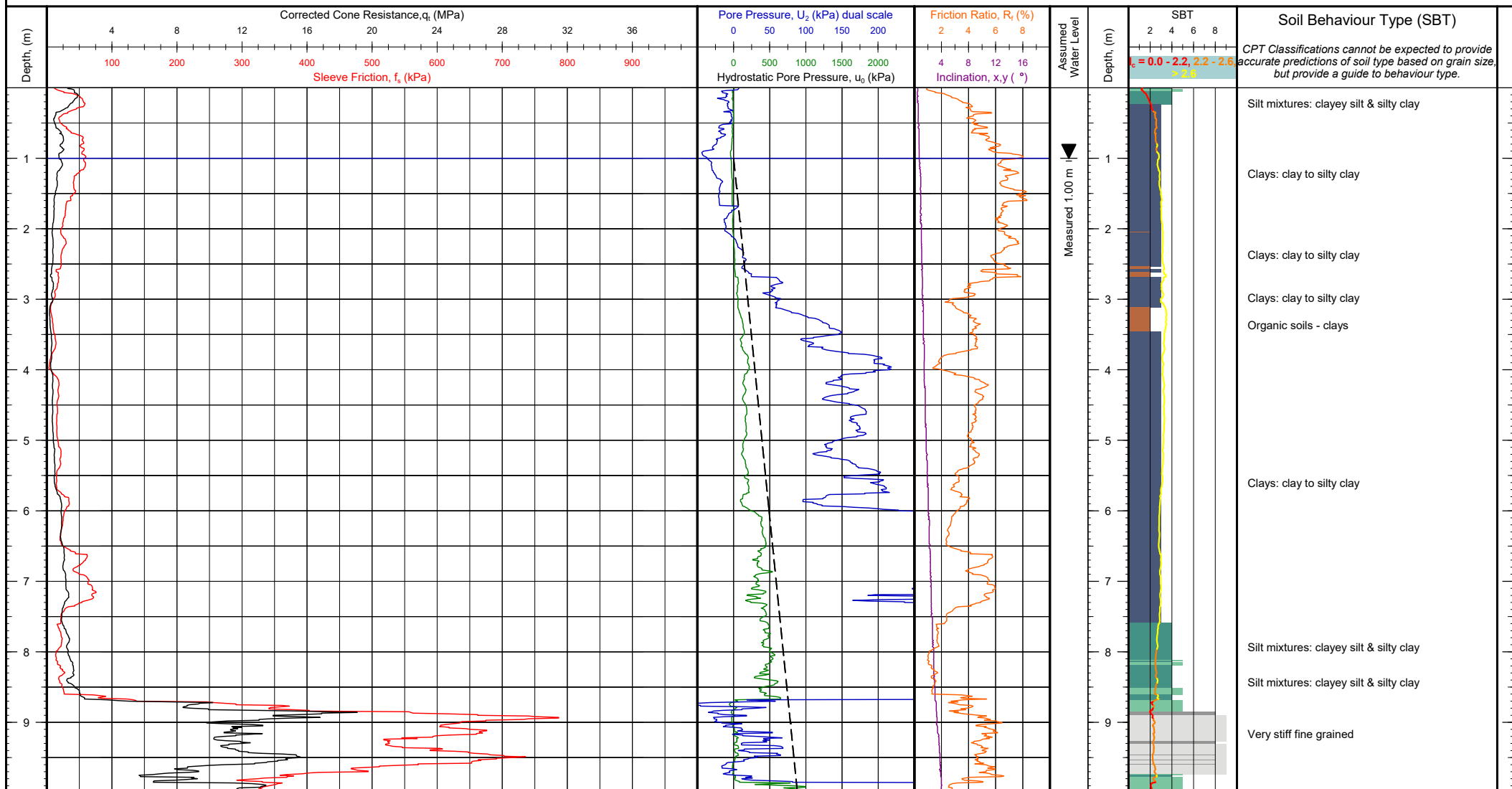
SHEET: 4 OF 4

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926691.00 mN 1743092.70 mE	DRILL TYPE: Track-mounted	HOLE STARTED: 06/11/2020
R.L.:	10.90m	DRILL METHOD: RC	HOLE FINISHED: 09/11/2020
DATUM:	NZVD2016		DRILLED BY: McMillan Drilling
			LOGGED BY: ROM CHECKED: CBM



17.80-21.15m

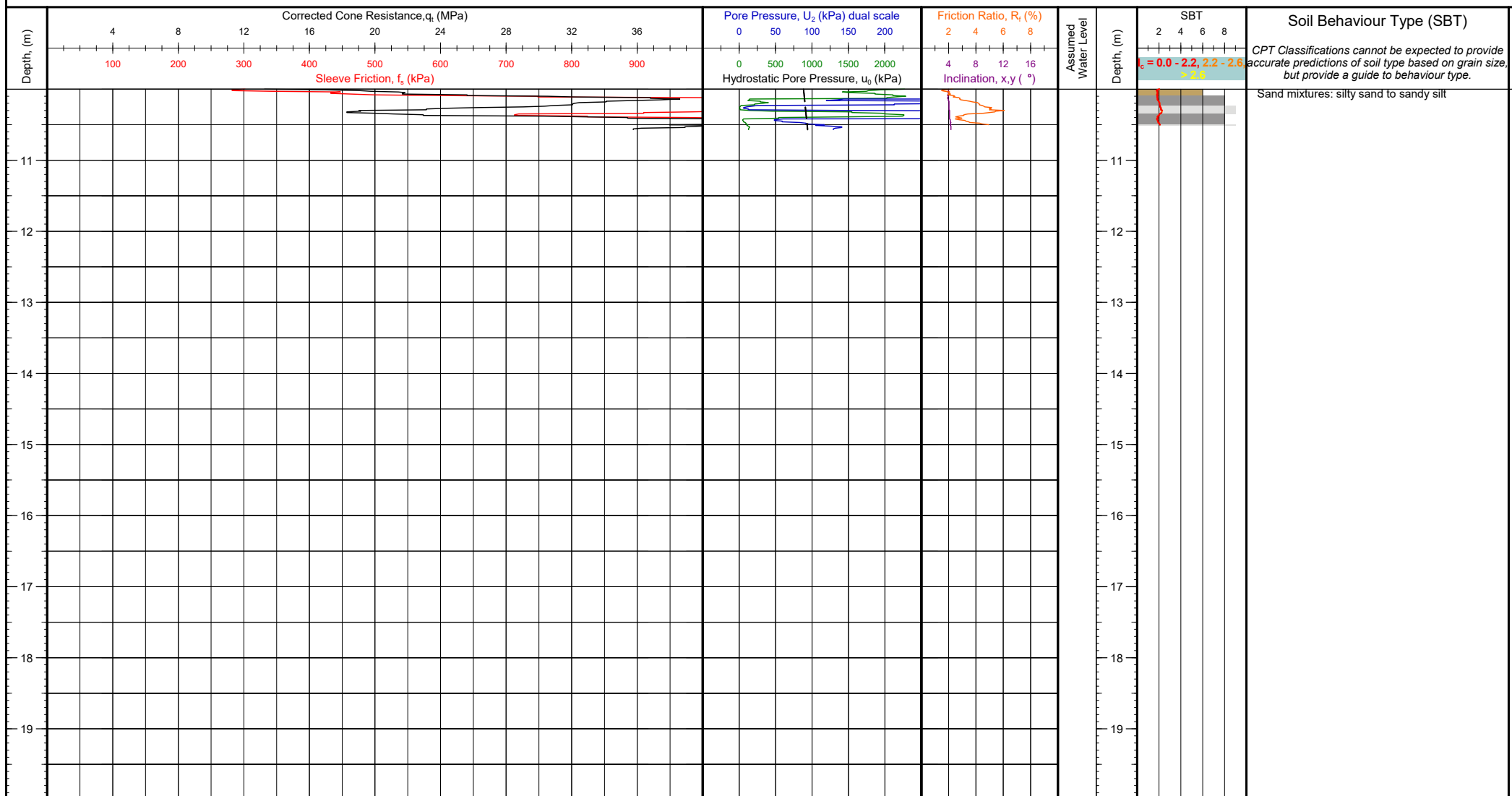
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u ₂	NZTM 2000 N, E (m): 5926555.13, 1743194.03 WGS84 (deg): -36.796009, 174.605017 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 10.57 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-02 G.I. Job Ref: 200824

Comments:

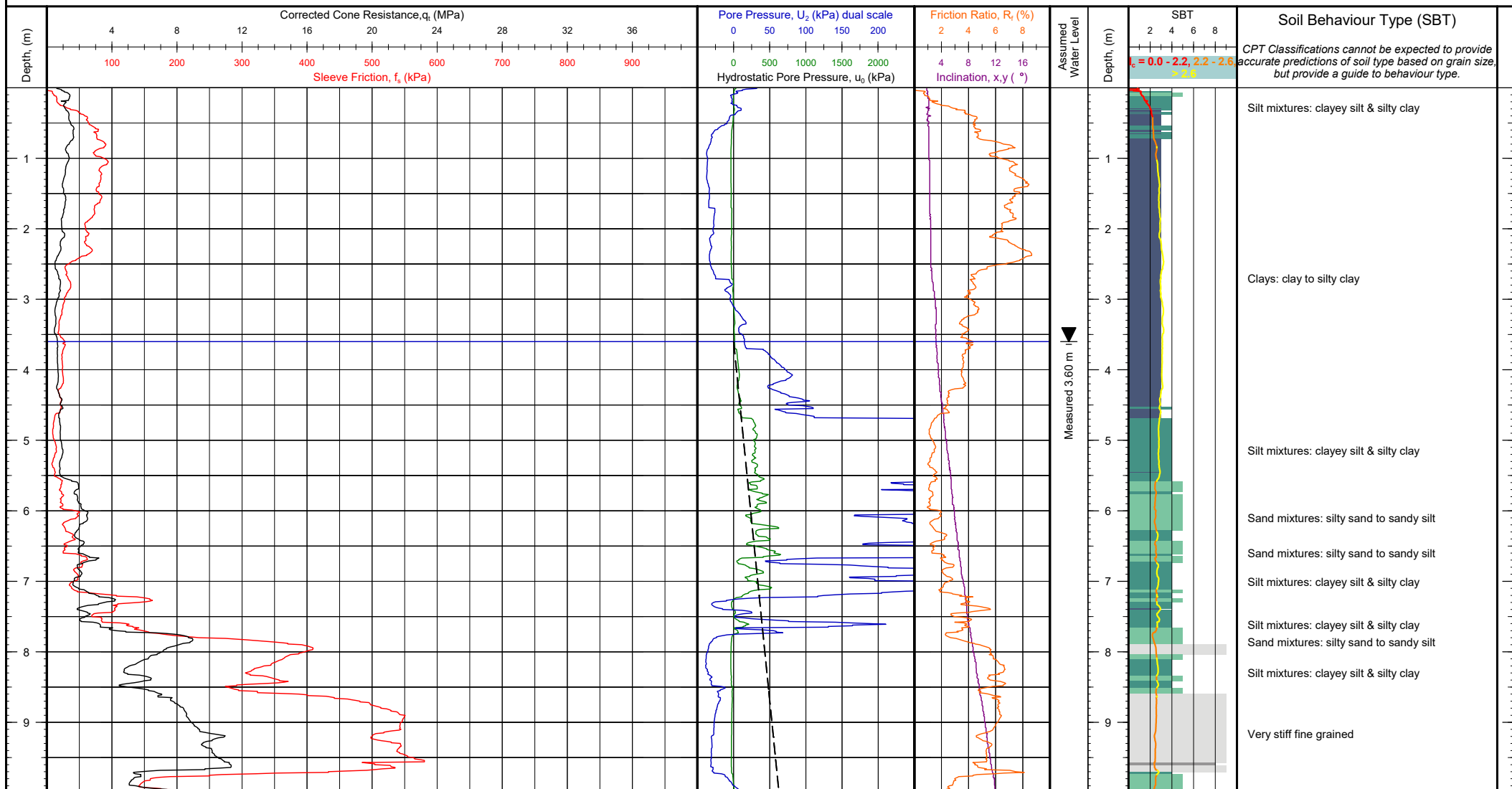
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926555.13, 1743194.03 WGS84 (deg): -36.796009, 174.605017 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 10.57 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-02 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

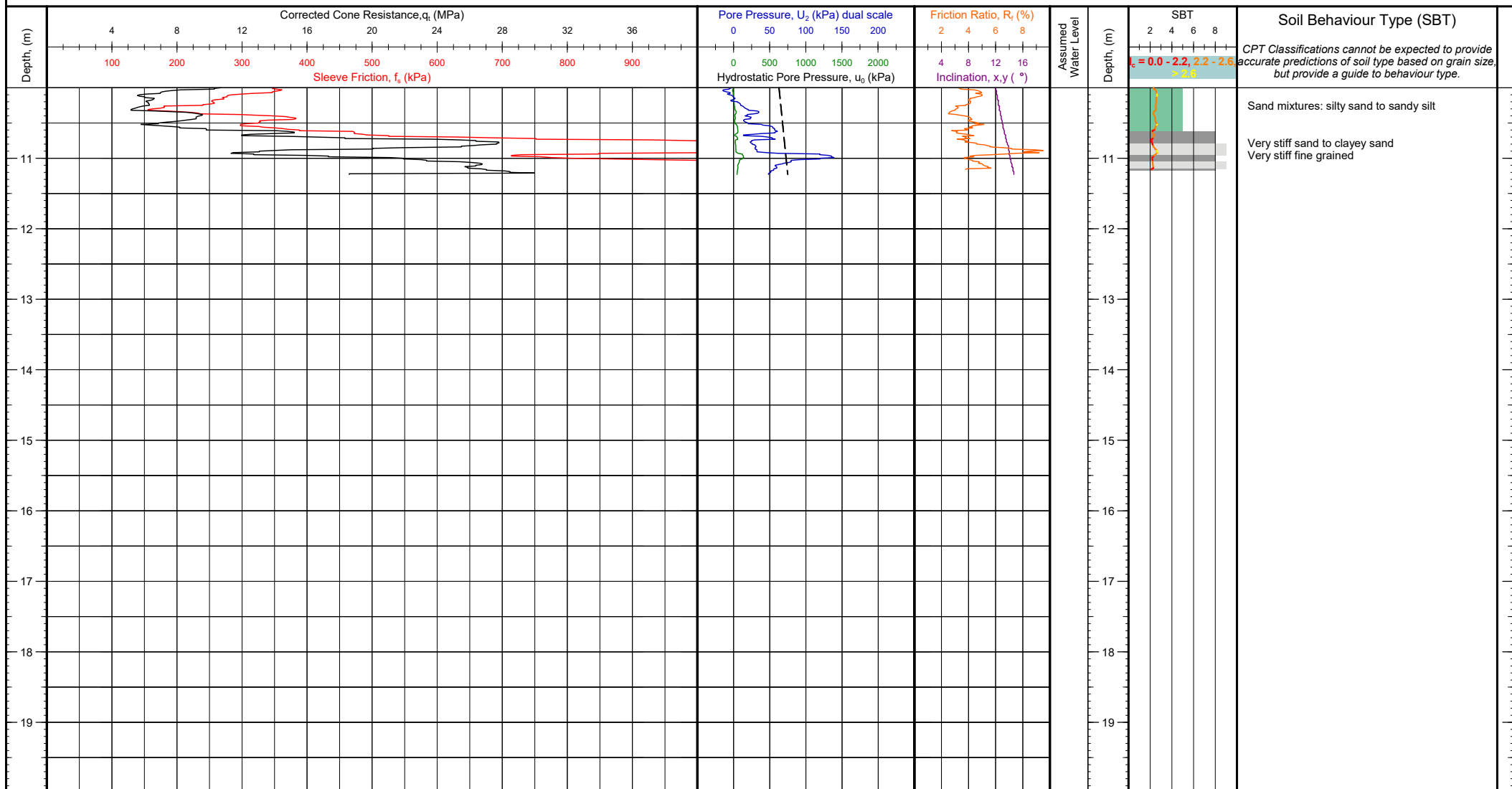
NZTM 2000 N, E (m): 5926510.40, 1743188.37
WGS84 (deg): -36.796413, 174.604962
Location Method: Handheld GPS
Surveyor:
Termination Reason: Danger of buckling rods

Elevation (m): Unknown
Date of Test: 3/11/2020
Depth (m): 11.23
Pre Drill (m): N/A

Client Reference:
Test Number: **CPT-03**
G.I. Job Ref: 200824

Comments:

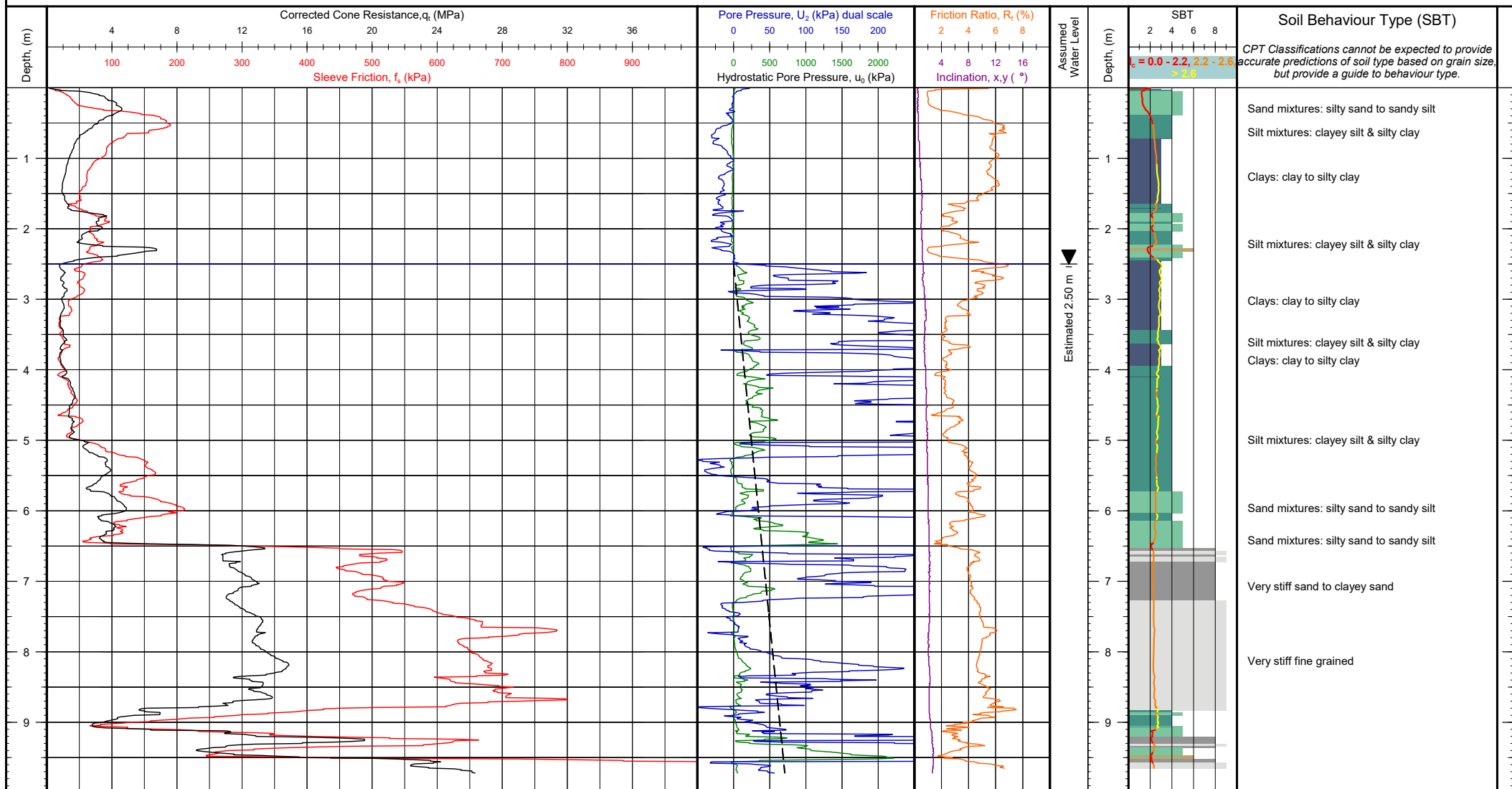
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926510.40, 1743188.37 WGS84 (deg): -36.796413, 174.604962 Location Method: Handheld GPS Surveyor: Termination Reason: Danger of buckling rods	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 11.23 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-03 G.I. Job Ref: 200824

Comments:

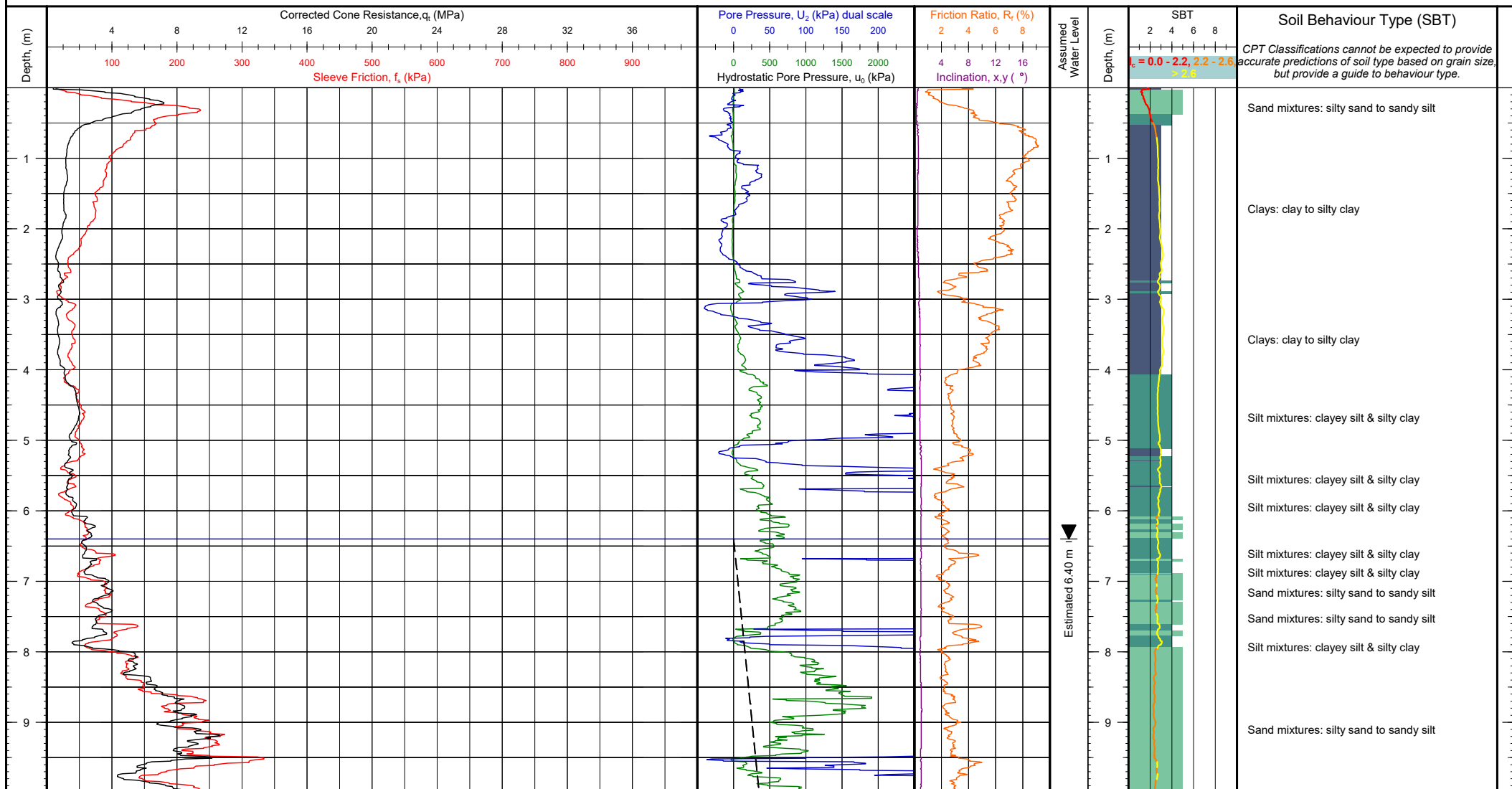
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926415.00, 1743205.87 WGS84 (deg): -36.797270, 174.605176 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 9.72 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-04 G.I. Job Ref: 200824

Comments:

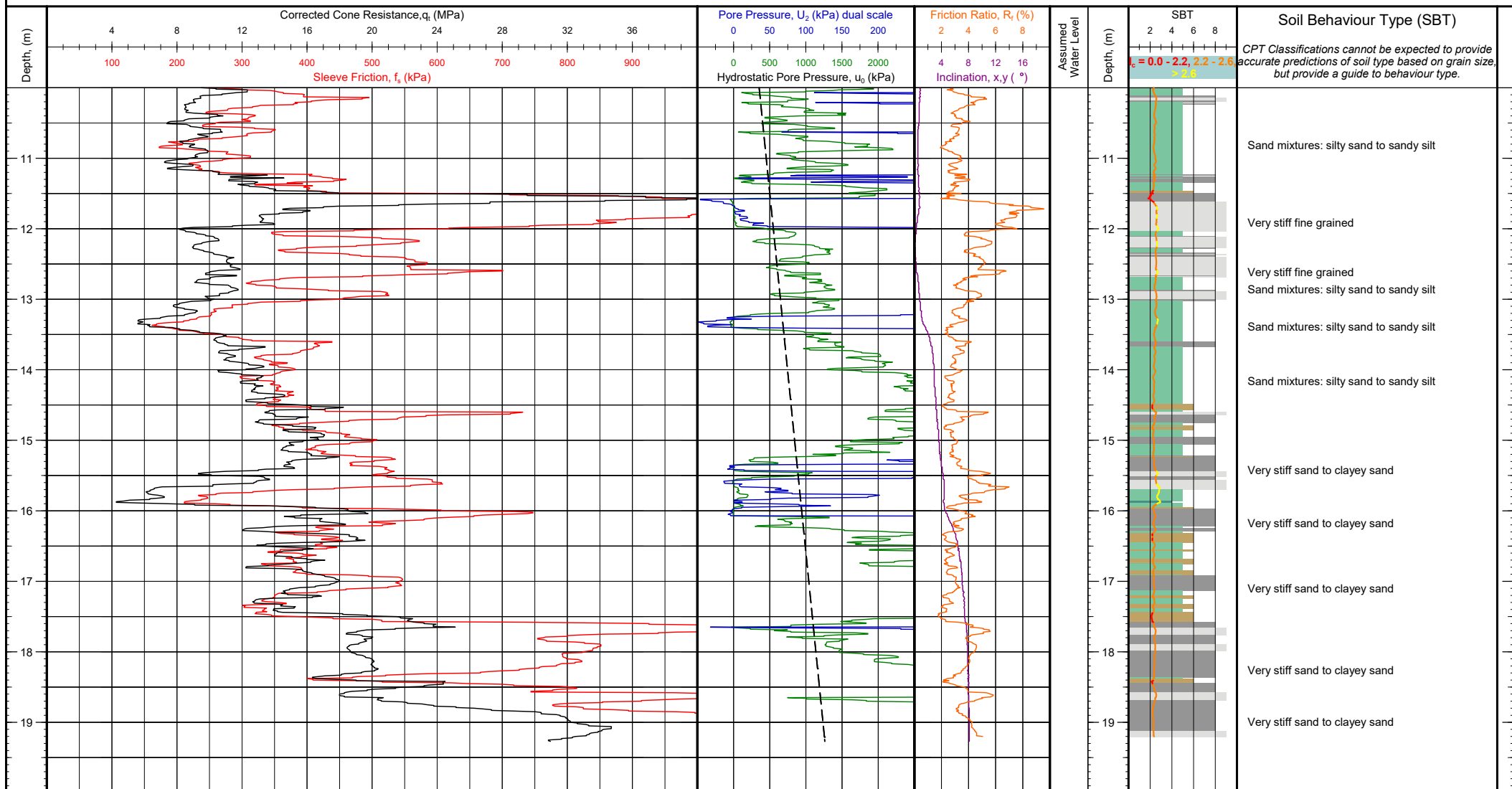
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926270.32, 1743217.01 WGS84 (deg): -36.798572, 174.605328 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 19.27 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-05 G.I. Job Ref: 200824

Comments:

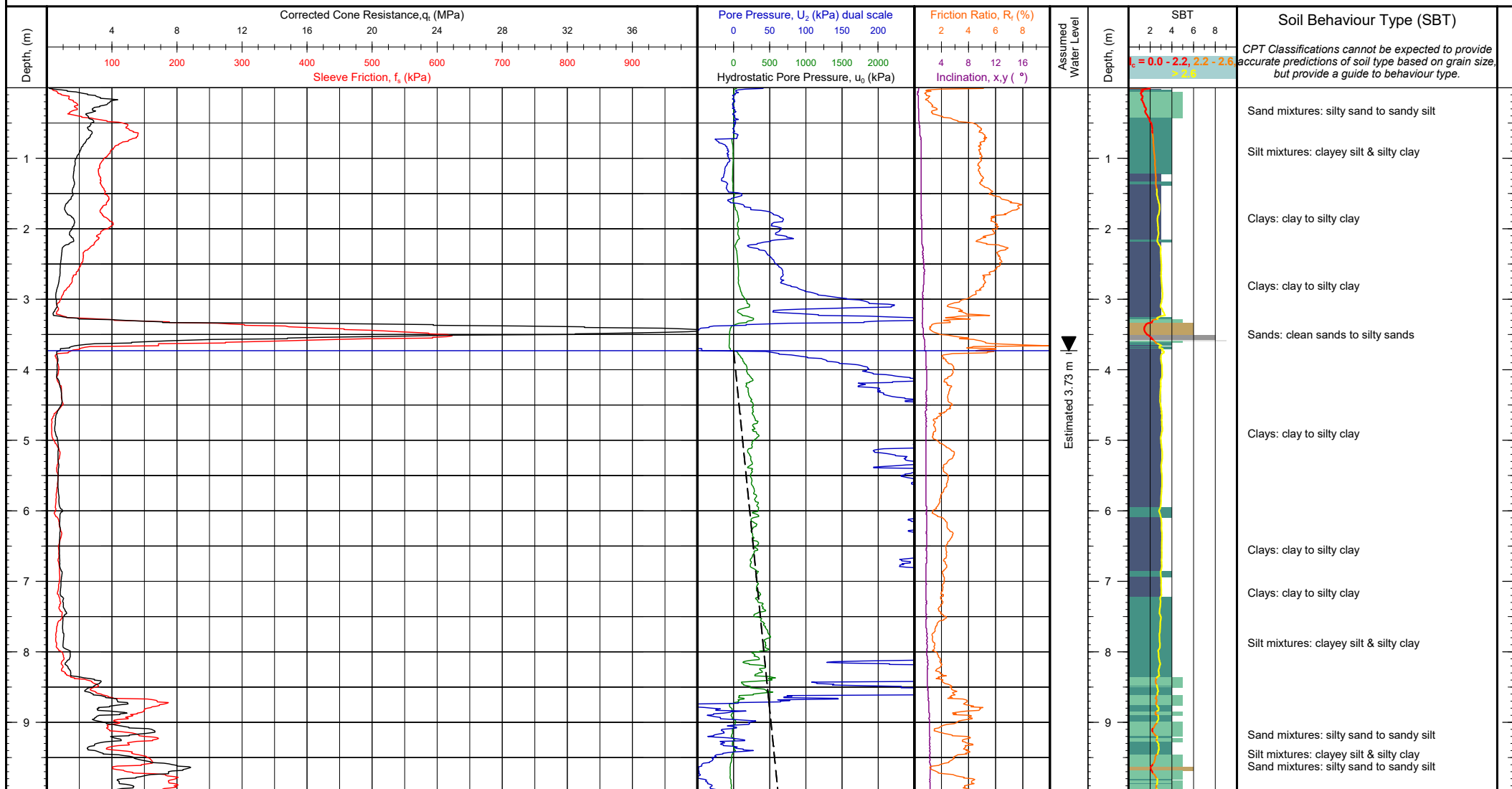
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926270.32, 1743217.01 WGS84 (deg): -36.798572, 174.605328 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 19.27 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-05 G.I. Job Ref: 200824

Comments:

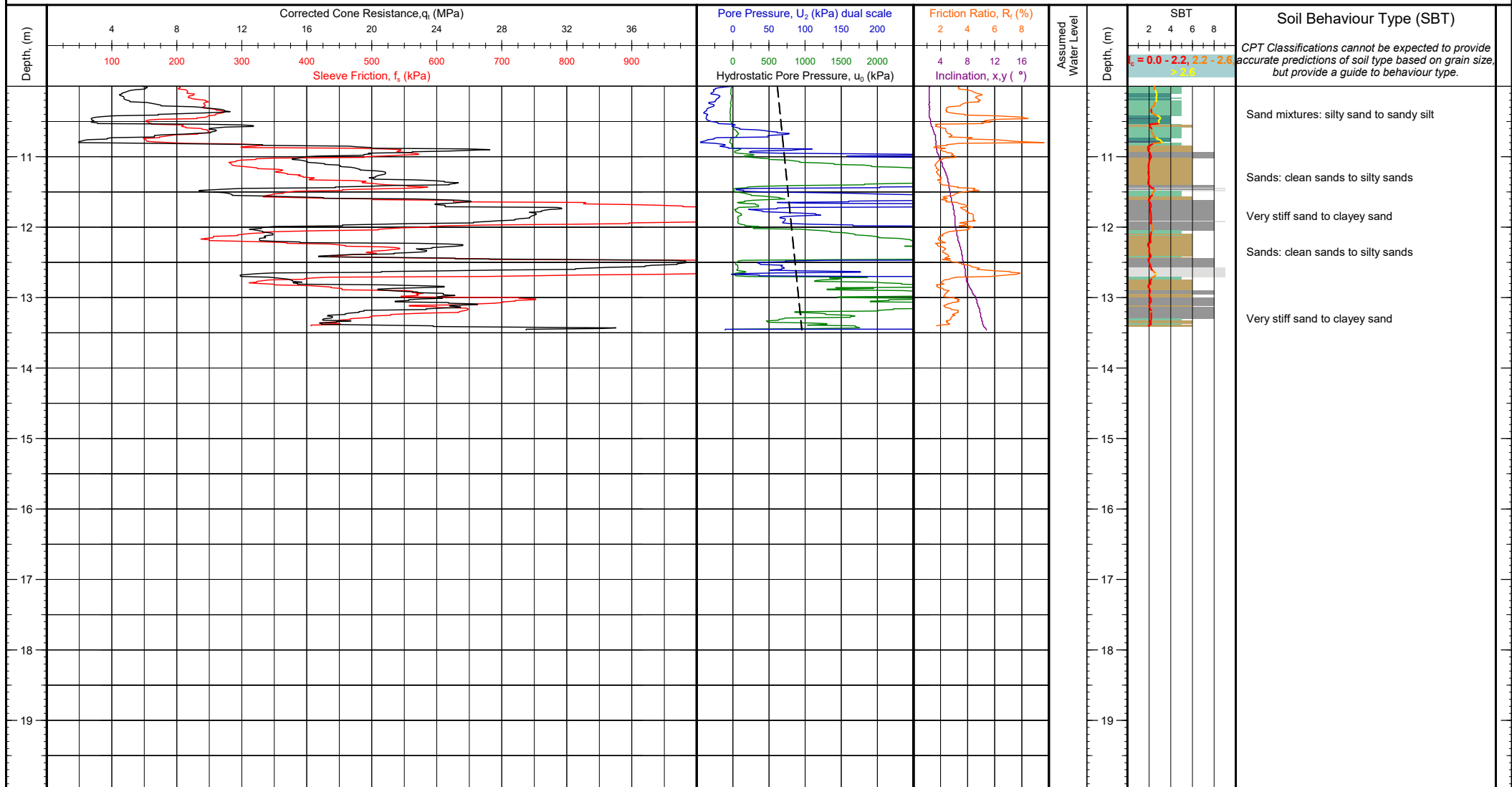
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926158.21, 1743337.57 WGS84 (deg): -36.799564, 174.606700 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 13.46 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-06 G.I. Job Ref: 200824

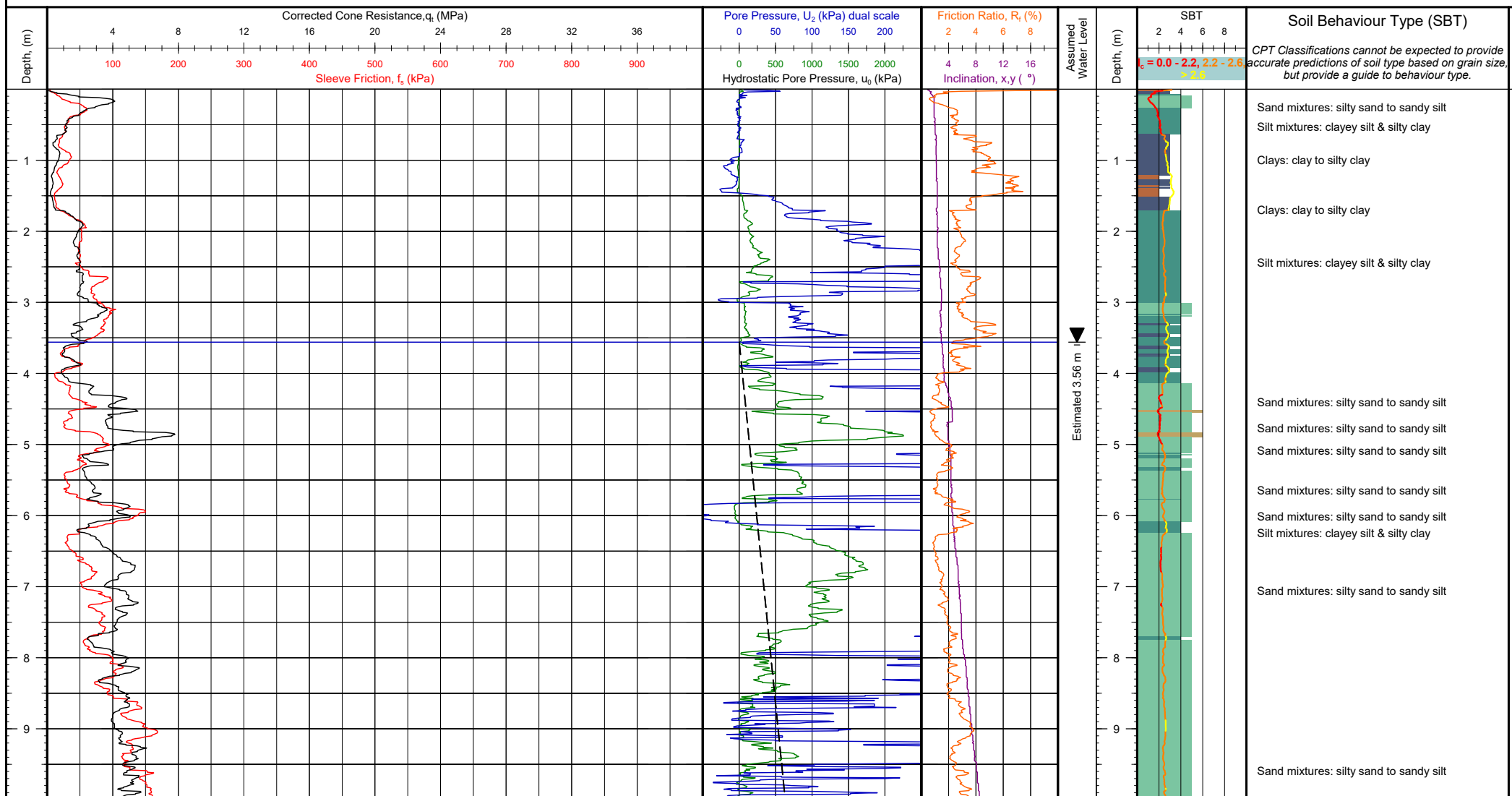
Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd Comments:	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u ₂	NZTM 2000 N, E (m): 5926158.21, 1743337.57 WGS84 (deg): -36.799564, 174.606700 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 13.46 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-06 G.I. Job Ref: 200824

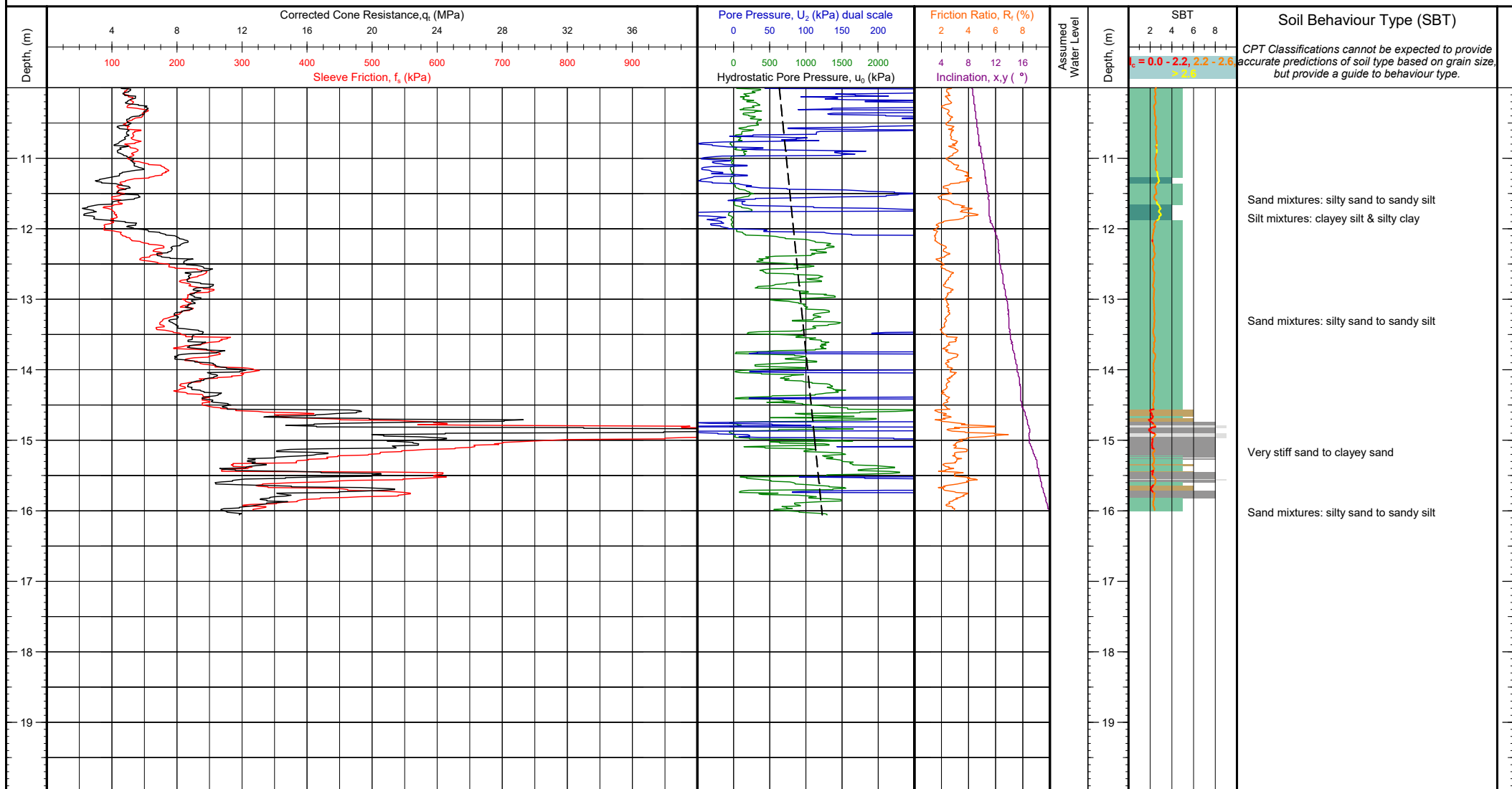
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926057.82, 1743414.41 WGS84 (deg): -36.800457, 174.607580 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 16.06 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-07 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG

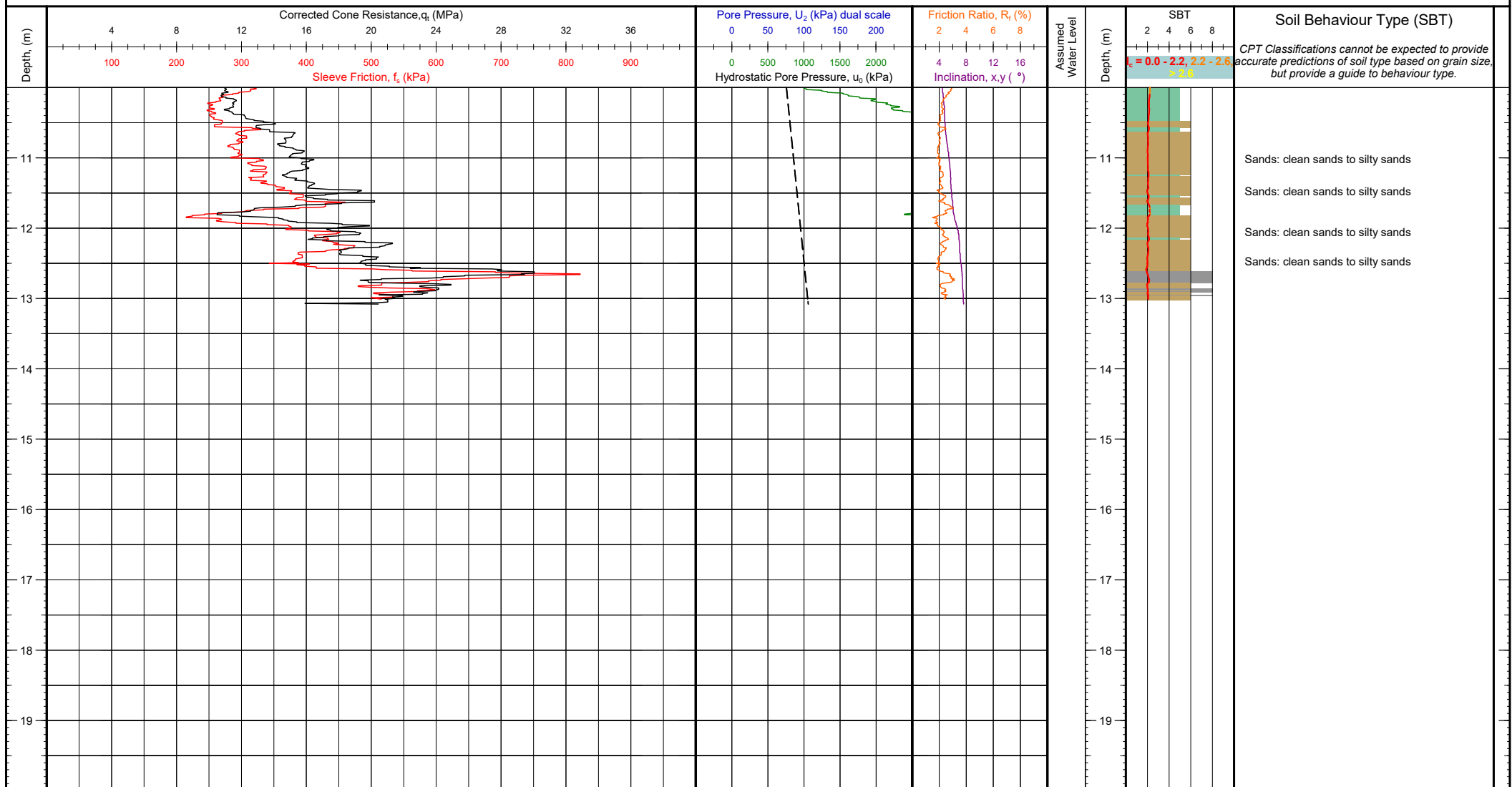


Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ333 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926057.82, 1743414.41 WGS84 (deg): -36.800457, 174.607580 Location Method: Handheld GPS Surveyor: Termination Reason: Inclination high or rapid increase	Elevation (m): Unknown Date of Test: 4/11/2020 Depth (m): 16.06 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-07 G.I. Job Ref: 200824

Comments:

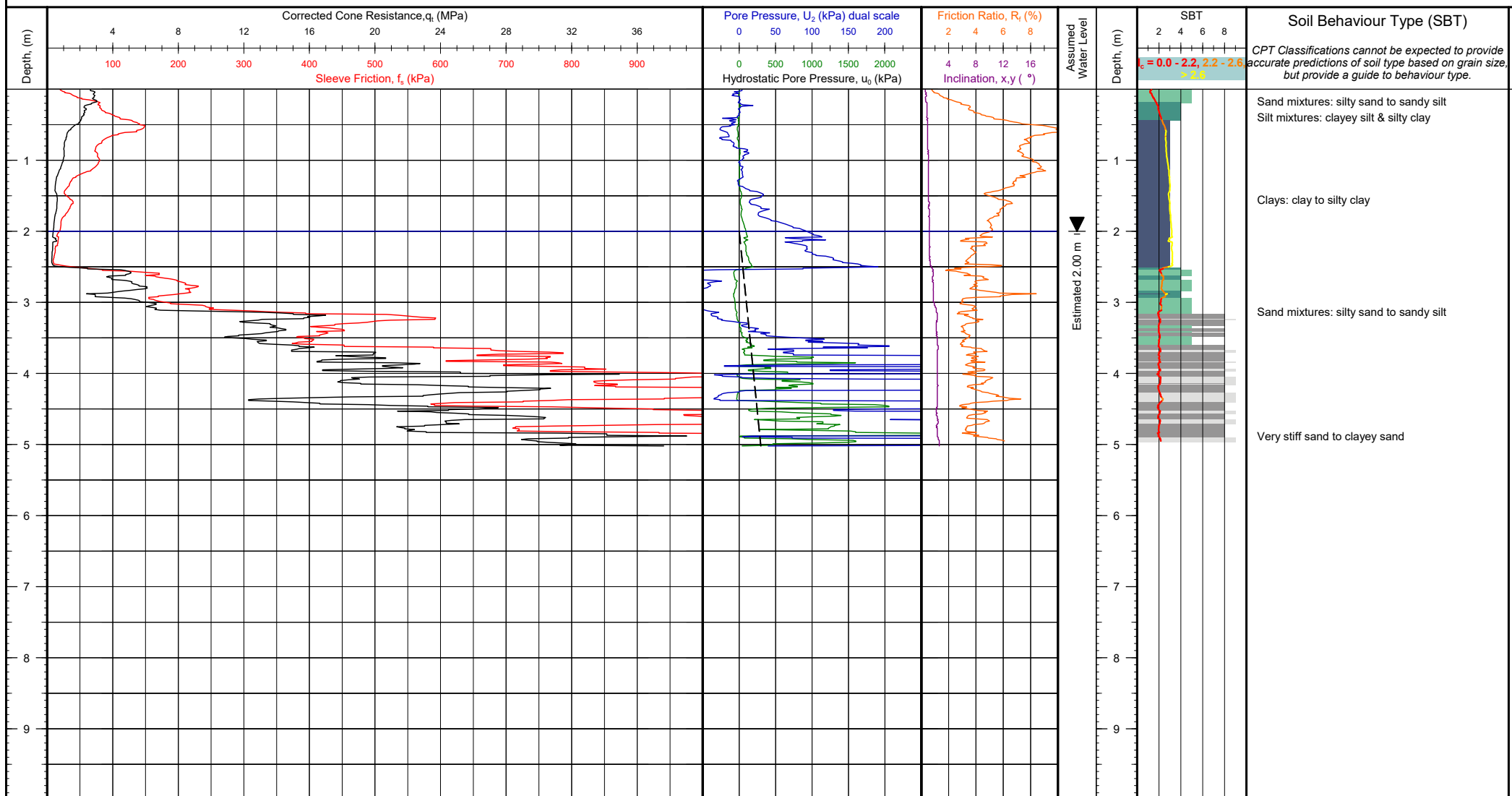
Comments:				
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CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ539 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5925758.53, 1744112.15 WGS84 (deg): -36.803048, 174.615455 Location Method: Handheld GPS Surveyor: Termination Reason: High pore water pressure	Elevation (m): Unknown Date of Test: 18/11/2020 Depth (m): 13.08 Pre Drill (m): N/A	Client Reference: Test Number: CPT-08 G.I. Job Ref: 200824
Comments:				

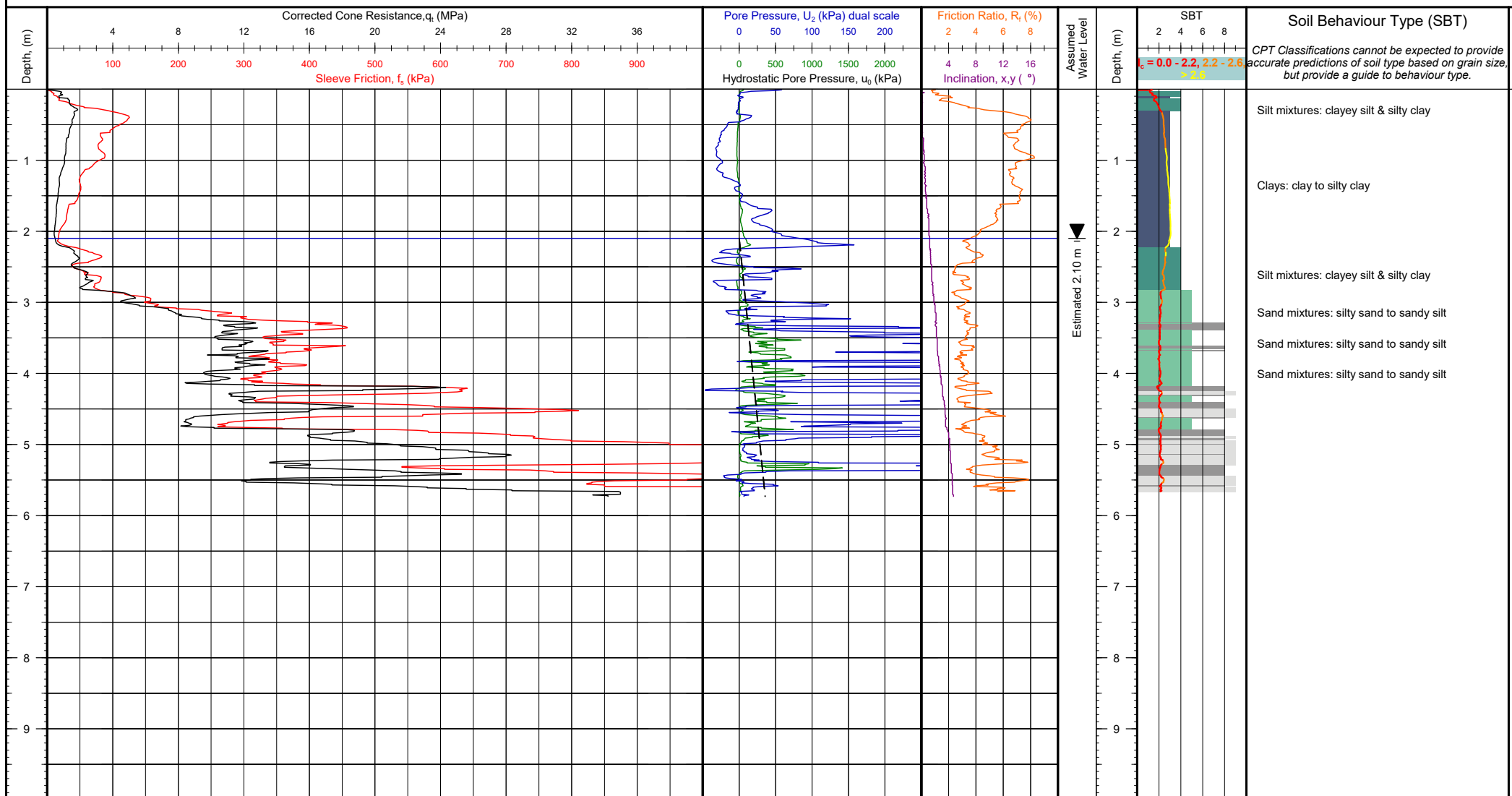
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926630.28, 1743073.91 WGS84 (deg): -36.795350, 174.603657 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 5.02 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-111 G.I. Job Ref: 200824

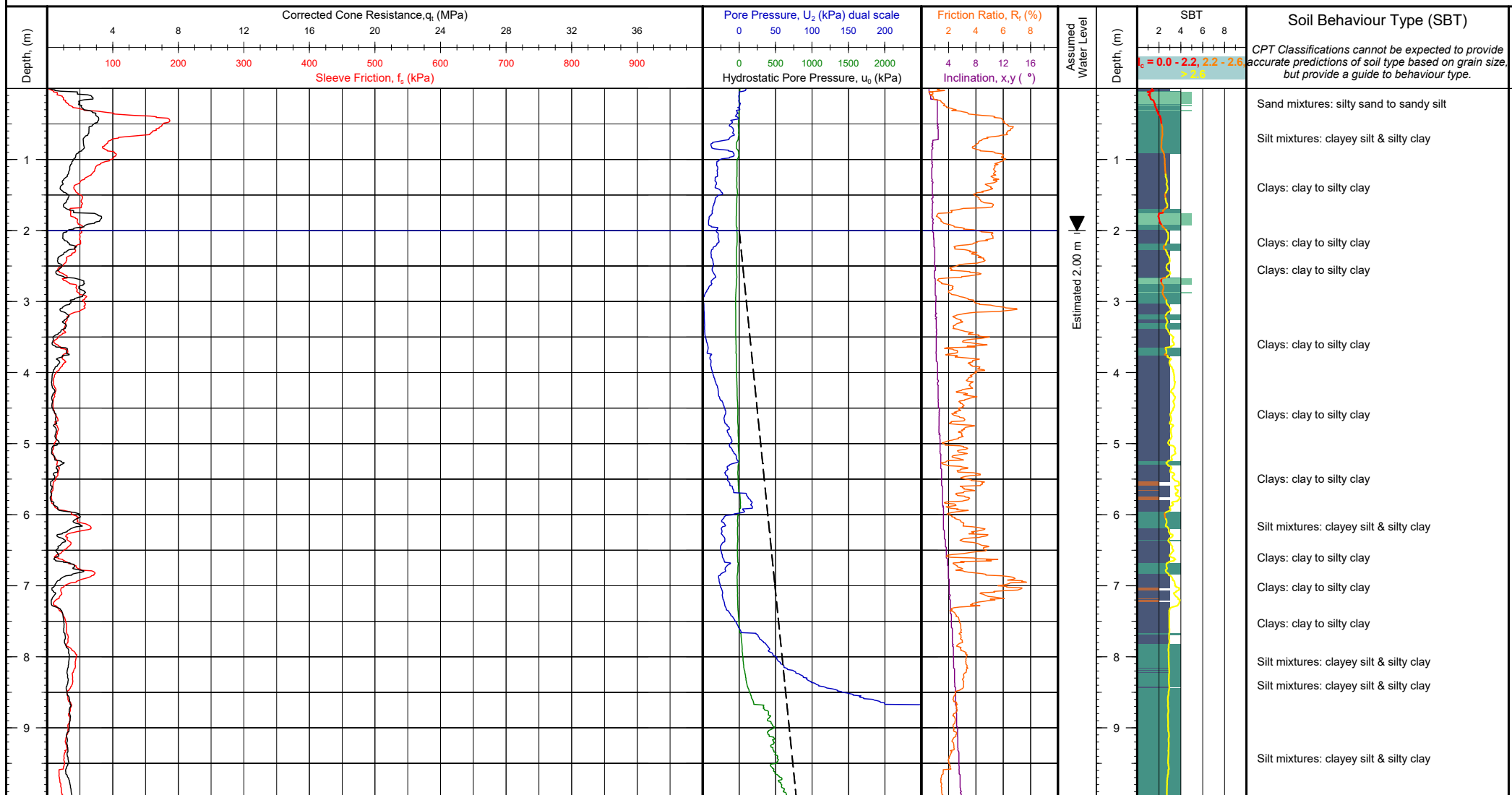
Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd Comments:	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u ₂	NZTM 2000 N, E (m): 5926598.39, 1743076.23	Elevation (m): Unknown	Client Reference:
		WGS84 (deg): -36.795637, 174.603689	Date of Test: 3/11/2020	Test Number: CPT-112
		Location Method: Handheld GPS	Depth (m): 5.73	
		Surveyor:	Pre Drill (m): N/A	
		Termination Reason: High friction resistance		G.I. Job Ref: 200824

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

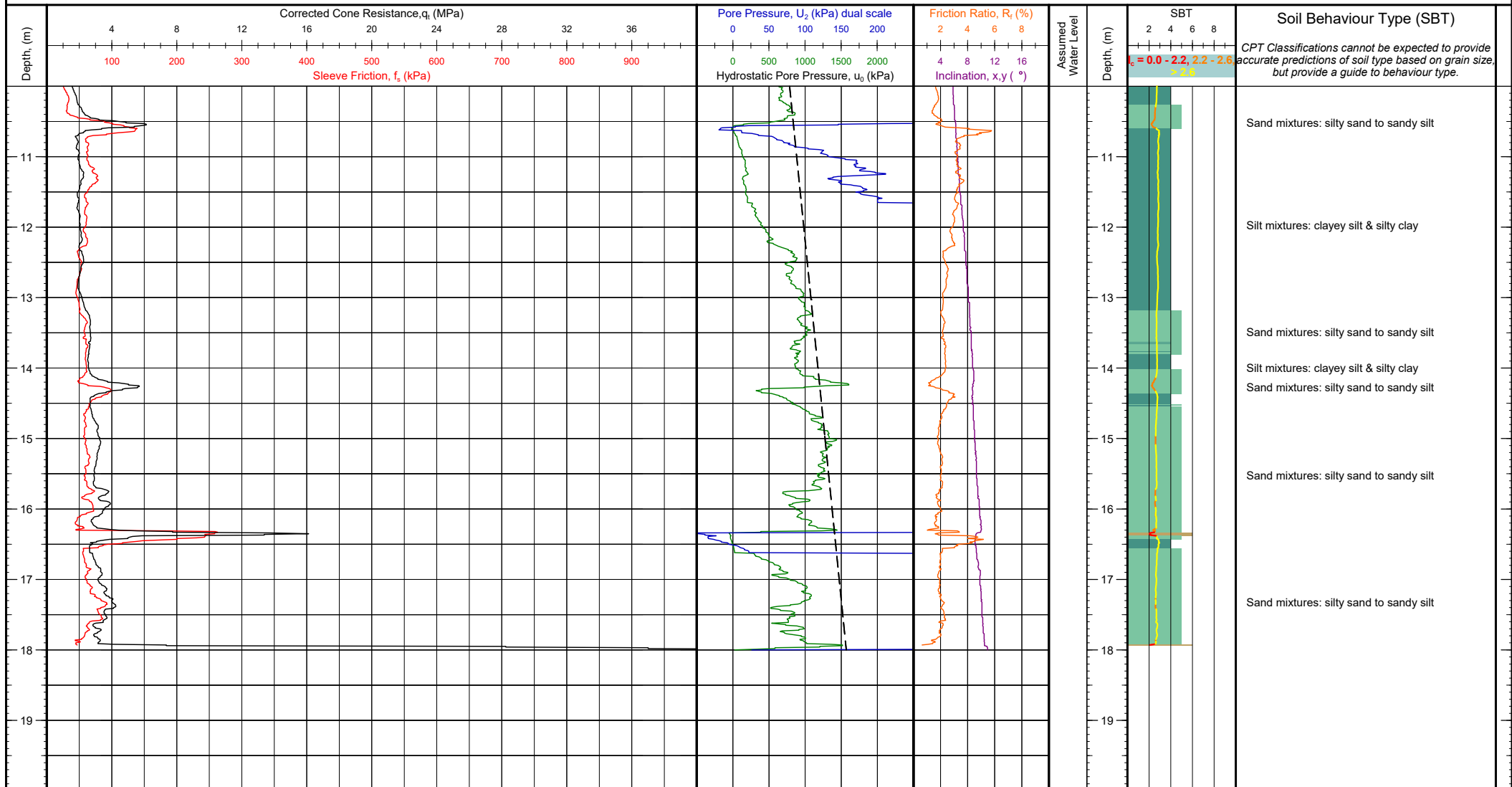
NZTM 2000 N, E (m): 5927036.96, 1743360.27
WGS84 (deg): -36.791642, 174.606789
Location Method: Handheld GPS
Surveyor:
Termination Reason: High cone end resistance

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 18.00
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-117
G.I. Job Ref: 200824

Comments:

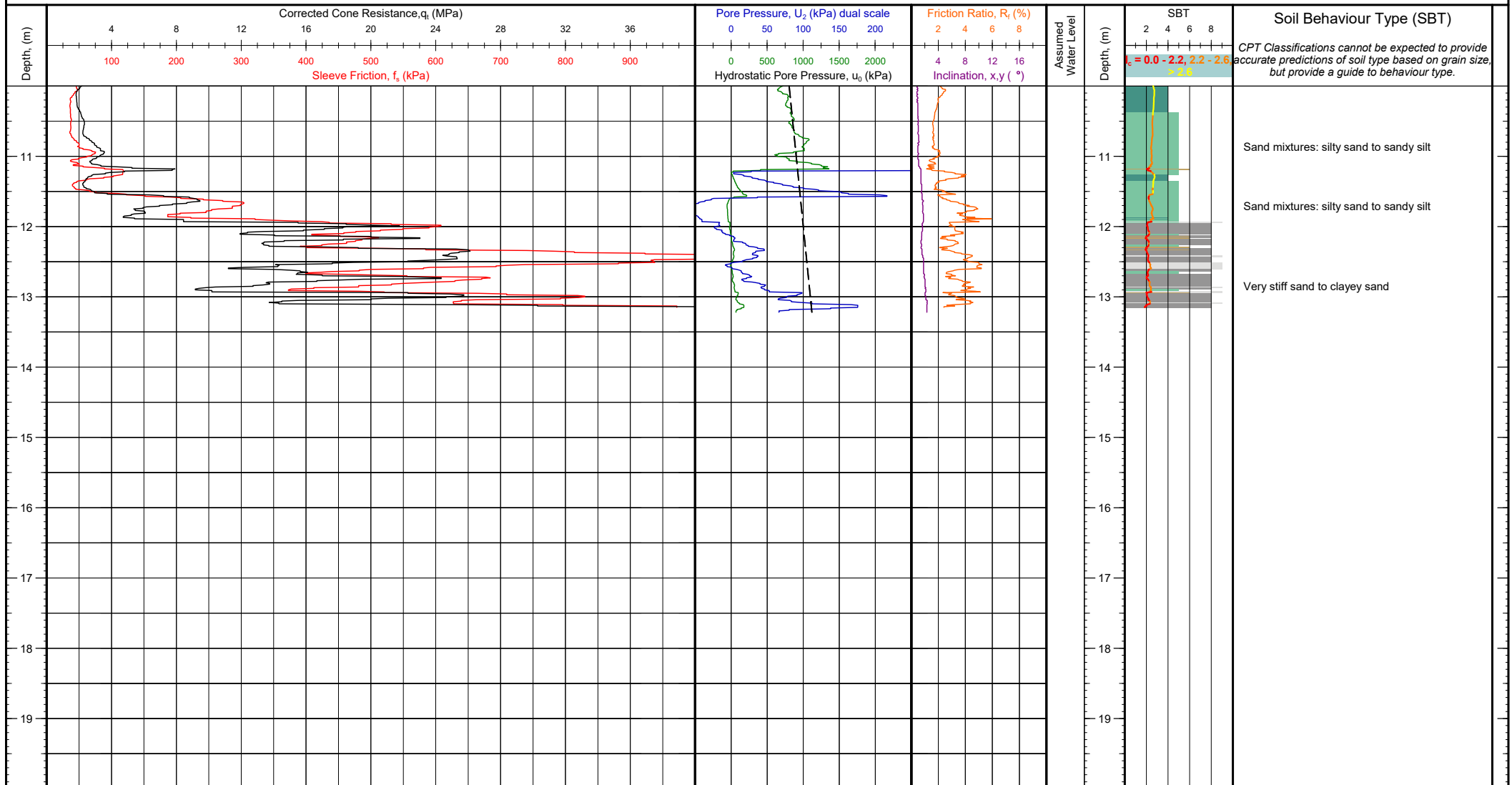
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5927036.96, 1743360.27 WGS84 (deg): -36.791642, 174.606789 Location Method: Handheld GPS Surveyor: Termination Reason: High cone end resistance	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 18.00 Pre Drill (m): N/A	Client Reference: Test Number: CPT-117 G.I. Job Ref: 200824
Comments:				

Client: Tonkin + Taylor	Operator: Ben Thom	NZTM 2000 N, E (m): 5926965.38, 1743234.65	Elevation (m): Unknown	Client Reference:
Project: Whenuapai-Redhills Wastewater Servicing	Cone Ref: MKJ309	WGS84 (deg): -36.792306, 174.605395	Date of Test: 2/11/2020	
Location: Trig Road to Tamiro Road, Auckland	Cone Type: 10cm ² Compression	Location Method: Handheld GPS	Depth (m): 13.22	Test Number: CPT-121
Engineer: Benjamin Westgate	Area Ratio: 0.80	Surveyor:	Pre Drill (m): 0.34 m	
Contractor: Ground Investigation Ltd	Filter Type: u ₂	Termination Reason: High total load		G.I. Job Ref: 200824

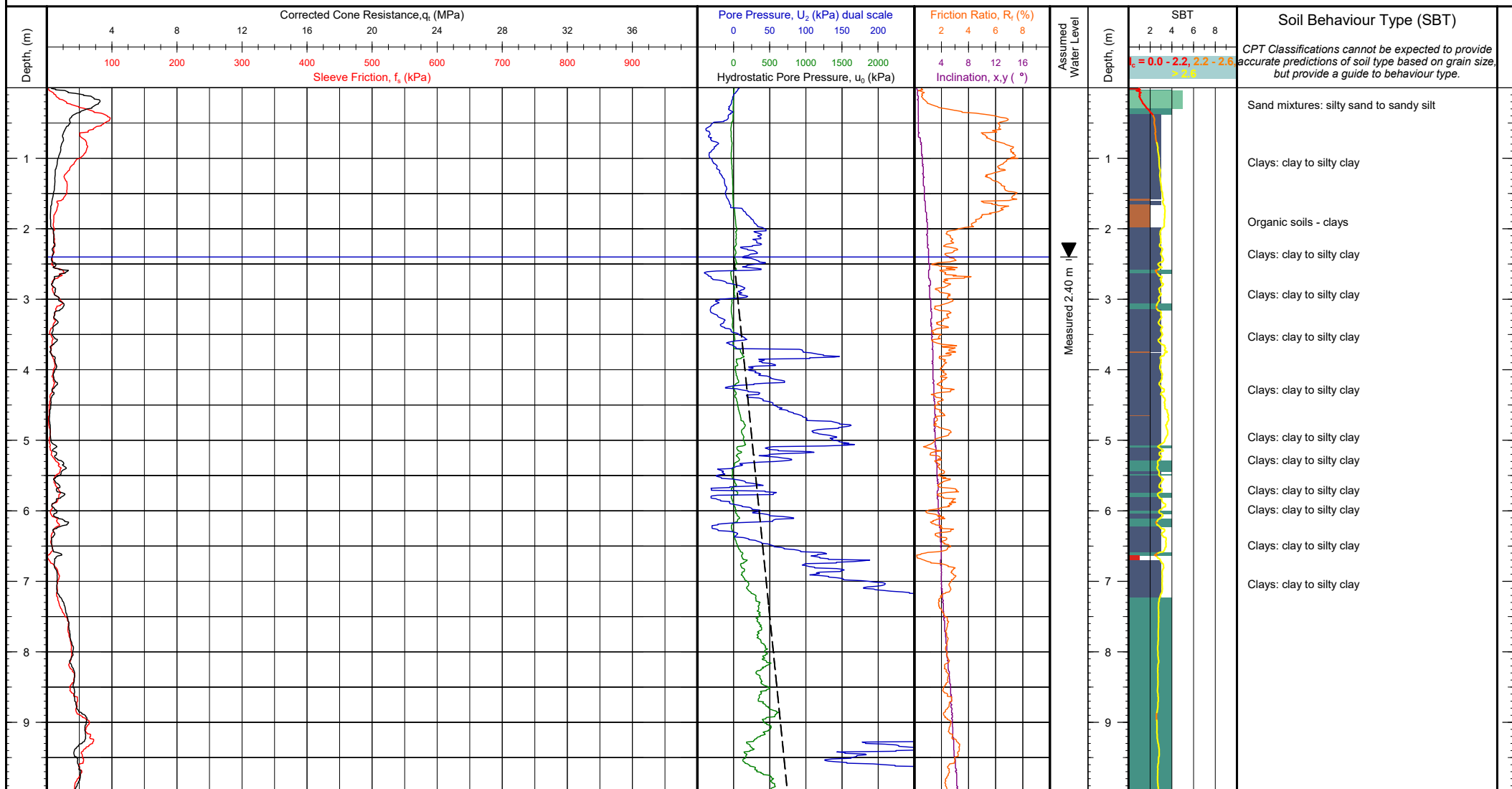
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926965.38, 1743234.65 WGS84 (deg): -36.792306, 174.605395 Location Method: Handheld GPS Surveyor: Termination Reason: High total load	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 13.22 Pre Drill (m): 0.34 m	Client Reference:
				Test Number: CPT-121 G.I. Job Ref: 200824

Comments:

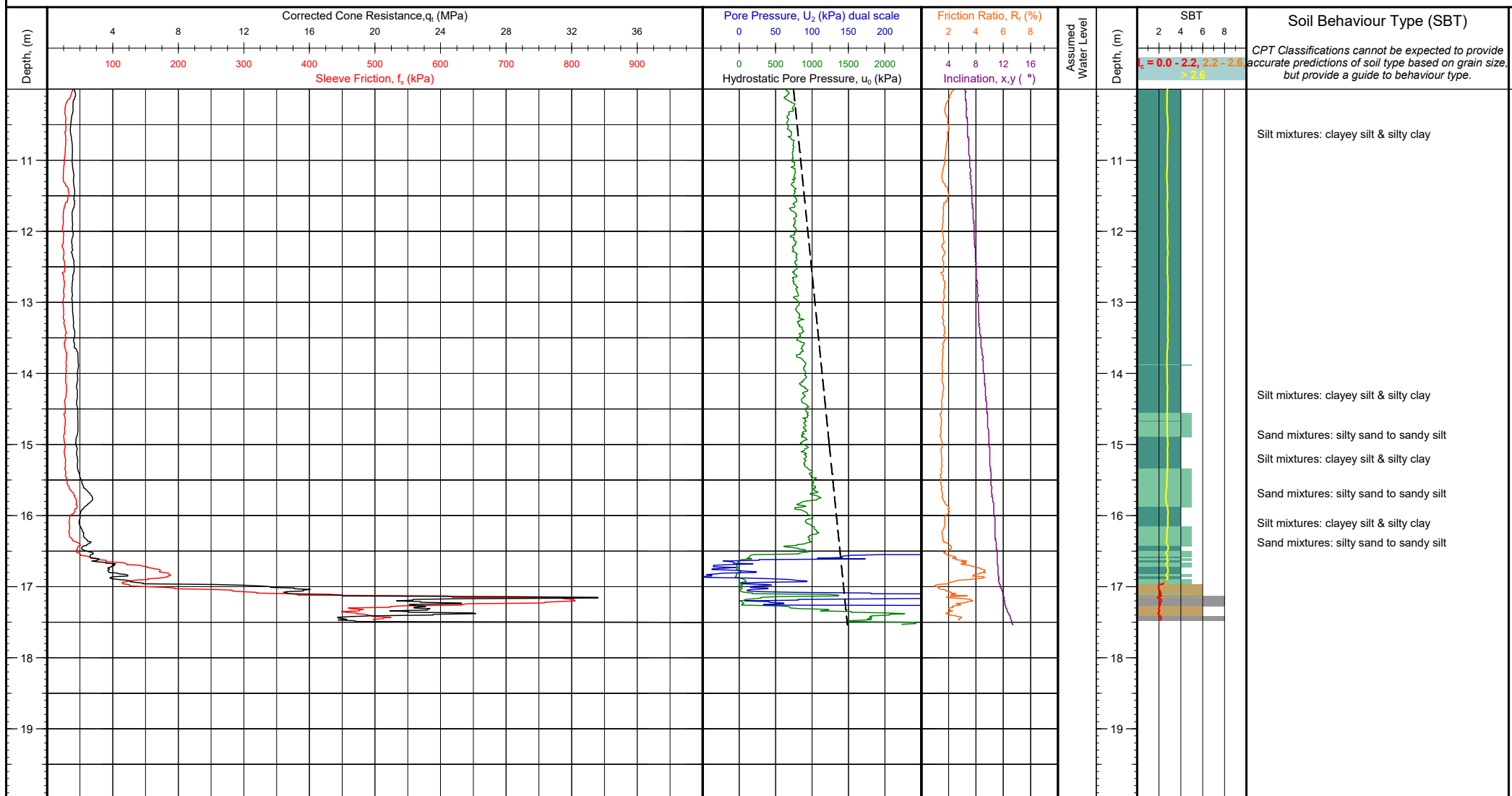
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926924.83, 1743237.45 WGS84 (deg): -36.792671, 174.605434 Location Method: Handheld GPS Surveyor: Termination Reason: Limit of reaction force	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 17.54 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-126 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

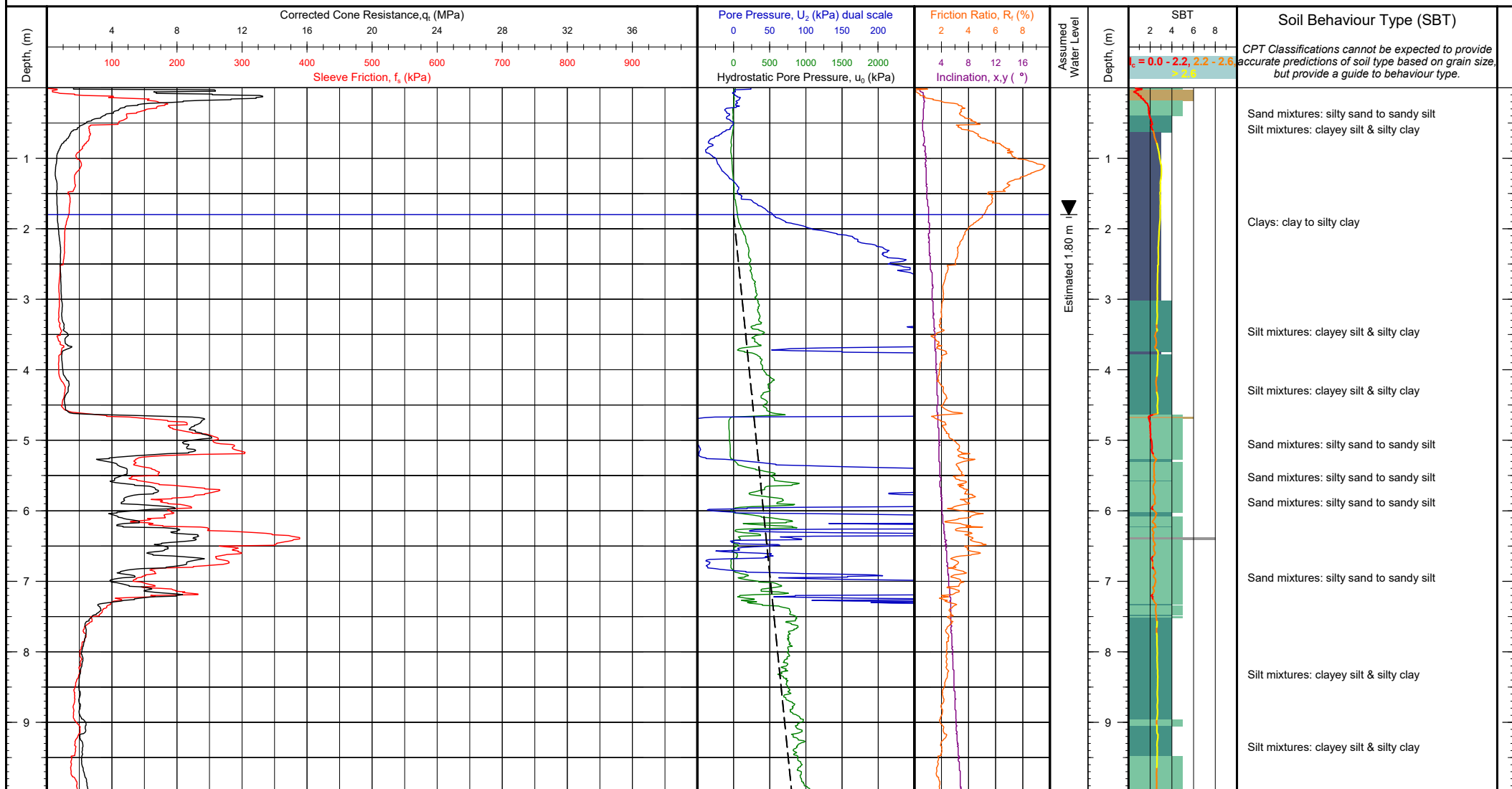
NZTM 2000 N, E (m): 5926924.83, 1743237.45
WGS84 (deg): -36.792671, 174.605434
Location Method: Handheld GPS
Surveyor:
Termination Reason: Limit of reaction force

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 17.54
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-126
G.I. Job Ref: 200824

Comments:

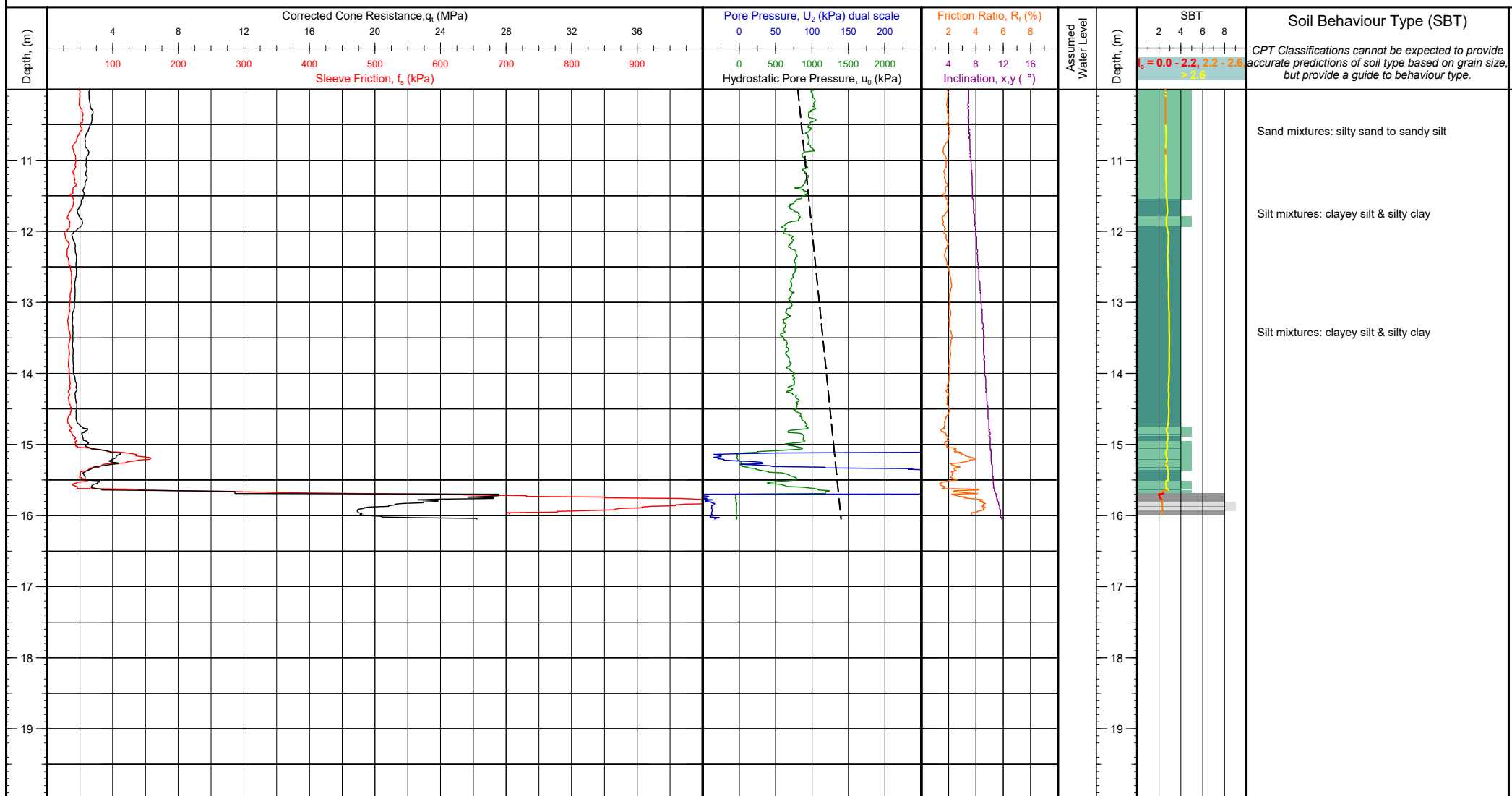
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ325 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u ₂	NZTM 2000 N, E (m): 5926740.32, 1743076.38 WGS84 (deg): -36.794358, 174.603664 Location Method: Handheld GPS Surveyor: Termination Reason: High total load	Elevation (m): Unknown Date of Test: 2/11/2020 Depth (m): 16.05 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-128 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ325
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

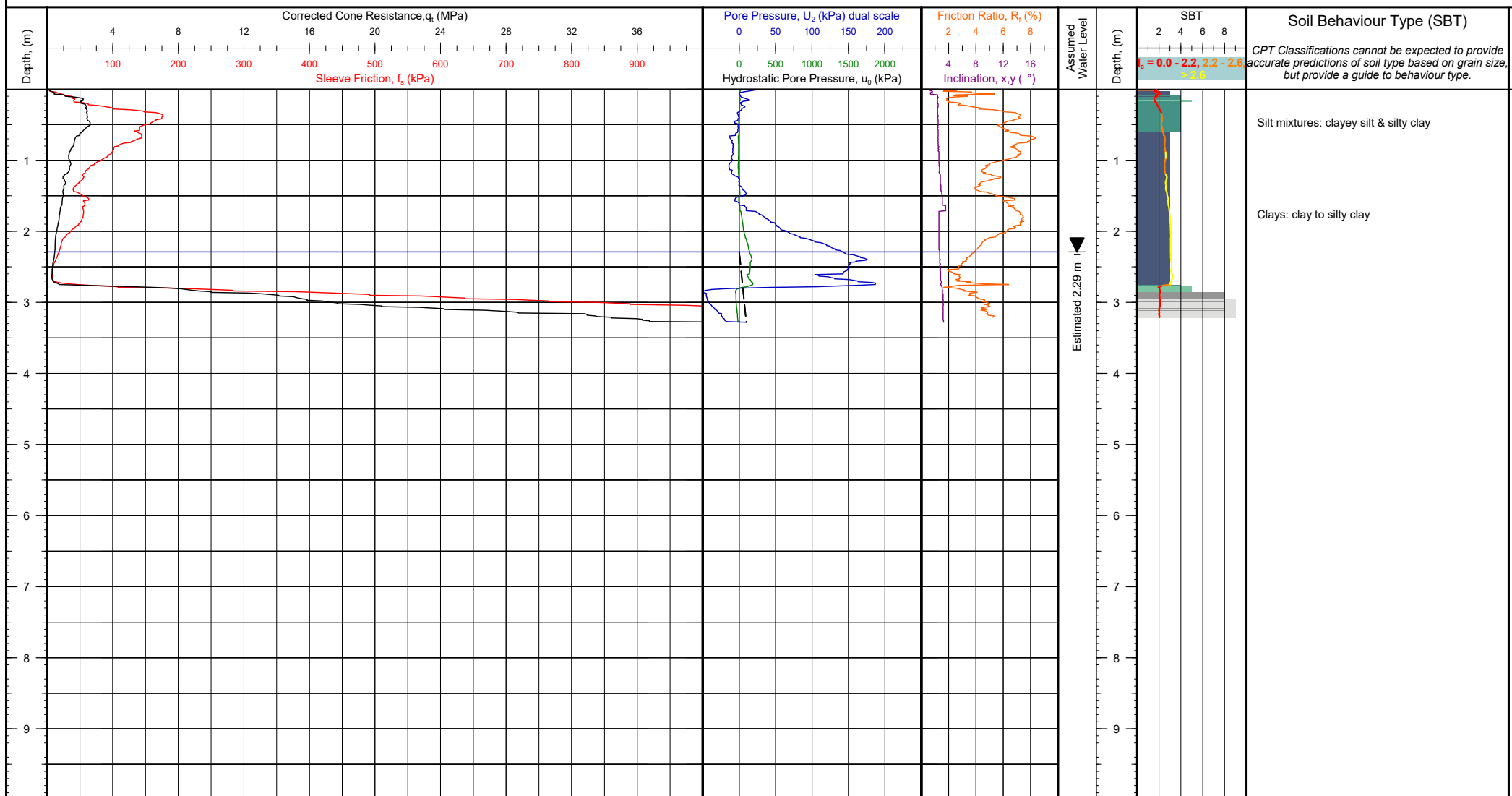
NZTM 2000 N, E (m): 5926740.32, 1743076.38
WGS84 (deg): -36.794358, 174.603664
Location Method: Handheld GPS
Surveyor:
Termination Reason: High total load

Elevation (m): Unknown
Date of Test: 2/11/2020
Depth (m): 16.05
Pre Drill (m): N/A

Client Reference:
Test Number: CPT-128
G.I. Job Ref: 200824

Comments:

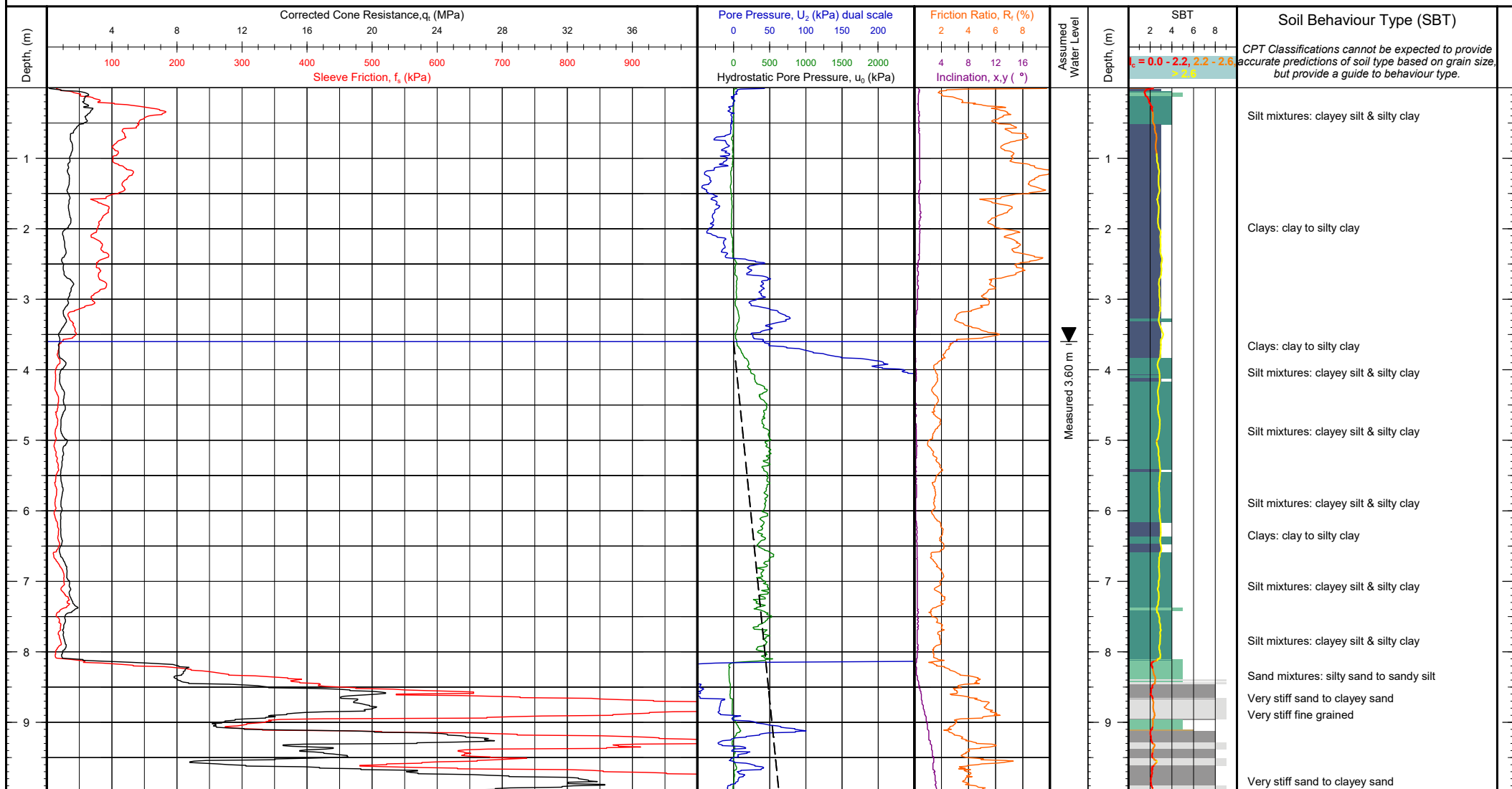
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926650.80, 1743015.08 WGS84 (deg): -36.795174, 174.602994 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 3.28 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-129 G.I. Job Ref: 200824

Comments:

CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Operator: Ben Thom
Cone Ref: MKJ309
Cone Type: 10cm² Compression
Area Ratio: 0.80
Filter Type: u_2

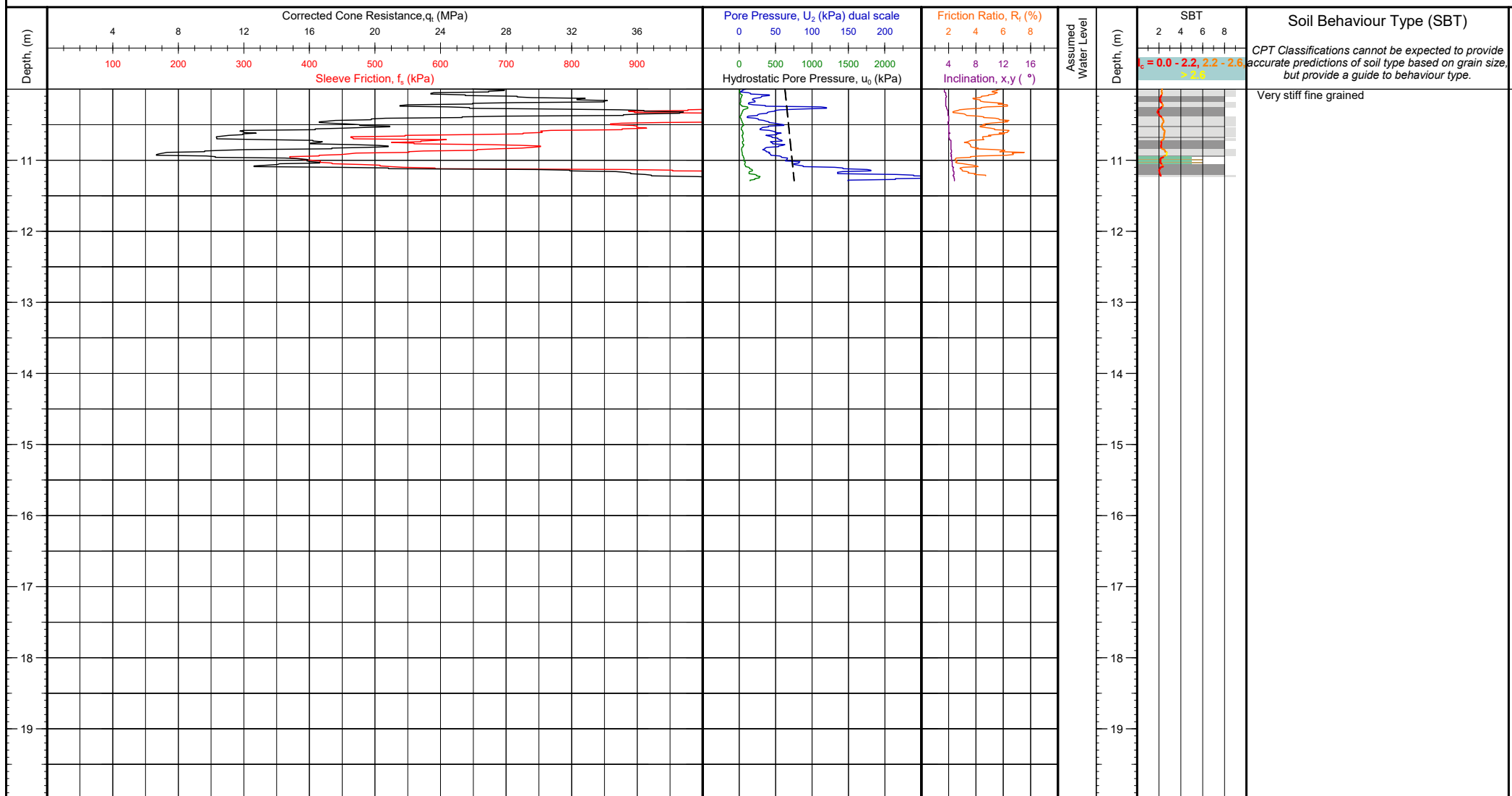
NZTM 2000 N, E (m): 5926584.78, 1743106.98
WGS84 (deg): -36.795755, 174.604036
Location Method: Handheld GPS
Surveyor:
Termination Reason: High friction resistance

Elevation (m): Unknown
Date of Test: 3/11/2020
Depth (m): 11.29
Pre Drill (m): N/A

Client Reference:
Test Number: **CPT-131**
G.I. Job Ref: 200824

Comments:

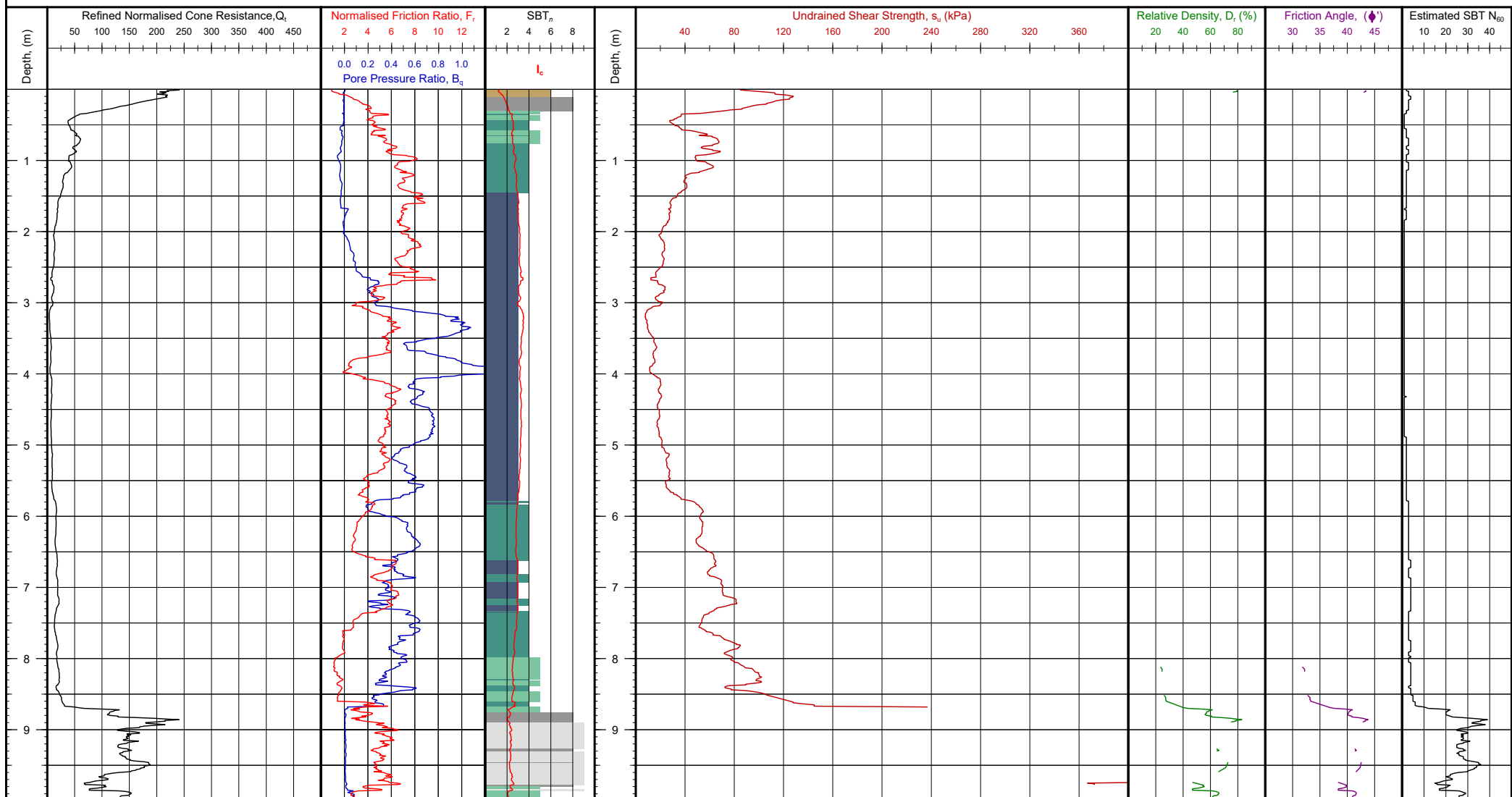
CONE PENETRATION TEST (CPT) LOG



Client: Tonkin + Taylor Project: Whenuapai-Redhills Wastewater Servicing Location: Trig Road to Tamiro Road, Auckland Engineer: Benjamin Westgate Contractor: Ground Investigation Ltd	Operator: Ben Thom Cone Ref: MKJ309 Cone Type: 10cm ² Compression Area Ratio: 0.80 Filter Type: u_2	NZTM 2000 N, E (m): 5926584.78, 1743106.98 WGS84 (deg): -36.795755, 174.604036 Location Method: Handheld GPS Surveyor: Termination Reason: High friction resistance	Elevation (m): Unknown Date of Test: 3/11/2020 Depth (m): 11.29 Pre Drill (m): N/A	Client Reference:
				Test Number: CPT-131 G.I. Job Ref: 200824

Comments:

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

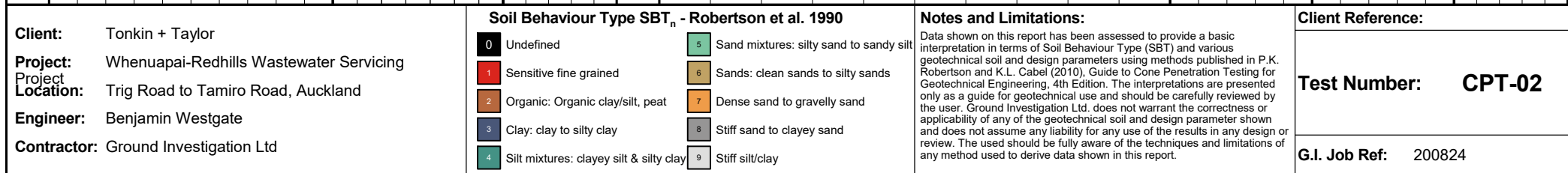
Notes and Limitations:

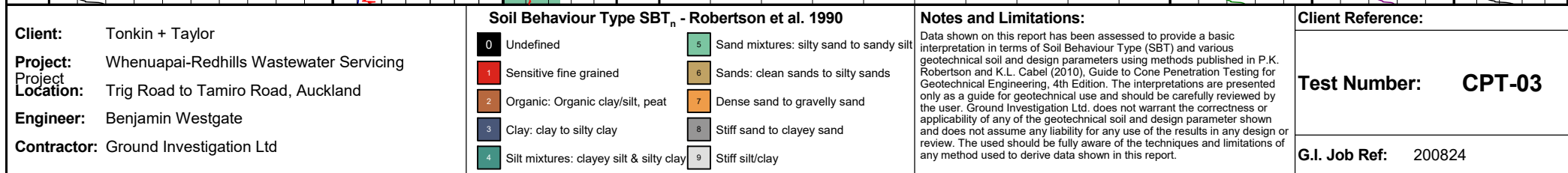
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

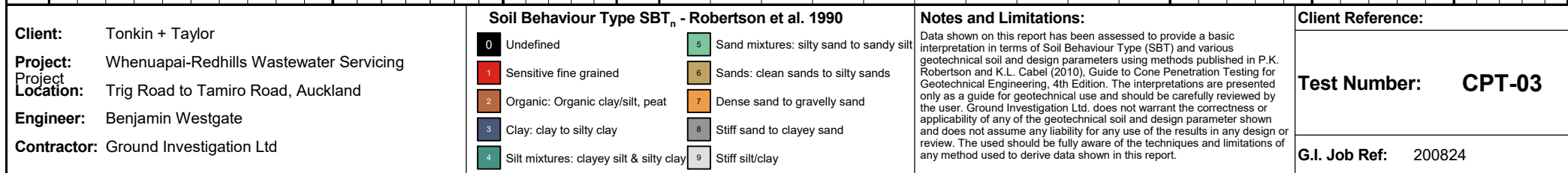
Client Reference:

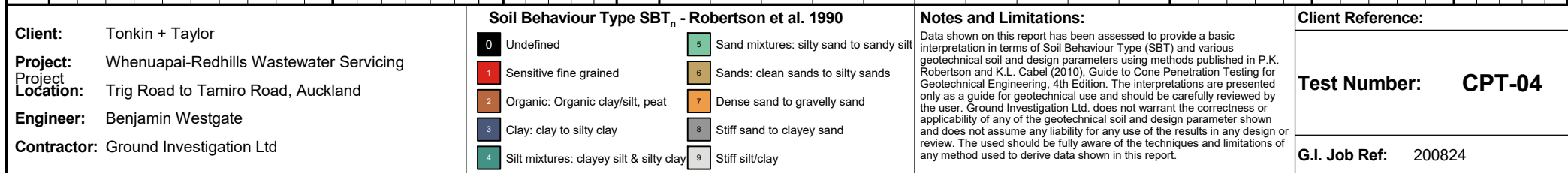
Test Number: CPT-02

G.I. Job Ref: 200824





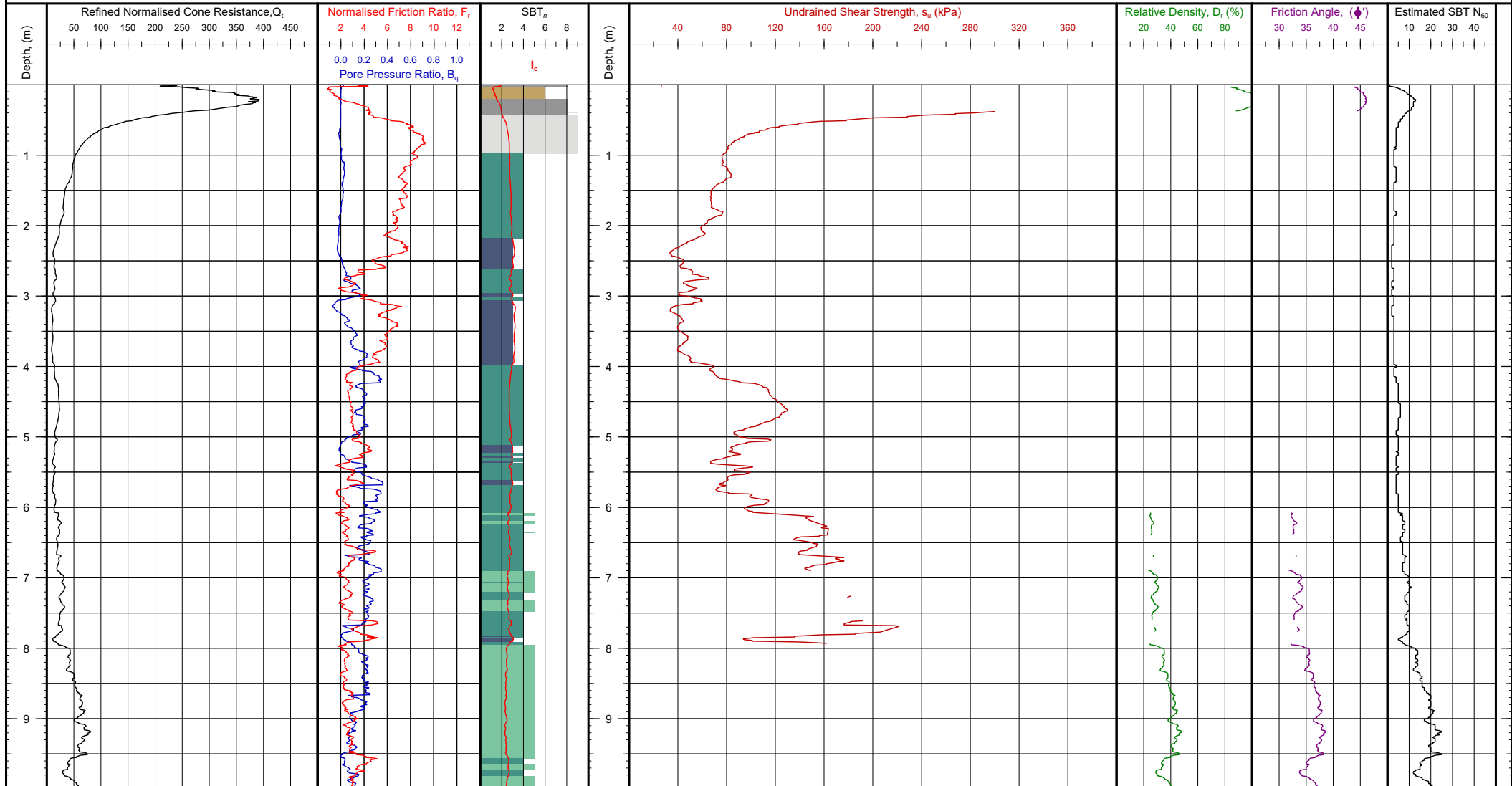






Tonkin+Taylor

CPT PARAMETER LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

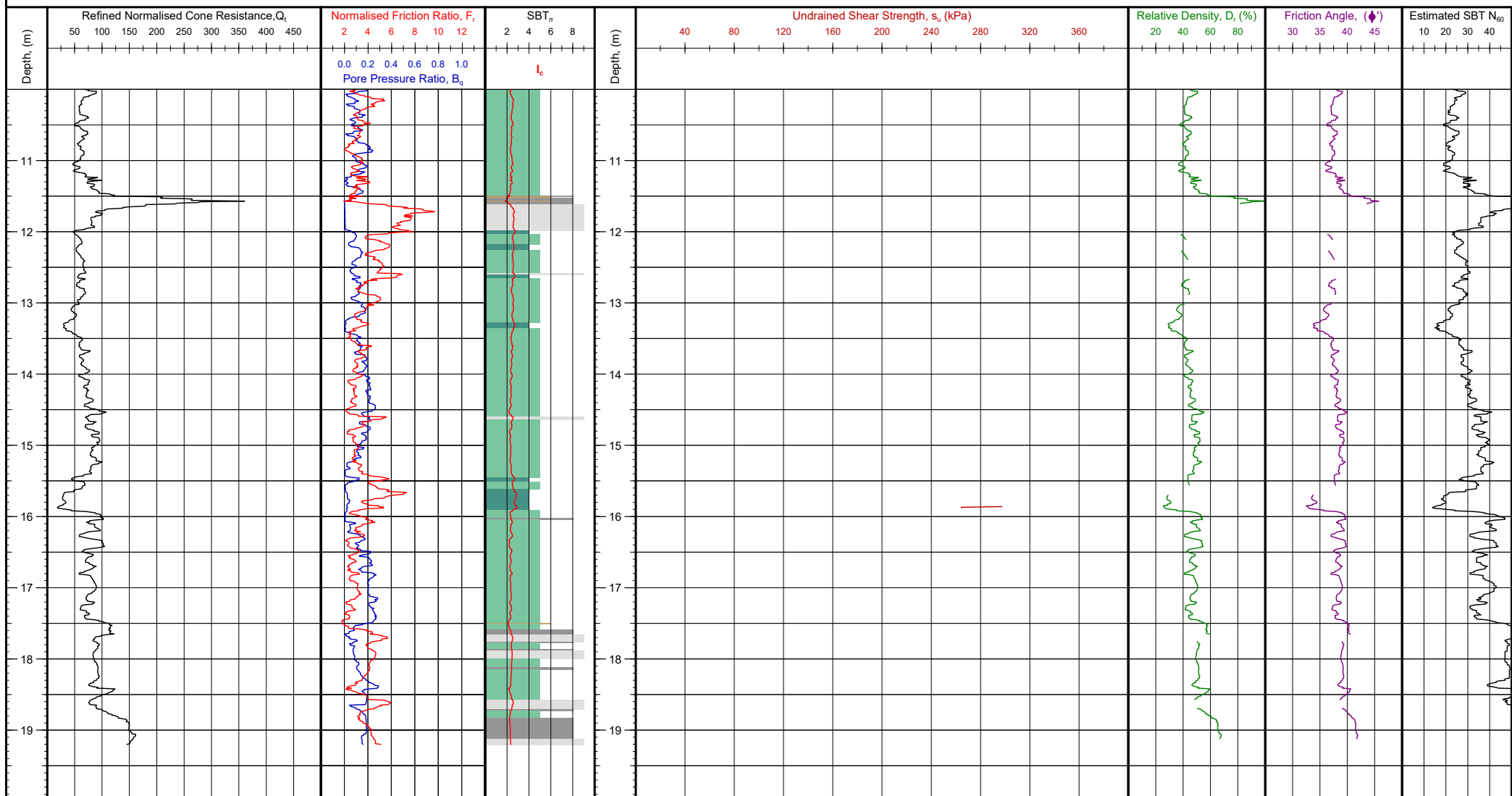
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-05

G.I. Job Ref: 200824

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

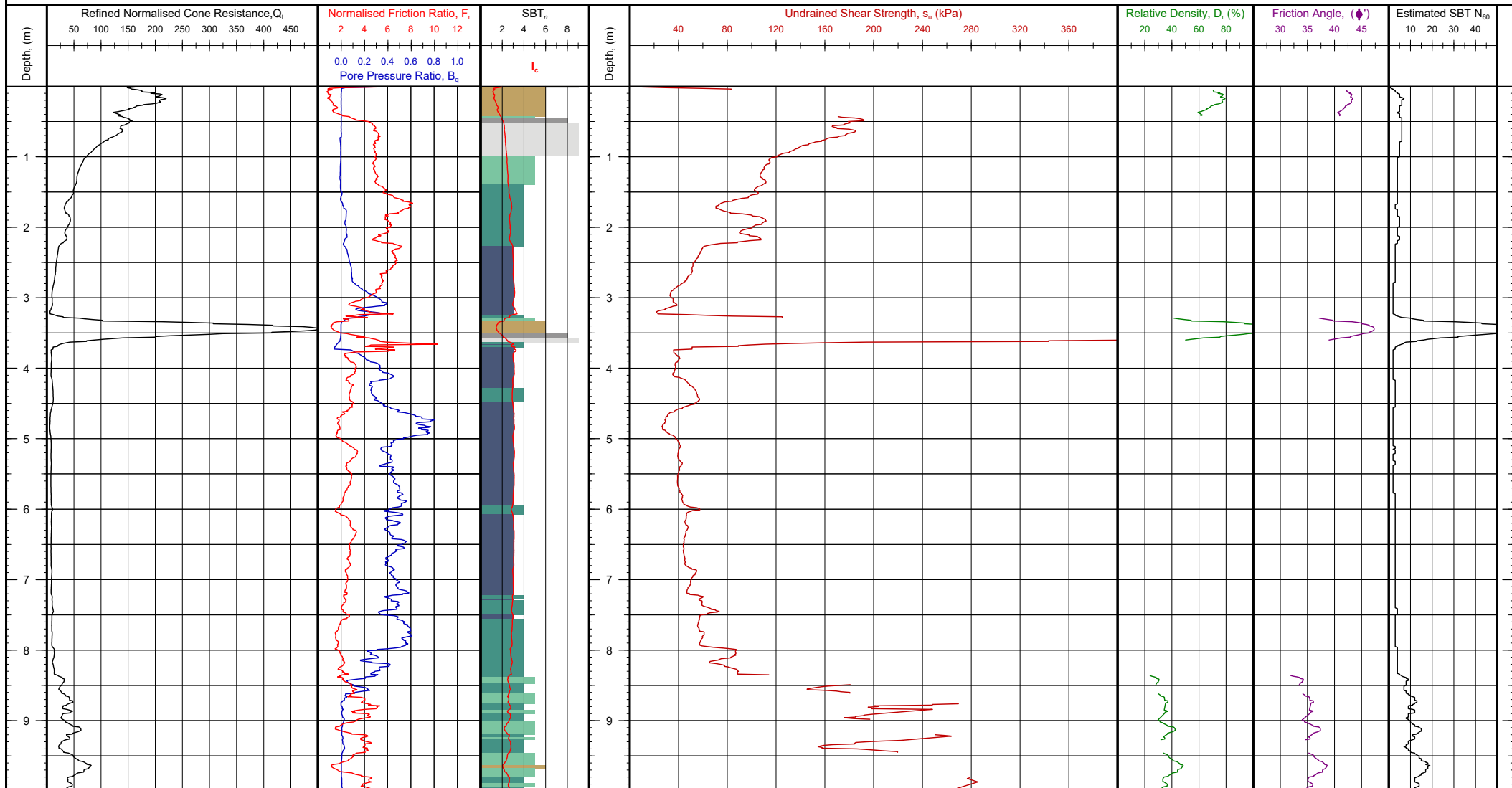
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-05

G.I. Job Ref: 200824

CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

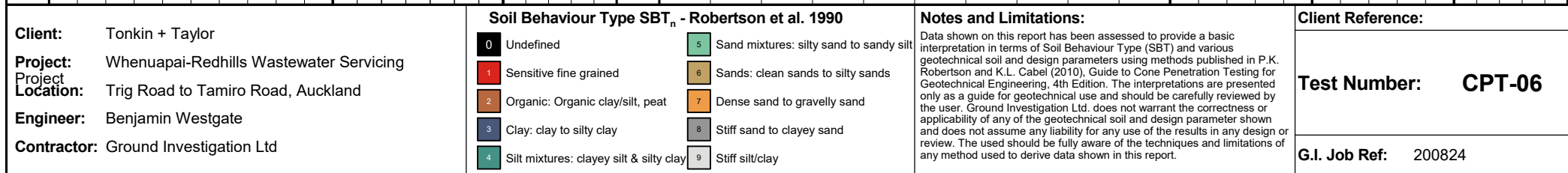
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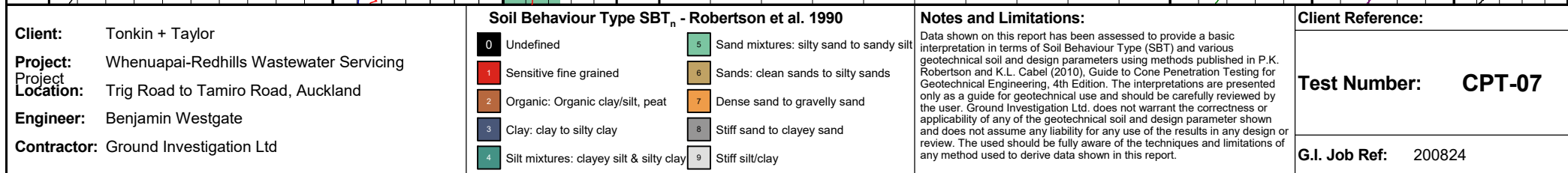
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

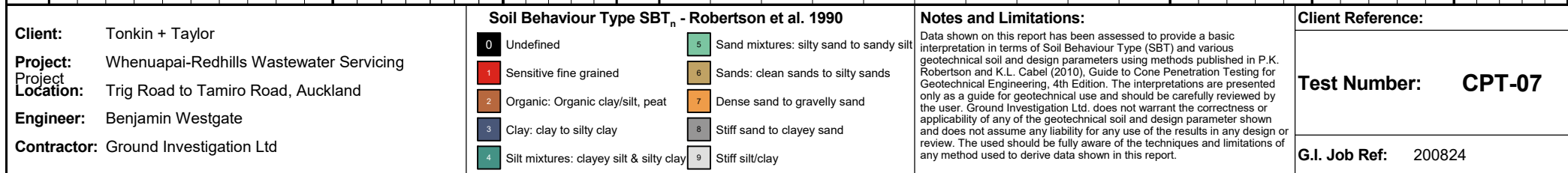
Client Reference:

Test Number: CPT-06

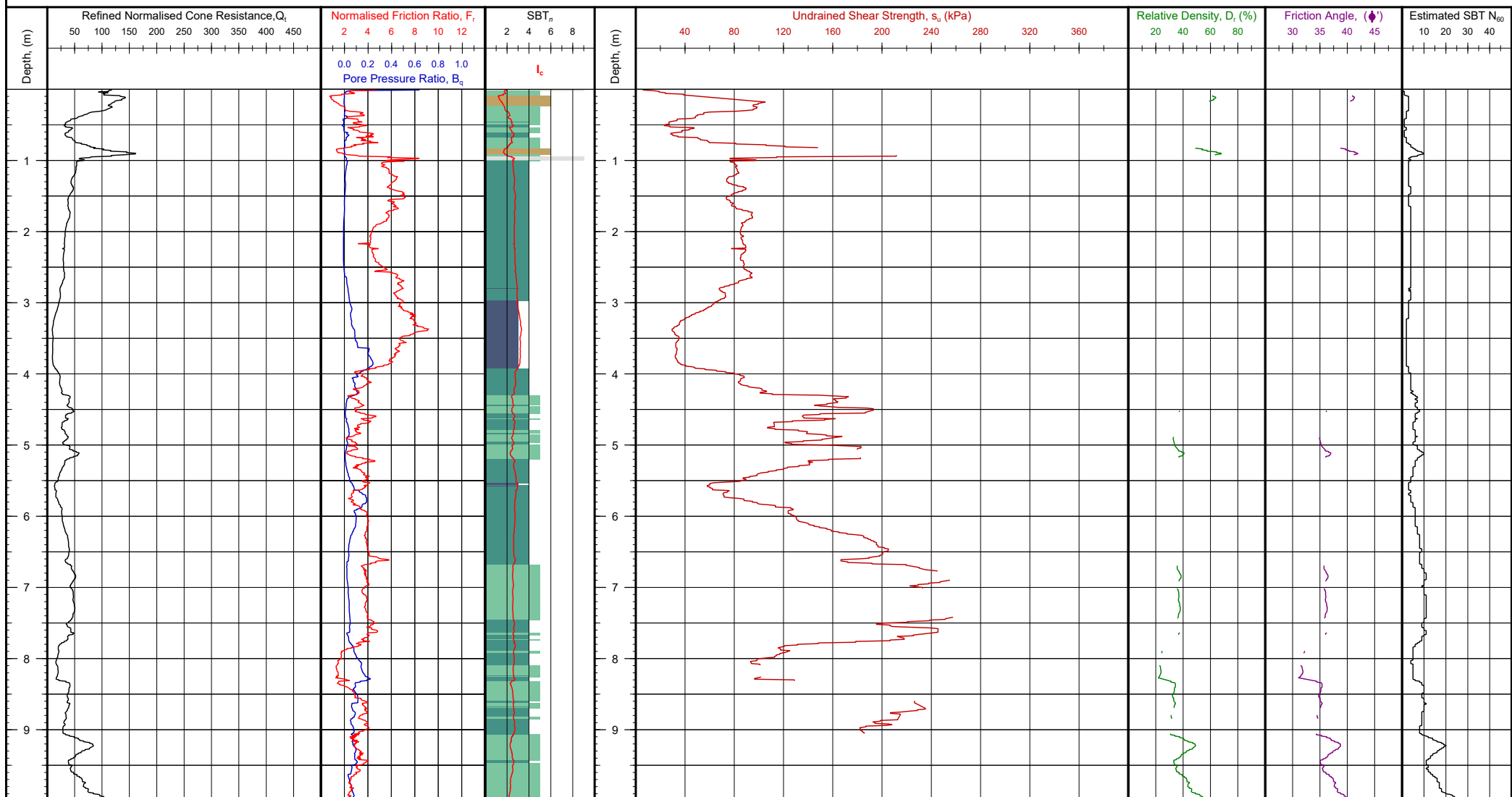
G.I. Job Ref: 200824







CPT PARAMETER LOG



Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

Notes and Limitations:

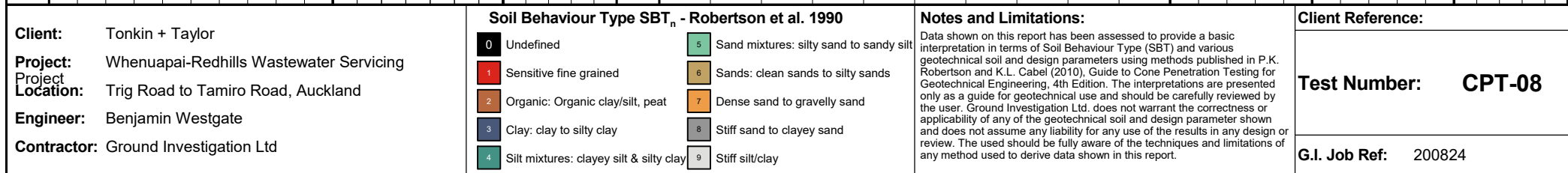
Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

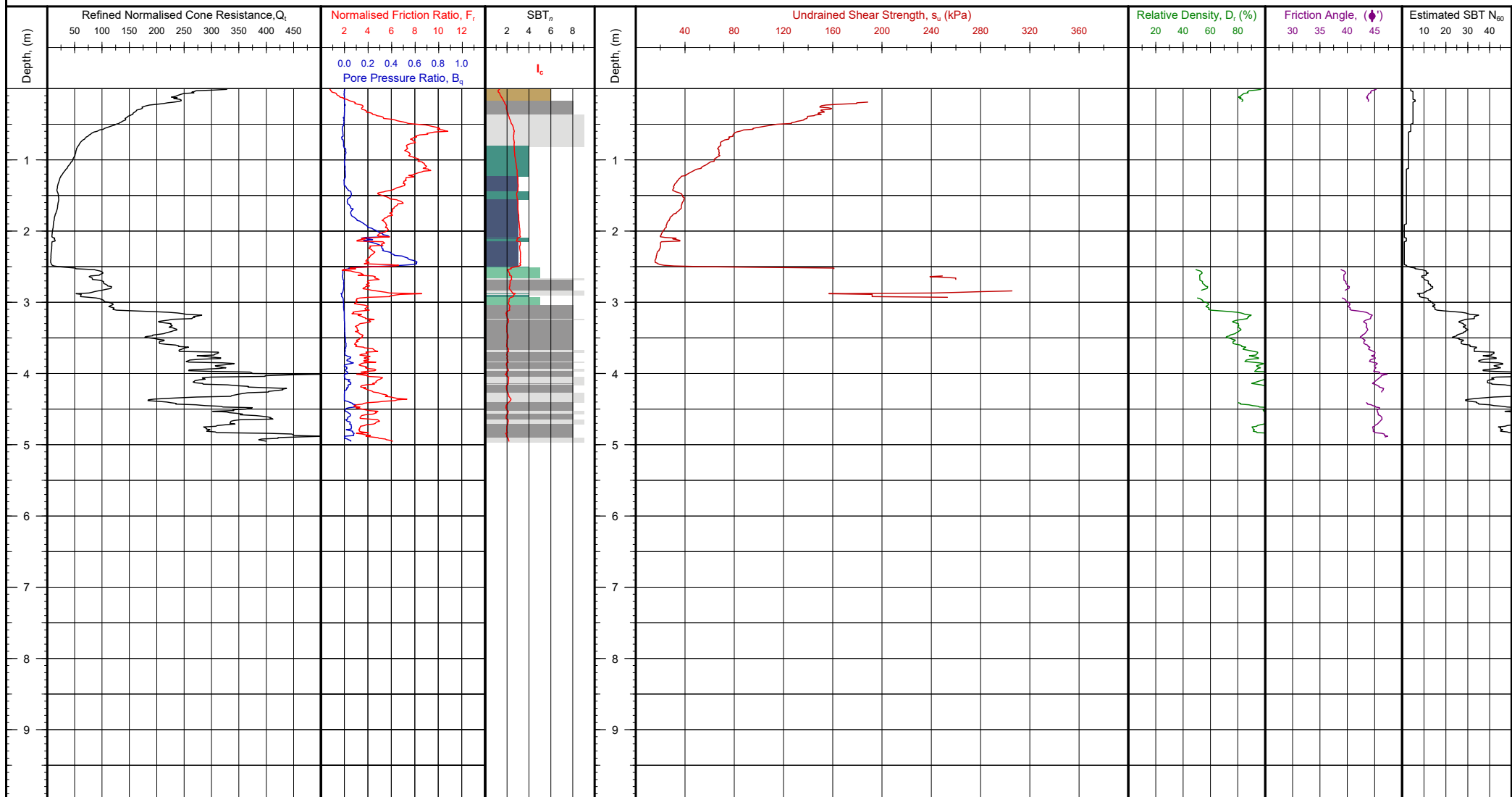
Test Number: CPT-08

G.I. Job Ref: 200824

Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd



CPT PARAMETER LOG



Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing
Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate
Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

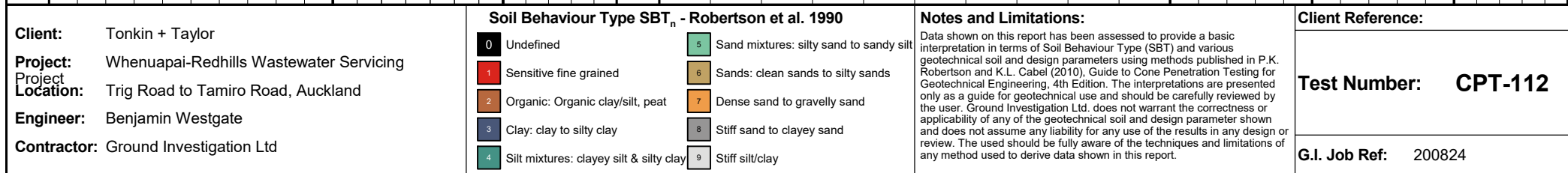
Notes and Limitations:

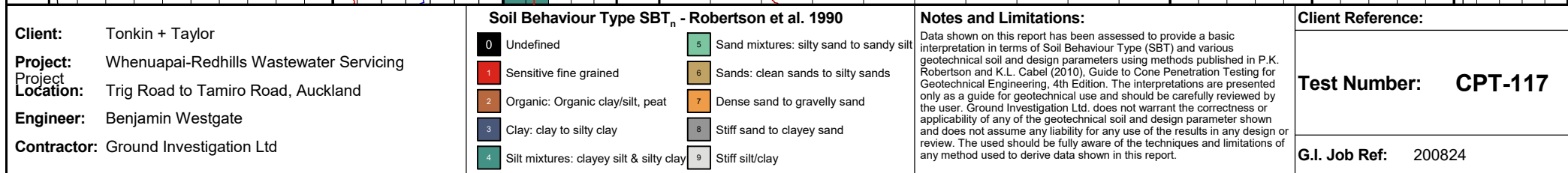
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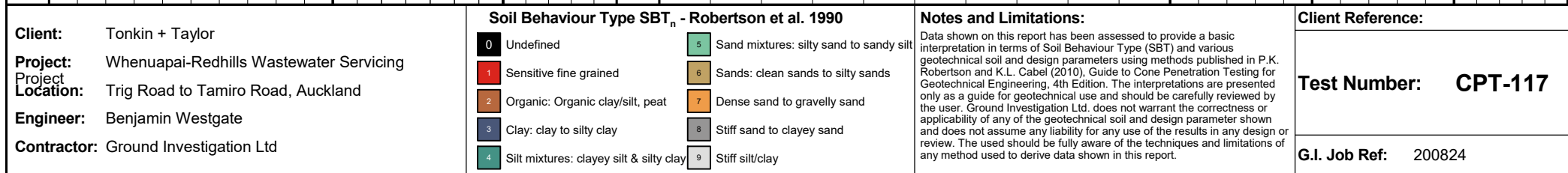
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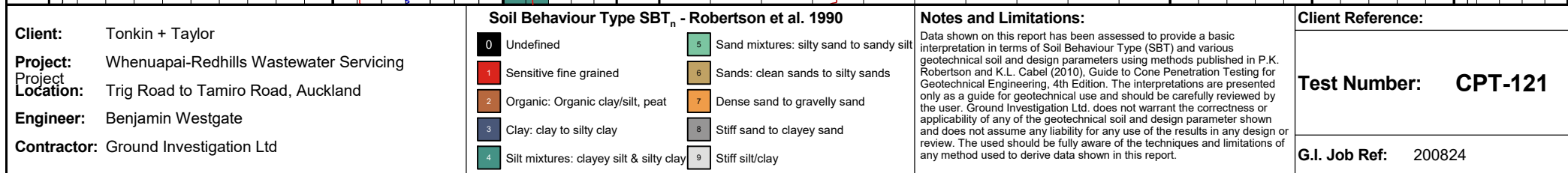
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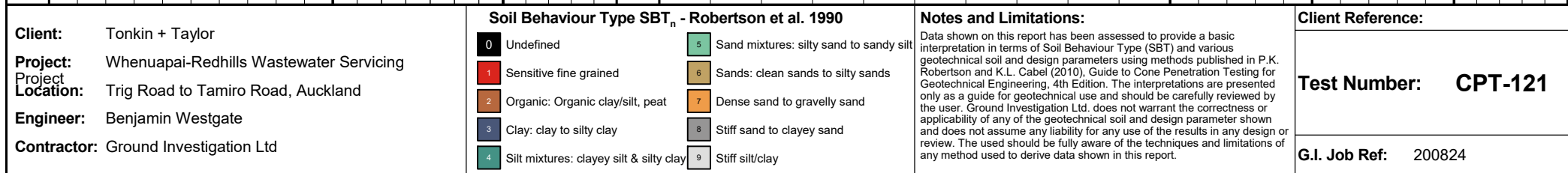
G.I. Job Ref: 200824



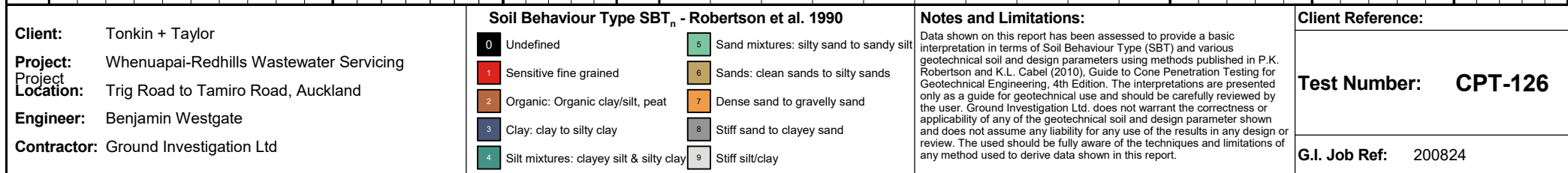






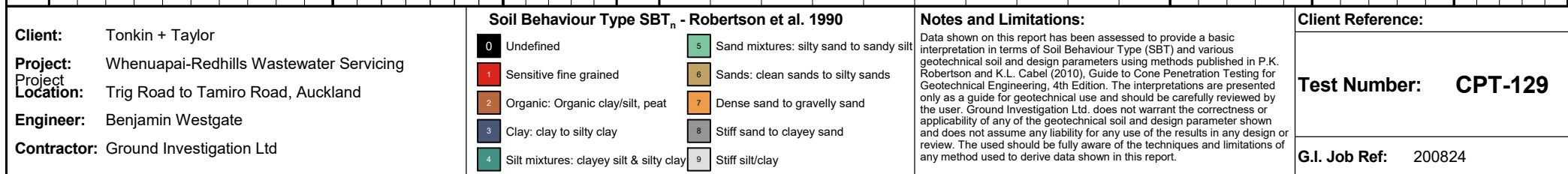




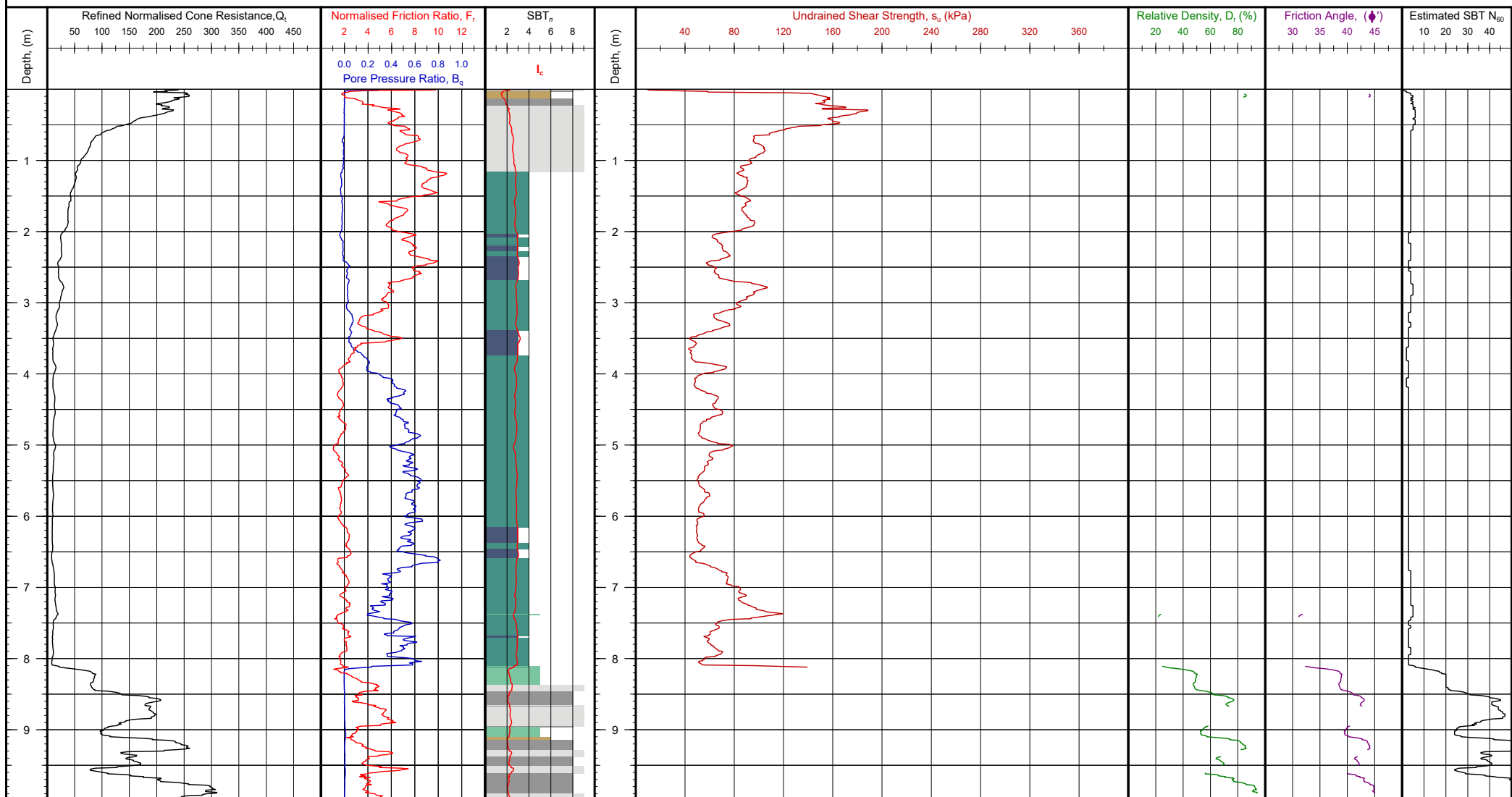








CPT PARAMETER LOG



Client: Tonkin + Taylor

Project: Whenuapai-Redhills Wastewater Servicing

Location: Trig Road to Tamiro Road, Auckland

Engineer: Benjamin Westgate

Contractor: Ground Investigation Ltd

Soil Behaviour Type SBT_n - Robertson et al. 1990

0	Undefined	5	Sand mixtures: silty sand to sandy silt
1	Sensitive fine grained	6	Sands: clean sands to silty sands
2	Organic: Organic clay/silt, peat	7	Dense sand to gravelly sand
3	Clay: clay to silty clay	8	Stiff sand to clayey sand
4	Silt mixtures: clayey silt & silty clay	9	Stiff silt/clay

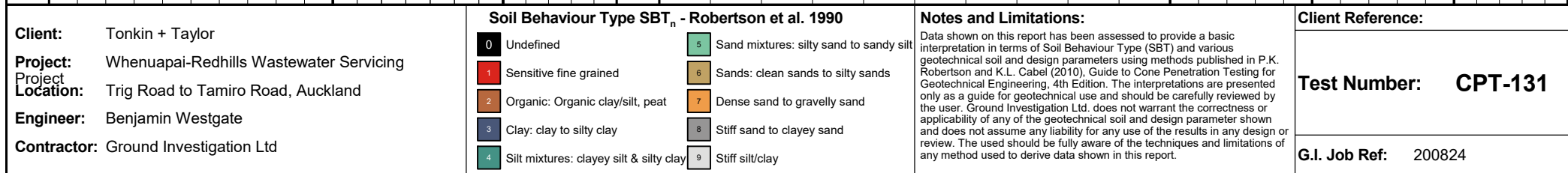
Notes and Limitations:

Data shown on this report has been assessed to provide a basic interpretation in terms of Soil Behaviour Type (SBT) and various geotechnical soil and design parameters using methods published in P.K. Robertson and K.L. Cabel (2010), Guide to Cone Penetration Testing for Geotechnical Engineering, 4th Edition. The interpretations are presented only as a guide for geotechnical use and should be carefully reviewed by the user. Ground Investigation Ltd. does not warrant the correctness or applicability of any of the geotechnical soil and design parameter shown and does not assume any liability for any use of the results in any design or review. The user should be fully aware of the techniques and limitations of any method used to derive data shown in this report.

Client Reference:

Test Number: CPT-131

G.I. Job Ref: 200824



CPT ZEROS AND DRIFT

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)
MKJ325	CPT-02	1	24.048	23.931	-117.3	0.2954	0.2954	0.0	2.7970	2.7994	2.4
MKJ309	CPT-03	1	9.804	9.762	-41.7	0.1323	0.1322	-0.1	1.4208	1.4215	0.7
MKJ325	CPT-04	1	24.091	24.027	-64.0	0.2951	0.2955	0.4	2.8024	2.8040	1.6
MKJ309	CPT-05	1	9.835	9.736	-99.0	0.1337	0.1324	-1.3	1.4195	1.4218	2.3
MKJ333	CPT-06	1	9.470	9.470	0.0	0.1200	0.1207	0.7	0.9416	0.9423	0.7
MKJ333	CPT-07	1	9.470	9.470	0.0	0.1215	0.1205	-1.0	0.9407	0.9426	1.9
MKJ539	CPT-08	1	20.626	20.611	-15.5	0.2498	0.2498	0.0	2.8176	2.8176	0.0
MKJ309	CPT-111	1	9.820	9.814	-5.3	0.1330	0.1331	0.1	1.4205	1.4213	0.8
MKJ325	CPT-112	1	23.995	23.974	-21.3	0.2940	0.2948	0.8	2.7981	2.7988	0.7
MKJ325	CPT-117	1	24.144	24.006	-138.6	0.2954	0.2952	-0.2	2.8047	2.8083	3.6
MKJ309	CPT-121	1	9.830	9.741	-88.6	0.1343	0.1315	-2.8	1.4169	1.4194	2.5
MKJ325	CPT-126	1	24.123	23.984	-138.6	0.2956	0.2954	-0.2	2.8048	2.8069	2.1
MKJ325	CPT-128	1	24.064	24.022	-42.6	0.2947	0.2951	0.4	2.8065	2.8067	0.2
MKJ309	CPT-129	1	9.783	9.773	-10.5	0.1315	0.1318	0.3	1.4210	1.4219	0.9

Client: Tonkin + Taylor
Project: Whenuapai-Redhills Wastewater Servicing Project

Location: Trig Road to Tamiro Road, Auckland
Engineer: Benjamin Westgate

Note: Zero difference colour-coded based on application classes following ISO 22476-1:2012. Blue indicates Class 1, green Class 2, orange Class 3 and red Class 4. Grey represents if a test is below Class 4.

CPT ZEROS AND DRIFT

Cone Reference	CPT Name	Push Number	Tip Resistance			Local Friction			Pore Pressure		
			Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)	Initial (MPa)	Final (MPa)	Difference (kPa)
MKJ309	CPT-131	1	9.866	9.767	-99.1	0.1340	0.1322	-1.8	1.4200	1.4219	1.9

HAND AUGER LOG

HOLE Id: **ENVR-HA03**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI										LOCATION: Whenuapai										JOB No.: 1014985.0000																																																																																																																																																																																																																																																																																																																																																													
CO-ORDINATES: 5925787.00 mN (NZTM2000) 1744024.40 mE										DRILL TYPE: 50 mm HA										HOLE STARTED: 10/11/2020																																																																																																																																																																																																																																																																																																																																																													
R.L.: 36.70m										DRILL METHOD: HA										HOLE FINISHED: 10/11/2020																																																																																																																																																																																																																																																																																																																																																													
DATUM: NZVD2016																				DRILLED BY: Tonkin + Taylor Ltd																																																																																																																																																																																																																																																																																																																																																													
																				LOGGED BY: RVDK										CHECKED: CBM																																																																																																																																																																																																																																																																																																																																																			
GEOLOGICAL															ENGINEERING DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																		
GEOLOGICAL UNIT: GENERIC NAME: ORIGIN: MATERIAL COMPOSITION:															WATER	CORE RECOVERY (%)	METHOD	SCALE PENETROMETER (Blows/100mm)									TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																																																																																																																																																																																																																																																																																																																																													
Tauranga Group																												ENVR-HA03 -0.0-0.1 @ 0.00m																																																																																																																																																																																																																																																																																																																																																					

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925787.00 mN 1744024.40 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	36.70m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

HAND AUGER LOG

CORE PHOTOS

BOREHOLE No.: **ENVR-HA04**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925759.80 mN 1744104.70 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	39.50m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

HAND AUGER LOG

HOLE Id: **ENVR-HA05**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI										LOCATION: Whenuapai										JOB No.: 1014985.0000																									
CO-ORDINATES: 5925739.90 mN (NZTM2000) 1744151.80 mE										DRILL TYPE: 50 mm HA										HOLE STARTED: 10/11/2020																									
R.L.: 41.00m										DRILL METHOD: HA										HOLE FINISHED: 10/11/2020																									
DATUM: NZVD2016																				DRILLED BY: Tonkin + Taylor Ltd																									
																				LOGGED BY: RVDK										CHECKED: CBM															
GEOLOGICAL																				ENGINEERING DESCRIPTION																									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.										WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)						TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																	
													0 1 2 3 4 5 6 7 8 9						ENVR-HA05 -0.0-0.1m @ 0.00m												Clayey SILT; dark brown. Very stiff, moist, non-plastic.														
Tauranga Group																			ENVR-HA05 -0.5 @ 0.50m														SILT, trace sand; light grey. Very stiff, moist, non-plastic.												
																			ENVR-HA05 -1.0 @ 0.90m																	Clayey SILT; dark brown minor black mottle. Very stiff, moist, non-plastic.									
																																							1.0m: PID=0.0PPM						
																																			1m: Target depth										

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925739.90 mN 1744151.80 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 10/11/2020
R.L.:	41.00m	DRILL METHOD: HA	HOLE FINISHED: 10/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-1.00m

HAND AUGER LOG

HOLE Id: **ENVR-HA101**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926989.60 mN (NZTM2000) 1743340.30 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 04/11/2020
R.L.: 12.80m	DRILL METHOD: HA	HOLE FINISHED: 04/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: RVDK CHECKED: CBM

GEOLOGICAL													ENGINEERING DESCRIPTION												
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,													Description and Additional Observations												
WATER													CORE RECOVERY (%)												
METHOD													SCALA PENETROMETER (Blows/100mm)												
0													1												
2													3												
4													5												
6													7												
8													9												
TESTS													SAMPLES												
ENVR-HA 101-0.0- 0.1m @ 0.00m													RL (m)												
ENVR-HA 101-0.5- 0.6m @ 0.50m													DEPTH (m)												
ENVR-HA 101-1.6- 1.8m @ 1.60m													GRAPHIC LOG												
MOISTURE CONDITION													WEATHERING												
STRENGTH/DENSITY CLASSIFICATION													SHEAR STRENGTH (kPa)												
Tauranga Group													Clayey SILT; greyish brown. Stiff, dry, non-plastic.												
													Clayey SILT; brown, minor black streaking. Stiff, dry, low plasticity.												
													0.5m: PID= 0.0ppm												
													Clayey SILT; brownish grey with orange mottle. Stiff, moist, medium plasticity.												
													1.0m: PID= 0.0ppm												
													SILT, trace sand; light greyish brown with orange mottle. Stiff, moist, non-plastic.												
													2m: Target depth												

COMMENTS:
Hole Depth 2m

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926989.60 mN 1743340.30 mE	DRILL TYPE: 50 mm HA	HOLE STARTED: 04/11/2020
R.L.:	12.80m	DRILL METHOD: HA	HOLE FINISHED: 04/11/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: RVDK CHECKED: CBM



0.00-2.00m

HAND AUGER LOG

HOLE Id: **HA03**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926343.50 mN (NZTM2000) 1743214.30 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020							
R.L.: 19.40m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.								Description and Additional Observations							
WATER CORE RECOVERY (%) METHOD								SCALA PENETROMETER (Blows/100mm) 024681012141618							
TESTS								SAMPLES RL (m) DEPTH (m) GRAPHIC LOG WEATHERING MOISTURE CONDITION STRENGTH/DENSITY CLASSIFICATION SHEAR STRENGTH (kPa)							
Topsoil								M							
● 186/56 kPa asb/gl @ 0.40m PID, 0.0ppm ● 121/48 kPa								VSt							
● 180/77 kPa asb/gl @ 0.90m PID, 0.0ppm ● 114/60 kPa								0.5m: mottled yellowish brown							
● 104/54 kPa att/psd @ 1.45m ● 114/60 kPa asb/gl @ 1.90m ● 162/77 kPa								2.1m: light greyish white, low plasticity							
● 122/66 kPa ● 119/72 kPa asb/gl @ 2.80m ● 175/74 kPa								Sandy SILT; light whitish grey. Moist to wet, non-plastic.							
● 122/85 kPa att/psd @ 3.45m ● 186/85 kPa								St-VSt							
● 122/82 kPa asb/gl @ 3.80m ● 123/77 kPa								SILT; light greyish white mottled yellowish brown. Very stiff, moist, non-plastic.							
● 147/101 kPa ● 96/32 kPa asb/gl @								Clayey SILT; light whitish grey mottled yellowish brown and brown. Very stiff to stiff, moist, low plasticity.							
								3.7m: Light brown with black mottles. Medium plasticity.							
								4.7m: Dark brown, organic stained.							
								St							
								Peaty clayey SILT; black. Stiff, moist, low							
COMMENTS: Farmland end Spedding Rd															
Hole Depth 6.45m															

CORE PHOTOS

BOREHOLE No.: **HA03**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926343.50 mN 1743214.30 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	19.40m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA04**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES: 5926082.10 mN (NZTM2000) 1743388.90 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020								
R.L.: 21.20m		DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020								
DATUM: NZVD2016						DRILLED BY: GEOTECHNICS								
				LOGGED BY: RBE				CHECKED: CBM						
GEOLOGICAL						ENGINEERING DESCRIPTION								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
Topsoil					0 2 4 6 8 10 12 14 16 18	asb/gl/dupB @ 0.00m		21		M	St		SILT; dark brown. Stiff, moist, non-plastic; inclusion of agricultural plastic sheet.	
					• >186 kPa asb/gl @ 0.40m PID, 0.0ppm @ 0.50m • 179/50 kPa		0.5		St-VSt		Sandy SILT; light whitish brown. Very stiff, moist, non-plastic.			
Tauranga Group						• 159/61 kPa asb/gl @ 0.90m PID, 0.1ppm @ 1.00m • 122/54 kPa		20					1.0m: light grey mottled yellowish brown	
					• 109/44 kPa		1.5				1.8m: some sand, light brownish white			
					att/psd @ 1.45m									
					• 90/35 kPa		2.0							
					asb/gl @ 1.90m									
					• 127/46 kPa		19		VSt		Clayey SILT; light brown. Very stiff, moist, low plasticity.			
					att/psd @ 2.45m		2.5		M-W		Silty SAND; white. Moist to wet; sand, fine to medium; well packed.			
					asb/gl @ 2.80m		3.0				2.5m: Scala (blows per 100mm): 13,22,22,20,18			
											3.0m: light brown			
					2		18		M	St		SILT; light brown. Stiff, moist, non-plastic; Scala (blows per 100mm): 5,6,8.		
					3						Clayey SILT; grey. Stiff, moist, low plasticity.			
					3									
					4									
					4									
						• 97/45 kPa								
					asb/gl @ 3.80m									
					• 90/32 kPa		4.0		W		Silty SAND; greyish brown. Wet; sand, fine to medium.			
					• 101/28 kPa			M	VSt		SILT; brown and grey. Very stiff, moist, non-plastic.			
					• 159/32 kPa		4.5				4.4m: abundant organics and inclusions of decomposed wood			
						• 117/33 kPa								
					asb/gl @						Clayey SILT; light grey. Very stiff, moist, low plasticity.			

COMMENTS: Farmland end Spedding Rd

Hole Depth
6.85m
Scale 1:25

HAND AUGER LOG

HOLE Id: **HA04**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000								
CO-ORDINATES: (NZTM2000)		5926082.10 mN 1743388.90 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020								
R.L.:		21.20m		DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020								
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS								
								LOGGED BY: RBE		CHECKED: CBM						
GEOLOGICAL								ENGINEERING DESCRIPTION								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)			TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
Tauranga Group					<											

CORE PHOTOS

BOREHOLE No.: **HA04**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926082.10 mN 1743388.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	21.20m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: HA05

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925977.70 mN (NZTM2000) 1743549.70 mE				DRILL TYPE: 75 and 50mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.: 27.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Fill						asb/gl/split @ 0.00m		27			M			SILT; dark brown. Moist, non-plastic; inclusions of gravel, black plastic twine.	
Tauranga Group		01/12/2020 W/L on completion				● 130/32 kPa asb/gl @ 0.40m PID, 0.1ppm @ 0.50m ● 88/29 kPa		0.5			St-Vst			Silty CLAY; light grey. Stiff to very stiff, moist, high plasticity.	
						● 82/32 kPa asb/gl @ 0.90m PID, 0.1ppm @ 1.00m ● 108/35 kPa		1.0							
						● 80/33 kPa att/psd @ 1.45m		1.5					1.8m: light greyish brown. Low plasticity		
						● 96/41 kPa asb/gl @ 1.90m		2.0	W	St		Sandy SILT; light greyish brown. Stiff, wet, non-plastic.			
						● 56/19 kPa att/psd2 @ 2.45m		2.5	M	F-St		Clayey SILT, trace sand; light brown. Stiff to firm, moist, low plasticity.			
						● 37/20 kPa asb/gl @ 2.70m									
						● 41/21 kPa		3.0		F		Silty CLAY; light grey. Firm, moist, high plasticity.			
						● 40/24 kPa									
						● 35/16 kPa asb/gl @ 3.70m		3.5							
						● 35/13 kPa		4.0				4.0m: brown			
						● 35/13 kPa		4.2					4.2m: blackish brown		
						● 41/21 kPa		4.5				4.5m: brown			
						● 45/21 kPa asb/gl @				St					
COMMENTS: Spedding Road															
Hole Depth 7.25m															

COMMENTS: Spedding Road

Hole Depth
7.25m

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: **HA05**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000											
CO-ORDINATES: 5925977.70 mN (NZTM2000) 1743549.70 mE				DRILL TYPE: 75 and 50mm Hand auger				HOLE STARTED: 01/12/2020											
R.L.: 27.20m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020											
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS											
								LOGGED BY: RBE											
								CHECKED: CBM											
GEOLOGICAL										ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION. </																			

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925977.70 mN 1743549.70 mE	DRILL TYPE: 75 and 50mm Hand auger	HOLE STARTED: 01/12/2020
R.L.:	27.20m	DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA06**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES:		5925924.30 mN (NZTM2000) 1743672.80 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.:		30.70m		DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.								Description and Additional Observations							
WATER CORE RECOVERY (%) METHOD SCALA PENETROMETER (Blows/100mm) TESTS SAMPLES RL (m) DEPTH (m) GRAPHIC LOG WEATHERING MOISTURE CONDITION STRENGTH/DENSITY CLASSIFICATION SHEAR STRENGTH (kPa)															
Tauranga Group 01/12/2020 W/L on completion 01/12/2020								SILT; dark brown. Moist, non-plastic; friable.							
								SILT; light yellowish brown. Very stiff, moist, non-plastic.							
								Clayey SILT; yellowish brown. Stiff to very stiff, moist; low to medium plasticity.							
								Silty CLAY; light brownish grey. Very stiff, moist, high plasticity.							
								Clayey SILT; light brown. Stiff to very stiff, moist, medium plasticity.							

HAND AUGER LOG

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925924.30 mN 1743672.80 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 01/12/2020
R.L.:	30.70m	DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA07**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5925859.50 mN (NZTM2000) 1743823.00 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.: 32.90m				DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil		01/12/2020	100	HA		asb/gl @ 0.10m				TS	M	F		Sandy SILT; dark brown. Firm, moist, low plasticity; sand, fine.	
Tauranga Group					85/22 kPa PID, 0.1ppm @ 0.50m asb/gl @ 0.50m		0.5				St	Sandy SILT, trace organics; brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets. 0.5m: Light brown, mottled orange. PID test, 0.1ppm.			
					att/psd @ 0.80m		32					Clayey SILT, minor sand, trace organics; light brown. Stiff, moist, medium plasticity; sand, fine; organics, rootlets. 1.0m: PID test, 0.2ppm			
					82/47 kPa PID, 0.2ppm @ 1.00m asb/gl & att/psd @ 1.00m		1.0					SILT, some clay, minor sand; light brown, mottled orange. Stiff, moist, medium plasticity; sand, fine.			
					69/37 kPa		1.5					SILT, some clay and sand; light brown, mottled orange and brown. Stiff, moist, medium plasticity; sand, fine.			
					corrosivity @ 1.80m		31					Sandy SILT, trace organics and clay; light brown, mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets. 2.5m: Grey and orange.			
					63/33 kPa asb/gl @ 2.00m		2.0					Sandy SILT, trace organics; light brown, mottled orange. Stiff to very stiff, moist, low plasticity; sand, fine; organics, rootlets. 3.4m: Light brown, mottled orange. 3.5m: Grey.			
					corrosivity @ 2.40m		2.5								
					90/47 kPa		3.0								
	87/31 kPa asb/gl @ 3.00m					3.0									
	131/31 kPa		3.5												
					>218 kPa asb/gl @ 4.00m		29			D-VD		Silty SAND, trace organics; light brown mottled orange. Dense to very dense, moist, poorly graded; sand, fine to medium; organics, rootlets.			
					UTP		4.5								
					UTP		28								

Box 1, 0.0-3.0m

Box 2, 3.0-5.0m

COMMENTS:

Hole Depth
5.9m

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: **HA07**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES:		5925859.50 mN (NZTM2000) 1743823.00 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 01/12/2020							
R.L.:		32.90m		DRILL METHOD: HA+DCP				HOLE FINISHED: 01/12/2020							
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd							
								LOGGED BY: ROM				CHECKED: CBM			
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
			0	DCP	<										

COMMENTS:

Hole Depth 5.9m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925859.50 mN 1743823.00 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 01/12/2020
R.L.:	32.90m	DRILL METHOD: HA+DCP	HOLE FINISHED: 01/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA07a**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925813.70 mN (NZTM2000) 1743968.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 25/11/2020
R.L.: 35.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 25/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL										ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,										Description and Additional Observations									
WATER										SHEAR STRENGTH (kPa)									
CORE RECOVERY (%)										STRENGTH/DENSITY CLASSIFICATION									
METHOD										WEATHERING									
SCALA PENETROMETER (Blows/50mm)										STRENGTH/DENSITY CLASSIFICATION									
TESTS										SHEAR STRENGTH (kPa)									
SAMPLES										GRAPHIC LOG									
RL (m)										MOISTURE CONDITION									
DEPTH (m)										STRENGTH/DENSITY CLASSIFICATION									
Topsoil										M									
asb @ 0.10m										TS									
● >218 kPa asb @ 0.50m PID, 0.0ppm @ 0.51m										VSt-H									
● 174/62 kPa asb @ 1.00m PID, 0.8ppm @ 1.01m corrosivity @ 1.20m										Grades to: clayey SILT, minor sand, trace organics; grey and brown mottled orange. Very stiff to hard, moist, medium plasticity. Sand, fine; organics, rootlets.									
● 187/75 kPa										VSt									
● 159/87 kPa asb @ 2.00m										Sandy SILT, some clay, trace organics; grey mottled orange and brown. Very stiff, moist, low to medium plasticity. Organics, rootlets.									
geo @ 2.20m										2.1m: trace clay; grey, mottled orange.									
geo @ 2.40m										Silty CLAY; grey, mottled orange and pink. Very stiff, moist, high plasticity.									
● 188/73 kPa										Sandy SILT, some clay, trace organics; grey mottled orange and brown. Very stiff, moist, low to medium plasticity. 2.8 - 2.9m: orange, mottled grey.									
● 199/84 kPa asb @ 3.00m										VSt-H									
● >218 kPa										VD									
● UTP asb @ 4.00m										VSt-H									
● UTP										Sandy SILT; grey, speckled white. Very stiff to hard, moist, low plasticity; sand, fine to coarse.									
● UTP										Grades to: Silty, fine to coarse SAND; grey, speckled white. Very dense, moist, well graded.									
4.6m: minor fine, rounded gravel.																			

COMMENTS:

Hole Depth
5.85m

Scale 1:25

HAND AUGER LOG

HOLE Id: **HA07a**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES:		5925813.70 mN (NZTM2000) 1743968.70 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 25/11/2020						
R.L.:		35.60m		DRILL METHOD: HA+DCP				HOLE FINISHED: 25/11/2020						
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd						
								LOGGED BY: ROM		CHECKED: CBM				
GEOLOGICAL							ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
					0 2 4 6 8 10 12 14 16 18	asb @ 5.00m					M			Silty CLAY; grey. Hard, moist, high plasticity. 5.0 m: END OF HAND AUGER. Scala only to 5.85 m (blows per 50 mm): 5,5,6,7,8,5,7,8,11,10,11,10,11,10,10,11,11
								30	5.5					
														5.85m: END OF INVESTIGATION

COMMENTS:

Hole Depth
5.85m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925813.70 mN	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 25/11/2020
	1743968.70 mE	DRILL METHOD: HA+DCP	HOLE FINISHED: 25/11/2020
	R.L.: 35.60m		DRILLED BY: Tonkin + Taylor Ltd
DATUM:	NZVD2016		LOGGED BY: ROM CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA08**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925683.60 mN (NZTM2000) 1744277.50 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.: 49.10m	DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL					ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil	24/11/2020				Env @ 0.10m		49		TS	M	F		Sandy SILT, trace organics; brown. Firm, moist, low plasticity; sand, fine. Organics, rootlets	
					48/16 kPa Env @ 0.50m PID, 1.8ppm @ 0.50m		0.5		TS				Sandy SILT, minor organics; grey-brown, mottled orange. Firm, moist, low plasticity; sand, fine; organics, rootlets.	
Tauranga Group			94 HA+DCP		57/11 kPa Env @ 1.00m PID, 2.5ppm @ 1.00m		1.0	48					1.2-1.5m: CORE LOSS	
					82/6 kPa		1.5				St		SILT, some sand, mior clay, trace organics; grey-brown, speckled black. Stiff, moist, high plasticity; sand, fine; organics, rootlets.	
					>200 kPa Env @ 2.00m		2.0	47			VSt-H		Grades to: Silty CLAY, minor sand, trace organics; brown, mottled orange, speckled brown. Very stiff to hard, moist, high plasticity; sand, fine; organics, rootlets.	
					>200 kPa		2.5						2.4m: dark brown.	
					>200 kPa Env @ 3.00m		3.0	46			VSt		Sandy SILT, minor clay, trace organics; brown, spotted brown. Very stiff to hard, moist, low plasticity; sand, fine ; organics, rootlets.	
					135/73 kPa		3.5				VSt-H		Sandy, silty CLAY, trace organics; brown, spotted dark brown. Very stiff, moist, medium plasticity; sand, fine; organics, rootlets.	
					149/72 kPa Env @ 4.00m		4.0	45			VSt		Grades to: Sandy SILT; brown, mottled orange, spotted black and dark brown. Very stiff, moist, low plasticity; sand, fine; organics, rootlets.	
					129/56 kPa		4.5						4.2m: light grey-brown, spotted black.	
					>200 kPa						H		4.9m: hard.	

COMMENTS:

Hole Depth
5.85m

Scale 1:25

HAND AUGER LOG

HOLE Id: **HA08**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES: 5925683.60 mN (NZTM2000) 1744277.50 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 24/11/2020						
R.L.: 49.10m				DRILL METHOD: HA+DCP				HOLE FINISHED: 24/11/2020						
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd						
								LOGGED BY: ROM		CHECKED: CBM				
GEOLOGICAL								ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
					0 2 4 6 8 10 12 14 16 18	Env @ 5.00m		44						5.0m: END OF HAND AUGER. Scala only to 5.85m(blow per 50mm): 4,5,5,6,6,7,9,8,14,8,8,9,10,10,11,11,12
									5.5					
														5.85m: END OF INVESTIGATION
								43	6.0					
									6.5					
									7.0					
								42						
									7.5					
									8.0					
								41						
									8.5					
									9.0					
								40						
									9.5					
					</									

COMMENTS:

Hole Depth
5.85m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5925683.60 mN (NZTM2000) 1744277.50 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.: 49.10m		DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA08a

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES: 5925734.60 mN (NZTM2000) 1744164.50 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 24/11/2020						
R.L.: 41.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 24/11/2020						
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd						
								LOGGED BY: ROM CHECKED: CBM						
GEOLOGICAL								ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.	WATER	CORE RECOVERY (%)	METHOD	SCALES PENETROMETER (Blows/50mm) 0 2 4 6 8 10 12 14 16 18	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
				5 4 4 7 5 7 7 7 8 9 8 7 9 0 10 9 0 10 10 12 12	asb/gl @ 5.00m 1 x Glass Jar 1x plastic Jar		5.5						5.0m: END OF HAND AUGER. Scala only to 6.2 m (blows per 50 mm): 2,2,3,2,4,5,4,5,4,4,4,7,5,5,7,7,7,8,9,8,7,9,10,10 ,9,10,10,10,12,12	
							6.5							
							35							
							7.0							
							7.5							
							34							
							8.0							
							8.5							
							33							
							9.0							
							9.5							
							32							
COMMENTS: Hole Depth 6.2m														

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5925734.60 mN 1744164.50 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 24/11/2020
R.L.:	41.80m	DRILL METHOD: HA+DCP	HOLE FINISHED: 24/11/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA107a

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926927.60 mN (NZTM2000) 1743320.80 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.: 13.50m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL										ENGINEERING DESCRIPTION																																																																																																																								
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION				WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)				TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																																																																																																															
Topsoil											Env @ 0.10m				TS	M	L		Silty SAND, trace organics; brown. Loose, moist, poorly graded; sand, fine; organics, rootlets.																																																																																																															
Tauranga Group				03/12/2020	100	HA+DCP					● 202/47 kPa Env @ 0.50m PID - 0.0ppm @ 0.51m	13	0.5		TS	VST-H		Silty CLAY, minor sand, trace organics; brown mottled orange and dark brown, speckled white. Very stiff to hard, moist, high plasticity; sand, fine; organics, rootlets.																																																																																																																
Tauranga Group				03/12/2020	100	HA+DCP					● 137/31 kPa Env @ 1.00m PID 0.0ppm @ 1.01m	12	1.0			St		Clayey SILT, minor sand; grey and grey brown mottled orange speckled black. Stiff, moist, high plasticity; sand, fine.																																																																																																																
Tauranga Group				03/12/2020	100	HA+DCP					● 81/31 kPa	11	1.5					Sandy SILT, minor clay, trace organics; brown mottled orange, speckled white. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																																
Tauranga Group				03/12/2020	100	HA+DCP					● 67/31 kPa Env @ 2.00m att/psd/corr osivity @ 2.20m	10	2.0					Sandy SILT, trace organics; grey & brown mottled orange. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																																
Tauranga Group				03/12/2020	100	HA+DCP					● 38/16 kPa	9	2.5						Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																															
Tauranga Group				03/12/2020	100	HA+DCP					● 31/22 kPa	8	3.0						Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																															
Tauranga Group				03/12/2020	100	HA+DCP					● 68/28 kPa corrosivity @ 3.50m	7	3.5						SILT, some clay and sand, trace organics; brown speckled dark brown. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																															
Tauranga Group				03/12/2020	100	HA+DCP					● 87/34 kPa	6	4.0							Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																														
Tauranga Group				03/12/2020	100	HA+DCP					● 72/30 kPa	5	4.5							Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																														
Tauranga Group				03/12/2020	100	HA+DCP					● 100/31 kPa	4	5.0							Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																														
Tauranga Group				03/12/2020	100	HA+DCP						3	5.5								Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																													
Tauranga Group				03/12/2020	100	HA+DCP						2	6.0									Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																												
Tauranga Group				03/12/2020	100	HA+DCP						1	6.5										Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																											
Tauranga Group				03/12/2020	100	HA+DCP						0	7.0											Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																										
Tauranga Group				03/12/2020	100	HA+DCP						-1	7.5												Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																									
Tauranga Group				03/12/2020	100	HA+DCP						-2	8.0													Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																								
Tauranga Group				03/12/2020	100	HA+DCP						-3	8.5														Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																							
Tauranga Group				03/12/2020	100	HA+DCP						-4	9.0														Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																							
Tauranga Group				03/12/2020	100	HA+DCP						-5	9.5															Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																						
Tauranga Group				03/12/2020	100	HA+DCP						-6	10.0															Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																						
Tauranga Group				03/12/2020	100	HA+DCP						-7	10.5																Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																					
Tauranga Group				03/12/2020	100	HA+DCP						-8	11.0																	Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																				
Tauranga Group				03/12/2020	100	HA+DCP						-9	11.5																		Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																			
Tauranga Group				03/12/2020	100	HA+DCP						-10	12.0																			Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																		
Tauranga Group				03/12/2020	100	HA+DCP						-11	12.5																				Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																																	
Tauranga Group				03/12/2020	100	HA+DCP						-12	13.0																					Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																																
Tauranga Group				03/12/2020	100	HA+DCP						-13	13.5																						Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																															
Tauranga Group				03/12/2020	100	HA+DCP						-14	14.0																							Silty SAND, trace organics; grey. Loose, wet, poorly graded; sand, fine; organics, rootlets.																																																																																														
Tauranga Group				03/12/2020	100	HA+DCP						-15	14.5																									Sandy SILT, trace organics; grey and brown speckled black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.																																																																																												
Tauranga Group				03/12/2020	100	HA+DCP						-16	15.0																																																																																																																					

COMMENTS:

Hole Depth
6.65m

Scale 1:25

Rev.: A

HAND AUGER LOG

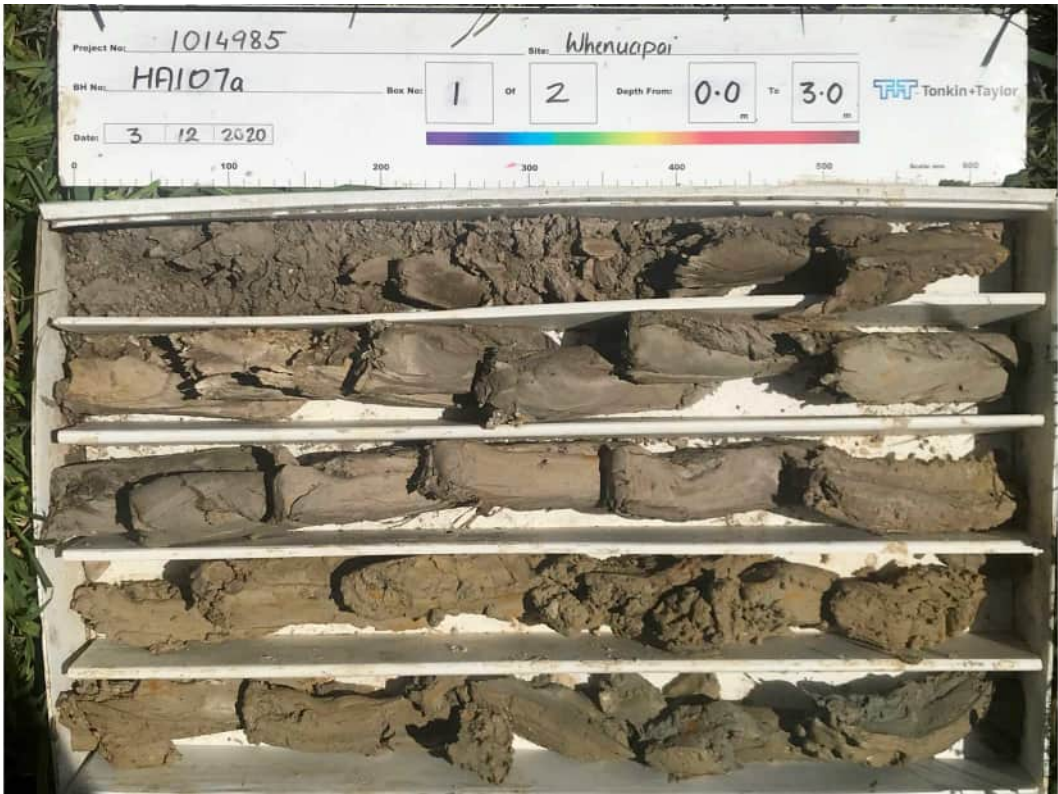
HOLE Id: **HA107a**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000						
CO-ORDINATES: 5926927.60 mN (NZTM2000) 1743320.80 mE				DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 03/12/2020						
R.L.: 13.50m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020						
DATUM: NZVD2016								DRILLED BY: Tonkin + Taylor Ltd						
								LOGGED BY: ROM CHECKED: CBM						
GEOLOGICAL								ENGINEERING DESCRIPTION						
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
					0 2 4 6 8 10 12 14 16 18									
					2 4 3 3 4 5 4 3 4 4 4 5 8 5 15 7 7 6 7 6 7 10 9 11 10 10 18 9 18 8 8			8	5.5					5.0 m: END OF HAND AUGER. Scala only to 6.65 m (blows per 50 mm): 1,2,2,2,1,2,4,3,3,3,4,5,4,3,4,4,4,5,6,5,5,7,7,6,7,6, 7,10,9,11,10,10,8,8,9,8,8
								7	6.5					
									7.0					6.65m: END OF INVESTIGATION
									6	7.5				
									8.0					
									5	8.5				
									9.0					
									4	9.5				
COMMENTS: Hole Depth 6.65m														

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926927.60 mN (NZTM2000) 1743320.80 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.: 13.50m		DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA107b

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926922.30 mN (NZTM2000) 1743265.20 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 04/12/2020
R.L.: 12.30m	DRILL METHOD: HA+DCP	HOLE FINISHED: 04/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL														ENGINEERING DESCRIPTION													
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION														Description and Additional Observations													
WATER														SHEAR STRENGTH (kPa)													
CORE RECOVERY (%)														STRENGTH/DENSITY CLASSIFICATION													
METHOD														WEATHERING / MOISTURE CONDITION													
SCALA PENETROMETER (Blows/50mm)														GRAPHIC LOG													
TESTS														SAMPLES													
0 2 4 6 8 10 12 14 16 18														RL (m) DEPTH (m)													
Topsoil														Sandy SILT, trace organics; brown. Firm, dry to moist, low plasticity; sand, fine; organics, rootlets.													
Fill														Sandy SILT, trace organics; light brown and orange brown. Very stiff, dry to moist, low plasticity; sand, fine; organics, rootlets.													
Tauranga Group														Sandy SILT, trace organics and clay; grey-brown mottled orange speckled white and black. Stiff, moist, low plasticity; sand, fine; organics, rootlets.													
Box 1, 0.0-3.0m														Box 2, 3.0-5.0m													

COMMENTS:

Hole Depth
6.85m

Scale 1:25

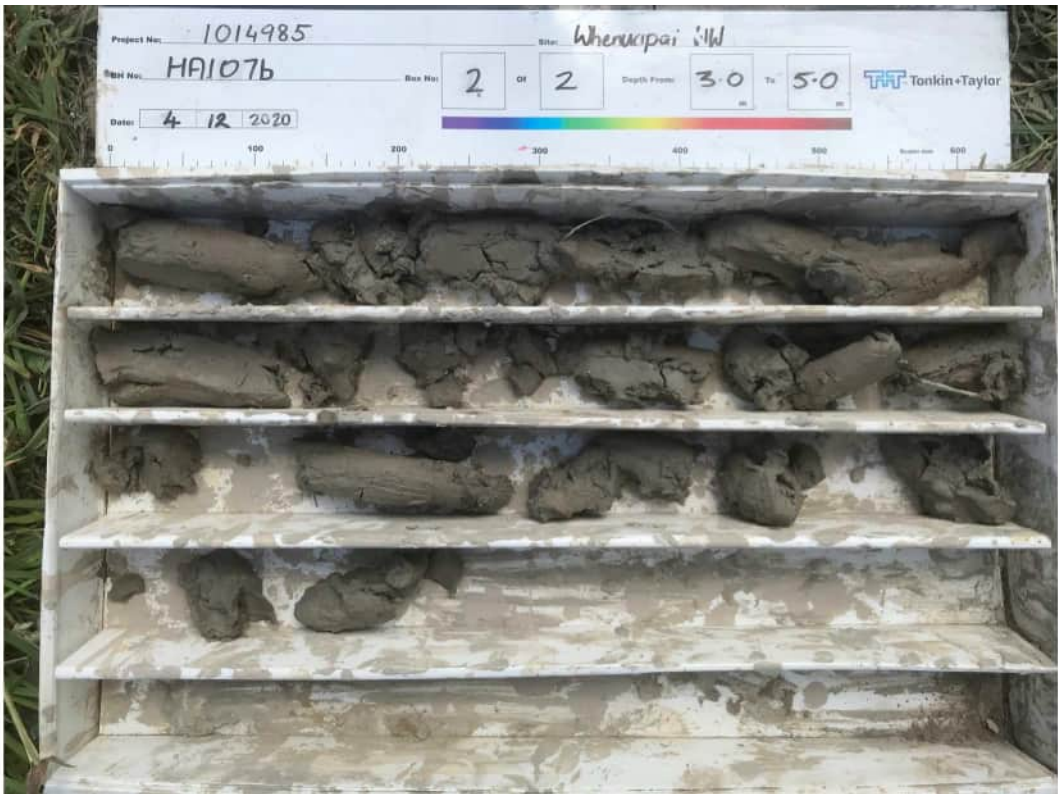
Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926922.30 mN 1743265.20 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 04/12/2020
R.L.:	12.30m	DRILL METHOD: HA+DCP	HOLE FINISHED: 04/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HAND AUGER LOG

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926898.60 mN (NZTM2000) 1743173.50 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.: 11.50m		DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA109**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926901.80 mN (NZTM2000) 1743136.40 mE				DRILL TYPE: 75 and 50mm handauger				HOLE STARTED: 03/12/2020							
R.L.: 11.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil						asb/gl/split @ 0.00m				TS	D-M			SILT; light brown. Dry to moist, non-plastic.	
						● 122/21 kPa asb/gl @ 0.40m		0.5		M	VSt		SILT; yellowish brown. Very stiff, moist, non-plastic.		
Tauranga Group		03/12/2020 inflow 1.5m W/L+2hrs				● 76/15 kPa						St		SILT, some clay; light brown mottled yellowish brown. Very stiff, moist; low to no plasticity.	
						● 76/8 kPa		1.0				F		Silty CLAY; light brown mottled yellowish brown. Firm, moist, high plasticity.	
						asb/gl @ 0.90m									
						● 29/16 kPa									
						● 48/19 kPa		1.5						Clayey SILT; light brown. Firm, moist, low plasticity.	
						att/psd @ 1.40m									
						● 32/8 kPa		2.0						Silty CLAY; light brown mottled yellowish brown. Firm, moist, medium plasticity.	
						asb/gl @ 1.70m									
						● 40/21 kPa					W			Clayey SILT; light grey. Firm, wet, low plasticity.	
						● 24/13 kPa		2.5		M	S			Silty CLAY; light brownish grey. Soft, moist, high plasticity.	
						att/psd @ 2.45m				S				Sandy SILT; grey. Soft, saturated, non-plastic.	
						● 24/13 kPa									
						asb/gl @ 2.70m				W	F			Clayey SILT; grey. Firm, wet, medium plasticity.	
						● 27/16 kPa		3.0							
						● 62/24 kPa					F-St			Clayey sandy SILT; grey. Firm to stiff, wet, low plasticity.	
						● 32/20 kPa		3.5			F			Silty CLAY; light grey. Firm, wet, medium plasticity.	
						asb/gl @ 3.70m								Clayey SILT; light grey. Firm, wet, medium plasticity.	
						● 32/16 kPa		4.0							
● 37/15 kPa															
● 36/20 kPa		4.5						Clayey sandy SILT; light grey. Firm, wet, low plasticity.							
● 32/17 kPa						F-St		Clayey SILT; light grey. Firm to stiff, moist, medium plasticity; sandy layers at 4.8m and 5m.							
asb/gl @															

COMMENTS: 26 Brigham Ck Rd

Hole Depth
7.25m

Scale 1:25

CORE PHOTOS

BOREHOLE No.: **HA109**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926901.80 mN 1743136.40 mE	DRILL TYPE: 75 and 50mm handauger	HOLE STARTED: 03/12/2020
R.L.:	11.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

HOLE Id: **HA110a**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926999.30 mN (NZTM2000) 1743387.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.: 14.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL														ENGINEERING DESCRIPTION																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION,	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)														TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
				0	2	4	6	8	10	12	14	16	18																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
Fill	100	HA																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					

COMMENTS:

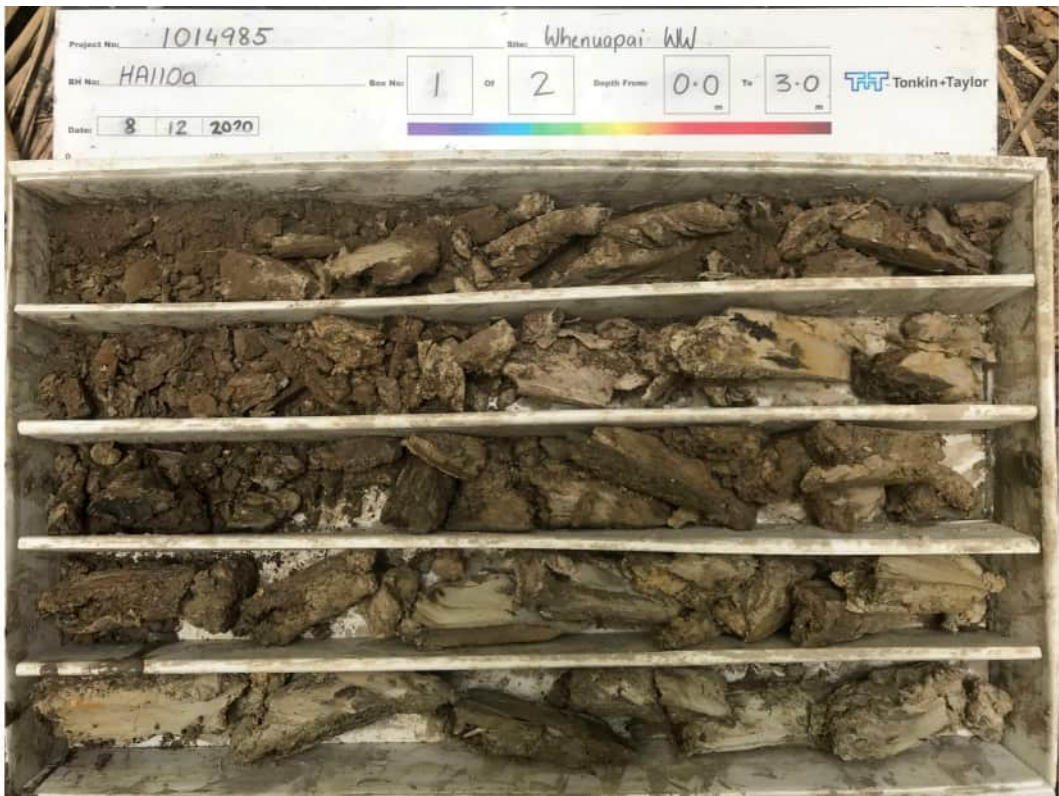
Hole Depth
6.85m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926999.30 mN 1743387.70 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.:	14.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: HA110b

SHEET: 1 OF 2

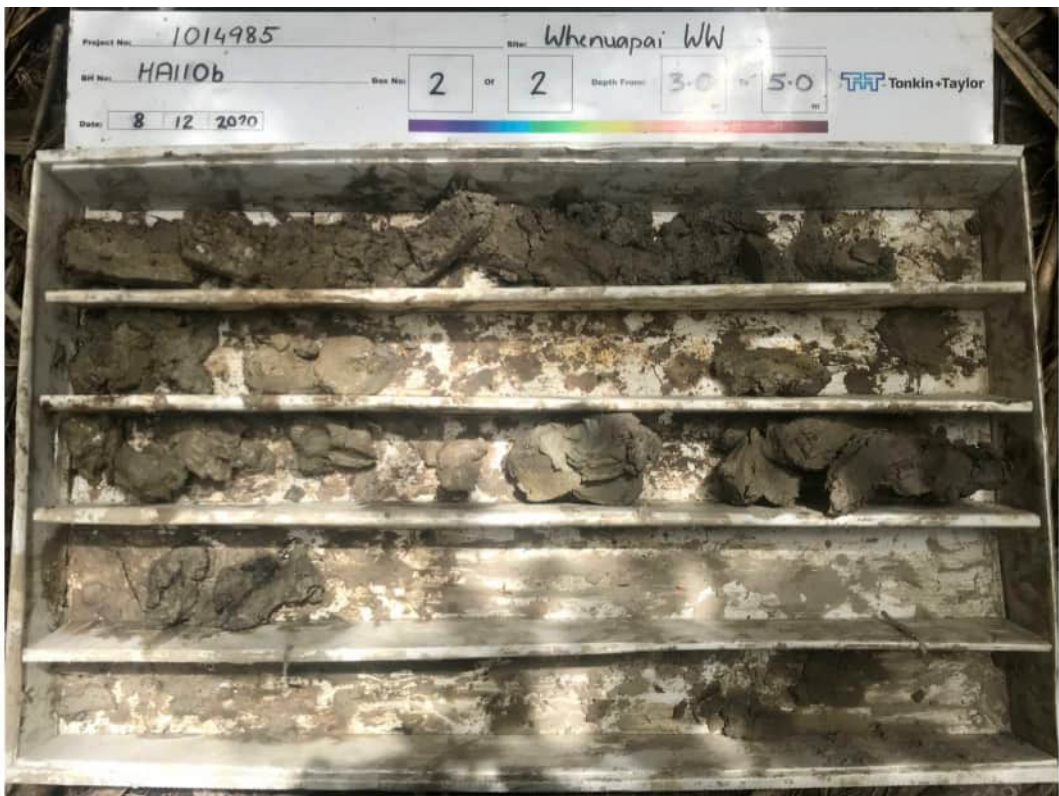
PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000																				
CO-ORDINATES: (NZTM2000)		5926965.40 mN 1743376.70 mE		DRILL TYPE: 50 mm Hand auger				HOLE STARTED: 08/12/2020																				
R.L.:		14.70m		DRILL METHOD: HA+DCP				HOLE FINISHED: 08/12/2020																				
DATUM:		NZVD2016						DRILLED BY: Tonkin + Taylor Ltd																				
								LOGGED BY: ROM				CHECKED: CBM																
GEOLOGICAL										ENGINEERING DESCRIPTION																		
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)				TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations											
Fill		08/12/2020	100	HA+DCP	0 2 4 6 8 10 12 14 16 18				Env/asb @ 0.10m					M	MD		Silty, fine SAND, minor gravel, trace organics; brown. Tightly packed, moist, poorly graded; organics, rootlets.											
					● UTP Env/asb @ 0.50m PID, 0.0ppm @ 0.51m Corrosivity @ 0.60m		14	0.5			St		Sandy SILT, minor gravel, trace organics; light grey-brown. Stiff, moist, low plasticity; organics, rootlets.															
					● UTP Env/asb @ 1.00m PID, 0.0ppm @ 1.01m			1.0			VSt		Silty CLAY, minor sand and gravel, trace organics; brown, mottled orange and dark brown. Very stiff, moist, high plasticity; sand, fine; gravel, fine to medium, sub-angular, sandstone; organics, rootlets.															
					● 79/25 kPa			1.5																				
					● 65/34 kPa Env/asb @ 2.00m			2.0			St		Grades to: SILT, some sand, minor clay, trace organics; brown and grey. Stiff, moist, medium plasticity; sand, fine; organics, rootlets.															
					● 93/37 kPa		12	2.5																				
					Corrosivity @ 2.90m			3.0					Sandy SILT, minor organics; brown, speckled black and white, mottled orange. Stiff, moist, low plasticity; sand, fine to medium; organics, rootlets.															
					att/psd @ 3.35m			3.5		W	L-MD		Silty, fine to coarse SAND, trace gravel and organics; grey, speckled white. Loosely packed, wet, poorly graded; gravel, fine, sub-angular, mudstone; organics, rootlets.															
							11	4.0																				
								4.5		M	St		Sandy SILT, minor organics; brown, speckled black and white, mottled orange. Stiff, moist, low plasticity; sand, fine to medium; organics, rootlets.															
Tauranga Group					13 12 11 10 9 8 7 6 5 4 3 2 1												Organic SILT; brown. Firm, moist, low plasticity.											
COMMENTS:																												
Hole Depth 6.95m																												
Box 1, 0.0-3.0m																												
Box 2, 3.0-6.0m																												

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926965.40 mN (NZTM2000) 1743376.70 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 08/12/2020
R.L.: 14.70m		DRILL METHOD: HA+DCP	HOLE FINISHED: 08/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

CORE PHOTOS

BOREHOLE No.: HA111

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5927039.30 mN 1743395.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 07/12/2020
R.L.:	14.40m	DRILL METHOD: HA+DCP	HOLE FINISHED: 07/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-3.10m

CORE PHOTOS

BOREHOLE No.: **HA112**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926554.90 mN 1743164.20 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	9.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-2.00m

HAND AUGER LOG

HOLE Id: HA113

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000									
CO-ORDINATES: 5926630.20 mN (NZTM2000) 1743032.10 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020											
R.L.: 7.90m		DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020											
DATUM: NZVD2016						DRILLED BY: GEOTECHNICS		LOGGED BY: RBE		CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)		TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations		
Topsoil		02/12/2020 Water info/level on completion			0 2 4 6 8 10 12 14 16 18		asb/gl/dupC @ 0.00m				TS	M			SILT; brown with yellowish brown inclusions. Very stiff, moist, non-plastic.		
													VSt		SILT; dark brown. Very stiff, moist, non-plastic.		
															SILT, some clay; light brown. Very stiff, moist; low to no plasticity.		
															St-VSt		Clayey SILT; light brown. Stiff to very stiff, moist; low to medium plasticity.
Tauranga Group							● 161/21 kPa asb/gl @ 0.40m PID, 0.0ppm @ 0.50m ● 150/37 kPa			0.5						Sandy SILT; light brown mottled orange brown. Stiff, moist, non-plastic; sand, fine.	
							● 96/32 kPa asb/gl @ 0.90m PID, 0.4ppm @ 1.00m ● 66/21 kPa			1.0						Silty SAND; brown, grey from 2.2m. Saturated, non-plastic.	
							● 54/16 kPa att/psd @ 1.45m ● 88/24 kPa asb/gl @ 1.90m ● 114/13 kPa			1.5						2.4m: Scala (blows per 50mm): 4.5, 4.5, 12, 26, bouncing Over augered, solid refusal at 2.6m	
							att/psd @ 2.45m			2.0						2.6m: Refusal	
										2.5							
										3.0							
										3.5							
										4.0							
										4.5							
										5.0							

COMMENTS: Brigham Creek Road. ECBF outcrop in nearby creek bed.

Hole Depth
2.6m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926630.20 mN (NZTM2000) 1743032.10 mE		DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 7.90m		DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016			DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-2.60m

HAND AUGER LOG

HOLE Id: HA114

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926872.80 mN (NZTM2000) 1743108.40 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Fill						Dup D, Asb/gl @ 0.00m					D			Gravelly SILT; brown. Dry, non-plastic; (farm track).	
Topsoil						● 184/32 kPa asb/gl @ 0.40m					M	VSt		SILT; greyish brown. Very stiff, moist, non-plastic.	
Tauranga Group		03/12/2020 inflow 2.5m, w/l after 4hrs				● 186/29 kPa			0.5					SILT; light brown. Very stiff, moist, non-plastic.	
						● 109/33 kPa asb/gl @ 0.90m		10	1.0		St-VSt		Clayey SILT; light grey mottled yellowish brown. Stiff to very stiff, moist, low plasticity.		
						● 104/42 kPa						1.0m: medium plasticity 1.2m: low plasticity			
						● 56/27 kPa att/psd @ 1.45m		1.5		F		Silty CLAY; light greyish brown. Firm, moist, high plasticity.			
						● 40/24 kPa asb/gl @ 1.90m		2.0		W		SILT; light brown. Firm, wet, non-plastic.			
						● 41/27 kPa				M		Clayey SILT; light brown mottled orange brown. Firm, moist, medium plasticity.			
						● 42/21 kPa		2.5							
						● 61/16 kPa asb/gl @ 2.70m		3.0		F-St		Sandy SILT; light brown. Stiff to firm, moist, non-plastic.			
						● 56/15 kPa						3.0m: grey			
						● 37/16 kPa att/psd @ 3.45m		3.5		M-W	F	Silty CLAY; light greyish brown. Firm, moist to wet, high plasticity; difficult to recover.			
						● 40/9 kPa asb/gl @ 3.70m									
						● 27/11 kPa		7	4.0						
						● 27/11 kPa									
						● 49/24 kPa			4.5				Clayey SILT; greyish brown. Firm to stiff, moist, low plasticity.		
						● 37/20 kPa asb/gl @				M	F-St				

COMMENTS: 26 Brigham Ck Rd

Hole Depth
7.25m

Scale 1:25

HAND AUGER LOG

HOLE Id: HA114

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926872.80 mN (NZTM2000) 1743108.40 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.00m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/100mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	MOISTURE CONDITION	WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
Tauranga Group					0 2 4 6 8 10 12 14 16 18	4.70m ● 50/11 kPa									[CONT] Clayey SILT; greyish brown. Firm to stiff, moist, low plasticity.
					0 1 1 1 1 2 2 2 2 2 3 3 3 3 4 3 2 3 2 3 2 3 2 3 3 3 3 4 4 4 4				5.5 6.0 6.5 7.0						End of hand auger 5.2 m Scala (blows per 50 mm) 0,0,0,0,1,0,1,1,1,1,2,2,2,2,2,2 3,3,3,4,3,3,2,3,2,3,2,3,2,2,2,3 3,3,4,4,4,4,
									7.5 8.0 8.5 9.0 9.5						7.25m: Target depth
COMMENTS: 26 Brigham Ck Rd															
HandAugerLog - 23/12/2020 8:00:13 AM - Produced with Core-GS by GeRoc Hole Depth 7.25m Scale 1:25															

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926872.80 mN 1743108.40 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.:	11.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-5.20m

HAND AUGER LOG

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926794.20 mN 1743054.00 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 03/12/2020
R.L.:	9.90m	DRILL METHOD: HA+DCP	HOLE FINISHED: 03/12/2020
DATUM:	NZVD2016	LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA116**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926675.90 mN (NZTM2000) 1743047.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020							
R.L.: 8.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil		02/12/2020 level on completion				asb/gl/split @ 0.00m				TS	M			SILT; dark brown. Moist, non-plastic.	
Tauranga Group								● 86/27 kPa asb/gl @ 0.40m PID, 0.5ppm @ 0.50m ● 72/7 kPa		0.5		M-W	F-St		Clayey SILT; greyish brown. Stiff to firm, moist, medium plasticity.
							8		1.0				1.0m: wet to saturated		
								● 49/12 kPa asb/gl @ 0.90m PID, 1.0ppm @ 1.00m ● 58/5 kPa		1.5					
							7		2.0						
East Coast Bays Formation						● 80/19 kPa att/psd @ 1.45m ● 73/24 kPa asb/gl @ 1.90m ● 66/20 kPa				W	St-VSt		Sandy SILT; brown and orange brown; grey from 2.3m. Stiff to very stiff, wet, non-plastic.		
Box 1, 0.0-3.4m						● >186 kPa			2.5					Clayey SILT; grey. Very stiff, moist, low plasticity.	
					● UTP		6			M	VSt				
					att/psd @ 2.95m			S					Silty SAND; grey. Saturated; well packed.		
									3.0					2.95m: Scala (blows per 50mm) 7,7,7,8,11,16,18,23 then bouncing Over augered, solid refusal at 3.35m	
									3.5					3.35m: Refusal	
									4						
									5						
									4.0						
									4.5						

COMMENTS: Brigham Creek

Hole Depth
3.35m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926675.90 mN 1743047.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	8.80m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-3.35m

HAND AUGER LOG

HOLE Id: HA117

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 10.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL					ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Fill				0 2 4 6 8 10 12 14 16 18	Env/asb @ 0.10m					D	St		Sandy SILT, trace organics; light brown mottled orange and brown. Stiff, dry, low plasticity; sand, fine; organics, rootlets..	
													Silty CLAY, minor sand, trace organics & insulation fibres; light brown mottled orange. Very stiff, moist, high plasticity; sand, fine; organics, rootlets.	
					● 152/19 kPa Env/asb @ 0.50m PID 0.8ppm @ 0.51m			0.5		M	VSt			
					● 137/16 kPa Env/asb @ 1.00m PID 6.0ppm @ 1.01m			1.0		D-M	M		Sandy SILT, trace organics; dark brown and light brown mottled orange. Very stiff, dry to moist, low plasticity; sand, fine; organics, rootlets.	
													Silty CLAY, trace organics; light brown mottled orange. Very stiff, moist, high plasticity; organics, rootlets.	
					● 112/25 kPa			1.5						
					● 186/76 kPa Env/corrosiv ity @ 2.00m			2.0						
					● 218/81 kPa			2.5			VSt-H		Silty CLAY, some sand, minor organics; brown spotted black, speckled white and orange. Very stiff, moist, high plasticity; sand, fine; organics, carbonaceous.	
													Sandy SILT; grey and brown speckled orange. Very stiff to hard, moist, low plasticity; sand, fine.	
Tauranga Group					att/psd @ 2.70m			3.0						
													SILT, some clay and sand, trace peat (spongy); brown mottled orange, streaked black. Very stiff, moist, low plasticity; sand, fine.	
					● 171/48 kPa			3.5			VSt		3.6m: Grey mottled orange	
					● 156/75 kPa			4.0					Sandy SILT, trace organics; light brown mottled orange, streaked black. Very stiff, moist, low plasticity; sand, fine; carbonaceous & decomposed wood.	
					● 199/75 kPa			4.5						
													Silty SAND, trace organics; grey streaked black and brown. Moist, poorly graded; sand, fine, tightly packed; carbonaceous & decomposed wood.	
					● 209/72 kPa									
					● 184/73 kPa						D			

COMMENTS:

Hole Depth
6.3m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 10.00m		DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA119**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926938.00 mN (NZTM2000) 1743195.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.40m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
					0 2 4 6 8 10 12 14 16 18										
Topsoil						Dup E/ash/gl @ 0.00m				TS	D			SILT; light brown. Dry, non-plastic.	
Tauranga Group		03/12/2020 inflow 1.6m, W/L after 45mins				● 125/4 kPa ash/gl @ 0.40m		11	0.5		M	VSt		Clayey SILT; light brown. Very stiff, moist, low plasticity.	
						● 81/32 kPa						St		Silty CLAY; light brown mottled yellowish brown. Stiff, moist, medium plasticity.	
						● 74/21 kPa ash/gl @ 0.90m			1.0					1.1m: sandy layer	
						● 56/19 kPa								Clayey SILT; light brown mottled yellowish brown. Stiff, moist, low plasticity.	
						● 58/19 kPa att/psd @ 1.45m		10	1.5		S	F-St		Sandy SILT; brown mottled yellowish brown. Firm to stiff, saturated, non-plastic.	
						● 60/11 kPa ash/gl @ 1.90m			2.0						
						● 42/19 kPa					W	S-F		Clayey SILT; grey. Soft to firm, wet, medium plasticity.	
						● 66/16 kPa att/psd @ 2.45m		9	2.5						
						● 23/8 kPa ash/gl @ 2.70m									
						● 29/11 kPa			3.0						
						● 48/20 kPa		8	3.5		F		Clayey sandy SILT; grey. Firm, wet, low plasticity.		
						● 50/20 kPa ash/gl @ 3.70m									
						● 56/19 kPa			4.0		M	St	Clayey SILT; grey. Stiff, moist, medium plasticity.		
						● 61/32 kPa					W		Clayey sandy SILT; light grey. Stiff, moist, low plasticity.		
						● 25/11 kPa		7	4.5		M	F-St	Sandy SILT; grey. Stiff, wet, non-plastic.		
						● 32/19 kPa ash/gl @							Clayey SILT; grey. Firm to stiff, moist, medium plasticity.		
COMMENTS: 26 Brigham Ck Rd. No core photograph, the soil is very similar to HA109															
Hole Depth 7.25m															

COMMENTS: 26 Brigham Ck Rd. No core photograph, the soil is very similar to HA109

Hole Depth
7.25m

Scale 1:25

Rev.: A

HAND AUGER LOG

HOLE Id: **HA119**

SHEET: 2 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES:		5926938.00 mN (NZTM2000) 1743195.90 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.:		11.40m		DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE		CHECKED: CBM					
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Tauranga Group					0 2 4 6 8 10 12 14 16 18	4.70m ● 54/13 kPa								[CONT] Clayey SILT; grey. Firm to stiff, moist, medium plasticity. 5.1m: some sand, minor organics	
					0 0 0 0 1 1 1 1 1 1 13 3 2 13 3 4 2 3 2 13 2 3 13 13 3 13 13 4 4 6 6 6 7 6 6 5 5 6 7			6 5.5 6.0 6.5 7.0					end of handauger 5.2m Scala (blows per 100mm) 0,0,2,2,2,6,5,7,5,5, 5,6,6,6,8,12,13,12,10,13		
								4 7.5 8.0 8.5 9.0 9.5						7.25m: Target depth	

COMMENTS: 26 Brigham Ck Rd. No core photograph, the soil is very similar to HA109

Hole Depth
7.25m
Scale 1:25

HAND AUGER LOG

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926554.90 mN 1743164.20 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	9.60m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
			LOGGED BY: ROM CHECKED: CBM



0.00-2.00m

HAND AUGER LOG

HOLE Id: HA113

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000											
CO-ORDINATES:		5926630.20 mN (NZTM2000) 1743032.10 mE		DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020											
R.L.:		7.90m		DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020											
DATUM:		NZVD2016						DRILLED BY: GEOTECHNICS											
								LOGGED BY: RBE		CHECKED: CBM									
GEOLOGICAL										ENGINEERING DESCRIPTION									
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.										Description and Additional Observations									
WATER										SHEAR STRENGTH (kPa)									
CORE RECOVERY (%)										STRENGTH/DENSITY CLASSIFICATION									
METHOD										WEATHERING									
SCALA PENETROMETER (Blows/50mm)										MOISTURE CONDITION									
TESTS										GRAPHIC LOG									
SAMPLES										STRENGTH/DENSITY CLASSIFICATION									
RL (m)										SHEAR STRENGTH (kPa)									
DEPTH (m)										STRENGTH/DENSITY CLASSIFICATION									
Topsoil										SILT; brown with yellowish brown inclusions. Very stiff, moist, non-plastic.									
Tauranga Group										SILT; dark brown. Very stiff, moist, non-plastic.									
East Coast Bays Formation										SILT, some clay; light brown. Very stiff, moist; low to no plasticity.									
										Clayey SILT; light brown. Stiff to very stiff, moist; low to medium plasticity.									
										1.1m: medium plasticity									
										Sandy SILT; light brown mottled orange brown. Stiff, moist, non-plastic; sand, fine.									
										Silty SAND; brown, grey from 2.2m. Saturated, non-plastic.									
										2.4m: Scala (blows per 50mm): 4.5, 4.5, 12, 26, bouncing Over augered, solid refusal at 2.6m									
										2.6m: Refusal									

COMMENTS: Brigham Creek Road. ECBF outcrop in nearby creek bed.

Hole Depth
2.6m

Scale 1:25

Rev.: A

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926630.20 mN (NZTM2000) 1743032.10 mE		DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 7.90m		DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016			DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-2.60m

HAND AUGER LOG

HOLE Id: **HA116**

SHEET: 1 OF 1

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926675.90 mN (NZTM2000) 1743047.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 02/12/2020							
R.L.: 8.80m				DRILL METHOD: HA+DCP				HOLE FINISHED: 02/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION.		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil		02/12/2020 level on completion			0 2 4 6 8 10 12 14 16 18	asb/gl/split @ 0.00m				TS	M			SILT; dark brown. Moist, non-plastic.	
						● 86/27 kPa asb/gl @ 0.40m PID, 0.5ppm @ 0.50m ● 72/7 kPa		0.5			M-W	F-St		Clayey SILT; greyish brown. Stiff to firm, moist, medium plasticity.	
						● 49/12 kPa asb/gl @ 0.90m PID, 1.0ppm @ 1.00m ● 58/5 kPa		1.0						1.0m: wet to saturated	
						● 80/19 kPa att/psd @ 1.45m ● 73/24 kPa asb/gl @ 1.90m ● 66/20 kPa		1.5							
								2.0							
East Coast Bays Formation						● >186 kPa			2.5		W	St-VSt		Sandy SILT; brown and orange brown; grey from 2.3m. Stiff to very stiff, wet, non-plastic.	
						● UTP									
									3.0		M S	VSt		Clayey SILT; grey. Very stiff, moist, low plasticity.	
						att/psd @ 2.95m								Silty SAND; grey. Saturated; well packed.	
						</									

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: (NZTM2000)	5926675.90 mN 1743047.90 mE	DRILL TYPE: 75 and 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.:	8.80m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM:	NZVD2016		DRILLED BY: GEOTECHNICS
			LOGGED BY: RBE CHECKED: CBM



0.00-3.35m

HAND AUGER LOG

HOLE Id: **HA117**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI	LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE	DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 10.00m	DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016		DRILLED BY: Tonkin + Taylor Ltd
		LOGGED BY: ROM CHECKED: CBM

GEOLOGICAL										ENGINEERING DESCRIPTION																
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION	WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)														TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations
				0	2	4	6	8	10	12	14	16	18													
Fill																		Env/asb @ 0.10m				D	St		Sandy SILT, trace organics; light brown mottled orange and brown. Stiff, dry, low plasticity; sand, fine; organics, rootlets..	
																		● 152/19 kPa Env/asb @ 0.50m PID 0.8ppm @ 0.51m		0.5		M	VSt		Silty CLAY, minor sand, trace organics & insulation fibres; light brown mottled orange. Very stiff, moist, high plasticity; sand, fine; organics, rootlets.	
Tauranga Group		100	HA+DCP															● 137/16 kPa Env/asb @ 1.00m PID 6.0ppm @ 1.01m		1.0		D-M			Sandy SILT, trace organics; dark brown and light brown mottled orange. Very stiff, dry to moist, low plasticity; sand, fine; organics, rootlets.	
																		● 112/25 kPa		1.5		M			Silty CLAY, trace organics; light brown mottled orange. Very stiff, moist, high plasticity; organics, rootlets.	
																		● 186/76 kPa Env/corrosiv ity @ 2.00m		2.0						
																		● 218/81 kPa		2.5		VSt-H		Silty CLAY, some sand, minor organics; brown spotted black, speckled white and orange. Very stiff, moist, high plasticity; sand, fine; organics, carbonaceous.		
																		att/psd @ 2.70m							Sandy SILT; grey and brown speckled orange. Very stiff to hard, moist, low plasticity; sand, fine.	
																		● 171/48 kPa		3.0						
																		● 156/75 kPa		3.5					3.6m: Grey mottled orange	
																		● 199/75 kPa		4.0		VSt		SILT, some clay and sand, trace peat (spongy); brown mottled orange, streaked black. Very stiff, moist, low plasticity; sand, fine.		
																		● 209/72 kPa		4.5						
																		● 184/73 kPa				D		Silty SAND, trace organics; grey streaked black and brown. Moist, poorly graded; sand, fine, tightly packed; carbonaceous & decomposed wood.		

COMMENTS:

Hole Depth
6.3m

Scale 1:25

CORE PHOTOS

PROJECT: Watercare Whenuapai-Redhill GI		LOCATION: Whenuapai	JOB No.: 1014985.0000
CO-ORDINATES: 5926564.40 mN (NZTM2000) 1743138.40 mE		DRILL TYPE: 50 mm Hand auger	HOLE STARTED: 02/12/2020
R.L.: 10.00m		DRILL METHOD: HA+DCP	HOLE FINISHED: 02/12/2020
DATUM: NZVD2016		LOGGED BY: ROM	CHECKED: CBM



0.00-3.00m



3.00-5.00m

HAND AUGER LOG

HOLE Id: **HA119**

SHEET: 1 OF 2

PROJECT: Watercare Whenuapai-Redhill GI				LOCATION: Whenuapai				JOB No.: 1014985.0000							
CO-ORDINATES: 5926938.00 mN (NZTM2000) 1743195.90 mE				DRILL TYPE: 75 and 50 mm Hand auger				HOLE STARTED: 03/12/2020							
R.L.: 11.40m				DRILL METHOD: HA+DCP				HOLE FINISHED: 03/12/2020							
DATUM: NZVD2016								DRILLED BY: GEOTECHNICS							
								LOGGED BY: RBE							
								CHECKED: CBM							
GEOLOGICAL								ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MATERIAL COMPOSITION		WATER	CORE RECOVERY (%)	METHOD	SCALA PENETROMETER (Blows/50mm)	TESTS	SAMPLES	RL (m)	DEPTH (m)	GRAPHIC LOG	WEATHERING MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa)	Description and Additional Observations	
Topsoil		03/12/2020 inflow 1.6m, W/L after 45mins				Dup E/asb/gl @ 0.00m					D			SILT; light brown. Dry, non-plastic.	
Tauranga Group						● 125/4 kPa asb/gl @ 0.40m		11	0.5		M	VSt		Clayey SILT; light brown. Very stiff, moist, low plasticity.	
						● 81/32 kPa						St		Silty CLAY; light brown mottled yellowish brown. Stiff, moist, medium plasticity.	
						● 74/21 kPa asb/gl @ 0.90m			1.0					1.1m: sandy layer	
						● 56/19 kPa								Clayey SILT; light brown mottled yellowish brown. Stiff, moist, low plasticity.	
						● 58/19 kPa att/psd @ 1.45m		10	1.5		S	F-St		Sandy SILT; brown mottled yellowish brown. Firm to stiff, saturated, non-plastic.	
						● 60/11 kPa asb/gl @ 1.90m			2.0						
						● 42/19 kPa									
						● 66/16 kPa att/psd @ 2.45m		9	2.5		W	S-F		Clayey SILT; grey. Soft to firm, wet, medium plasticity.	
						● 23/8 kPa asb/gl @ 2.70m									
						● 29/11 kPa			3.0						
						● 48/20 kPa		8	3.5			F		Clayey sandy SILT; grey. Firm, wet, low plasticity.	
						● 50/20 kPa asb/gl @ 3.70m									
						● 56/19 kPa			4.0		M	St		Clayey SILT; grey. Stiff, moist, medium plasticity.	
						● 61/32 kPa					W			Clayey sandy SILT; light grey. Stiff, moist, low plasticity.	
						● 25/11 kPa		7	4.5		M	F-St		Sandy SILT; grey. Stiff, wet, non-plastic.	
						● 32/19 kPa asb/gl @								Clayey SILT; grey. Firm to stiff, moist, medium plasticity.	
COMMENTS: 26 Brigham Ck Rd. No core photograph, the soil is very similar to HA109															
Hole Depth 7.25m															

Appendix C Groundwater monitoring results

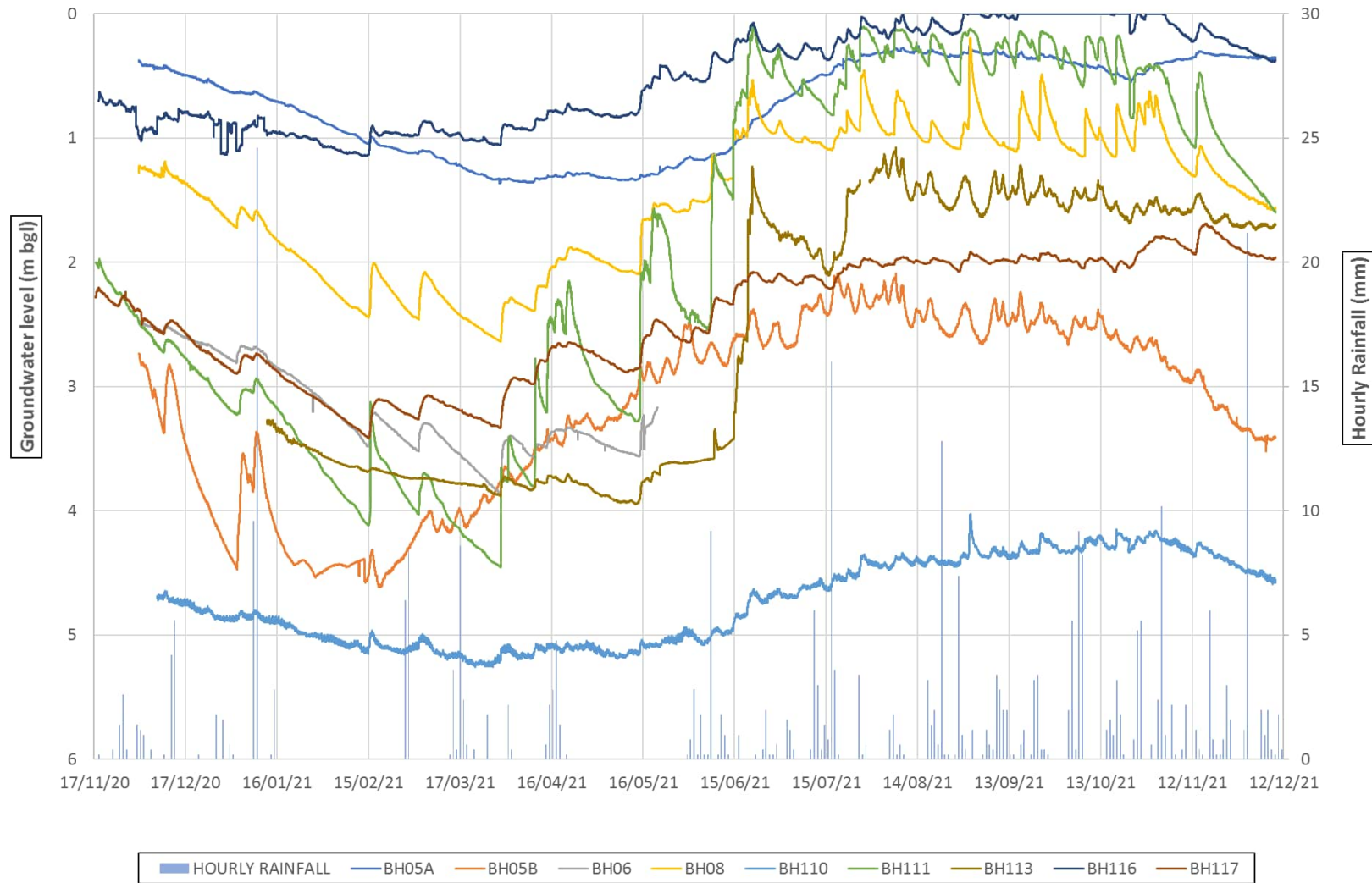


Figure 1.1: Continuous groundwater level monitoring results (m bgl) and rainfall (mm) recorded at the MOTAT gauging site located approx. 13 km southeast of the site.

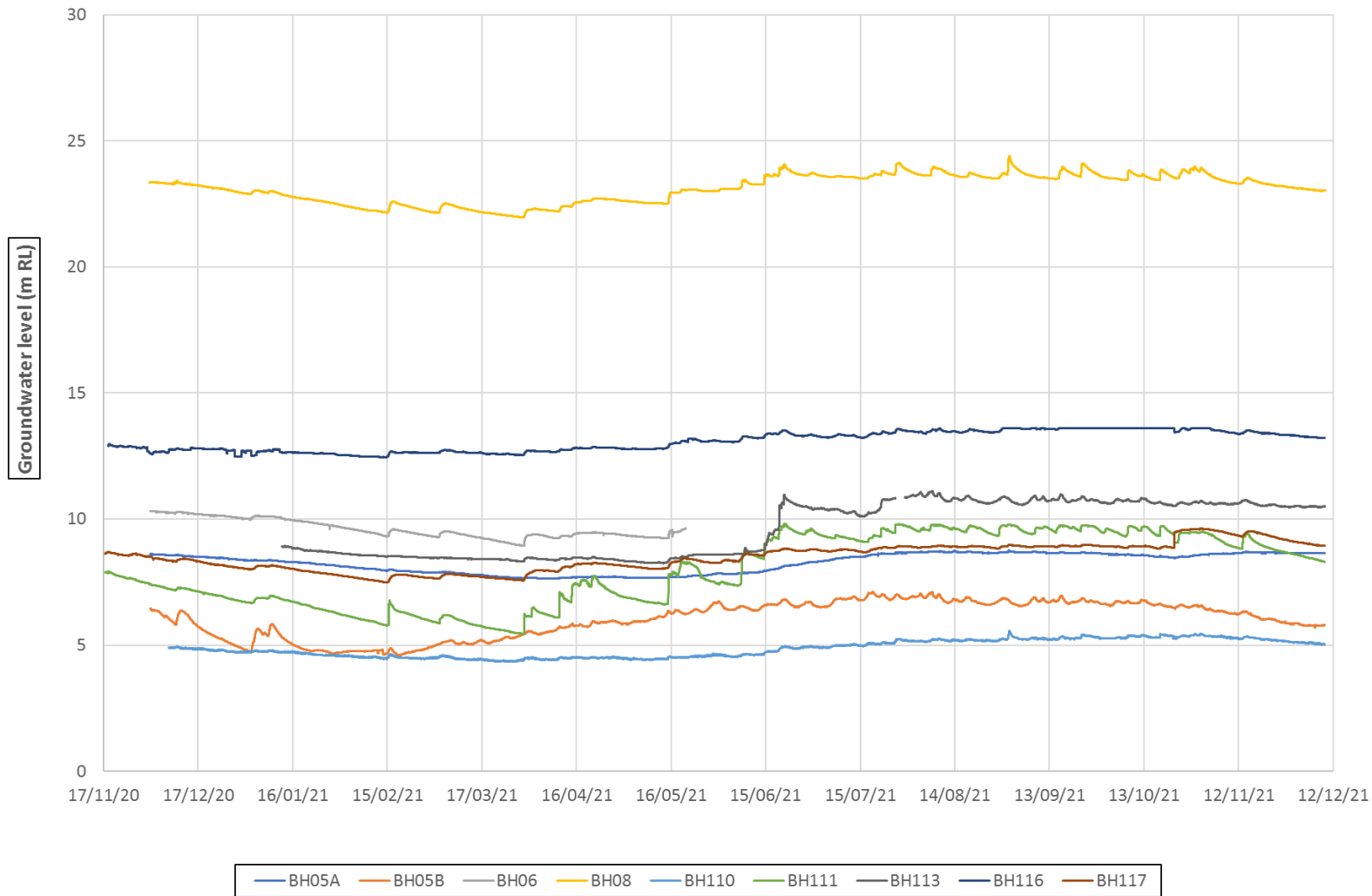


Figure 1.2: Continuous groundwater level monitoring results (m RL).

Appendix D SEEP/W outputs and groundwater induced settlement troughs

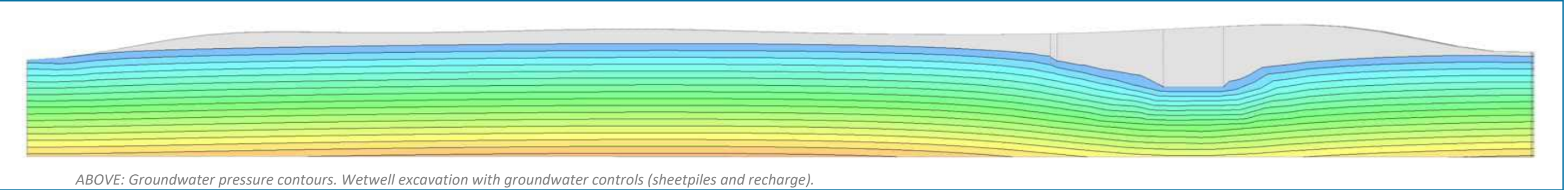
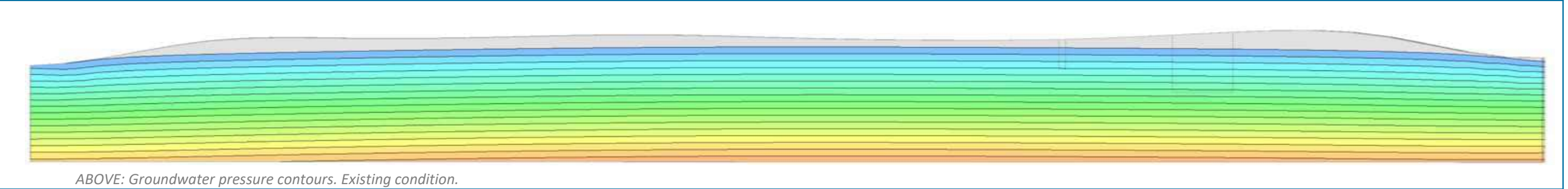
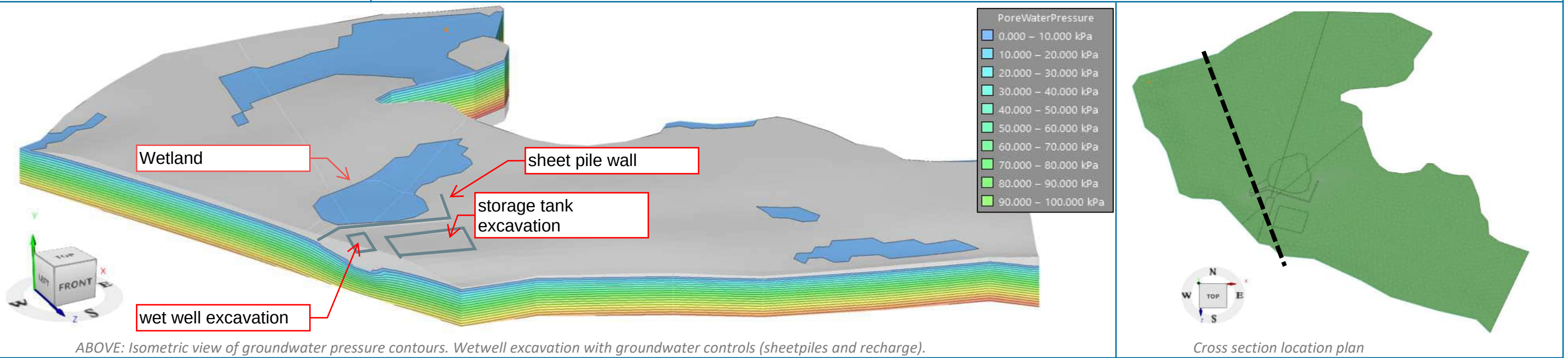
Predicted groundwater pressure contours

Plots of predicted groundwater pressure contours from 3D seepage analysis.

Project:	Whenuapai Redhills		
Job No.:	1013050	Date:	25/08/2023

FIGURE 1

CONDITIONS: WETWELL EXCAVATION. STEADY-STATE.
CROSS SECTION 1



Results

- Inflow rate of approx. 21m3/day into the wet well excavation under steady state.
 - Inflow rate of approx. 23m3/day into the storage tank excavation under steady state.
 - Rechage rate of approx 8m3/day required across the wetland under steady state for both excavations.
- Adopting a kv/kx ratio of 0.1 results in:
 - inflows of approx 15m3/day into either excavation
 - recharge rates of approx. 3 m3/day
 - Adopting a kx=1e-7 m/s and a kv/kx ratio of 0.5 results in:
 - inflows of approx 3m3/day into either excavation
 - recharge rates of less than 1 m3/day

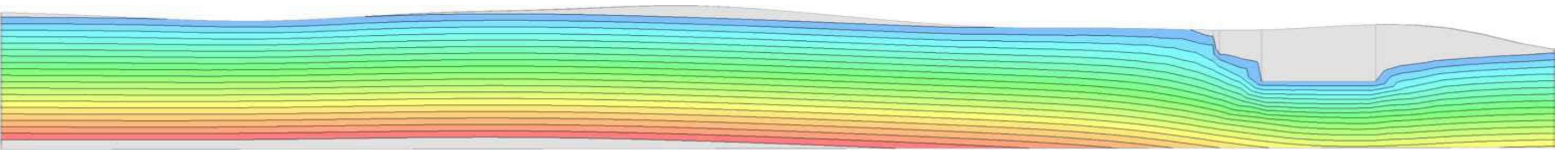
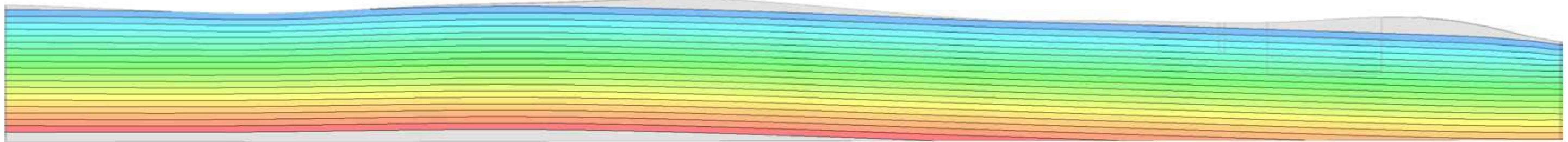
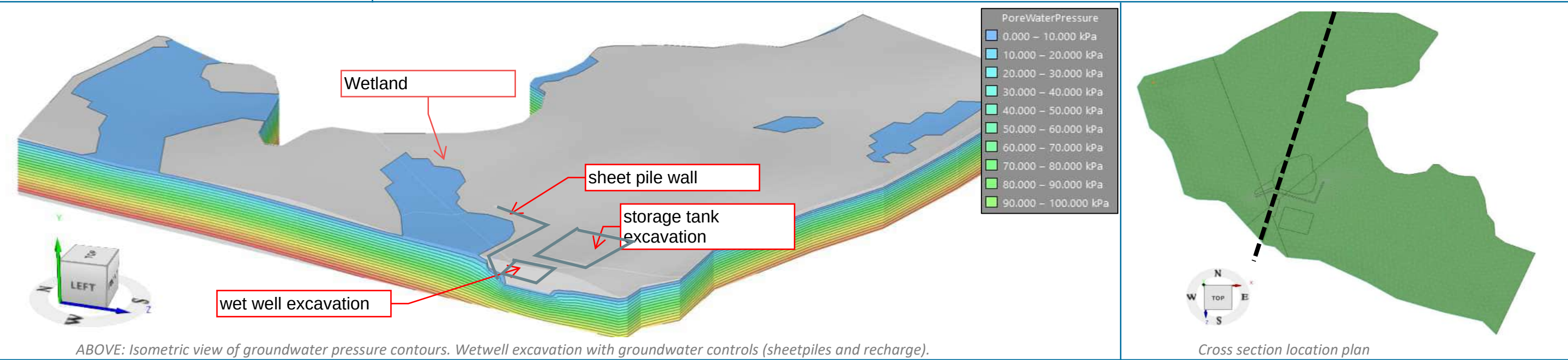
Predicted groundwater pressure contours

Plots of predicted groundwater pressure contours from 3D seepage analysis.

Project:	Whenuapai Redhills		
Job No.:	1013050	Date:	25/08/2023

FIGURE 2

CONDITIONS: WETWELL EXCAVATION. STEADY-STATE.
CROSS SECTION 2

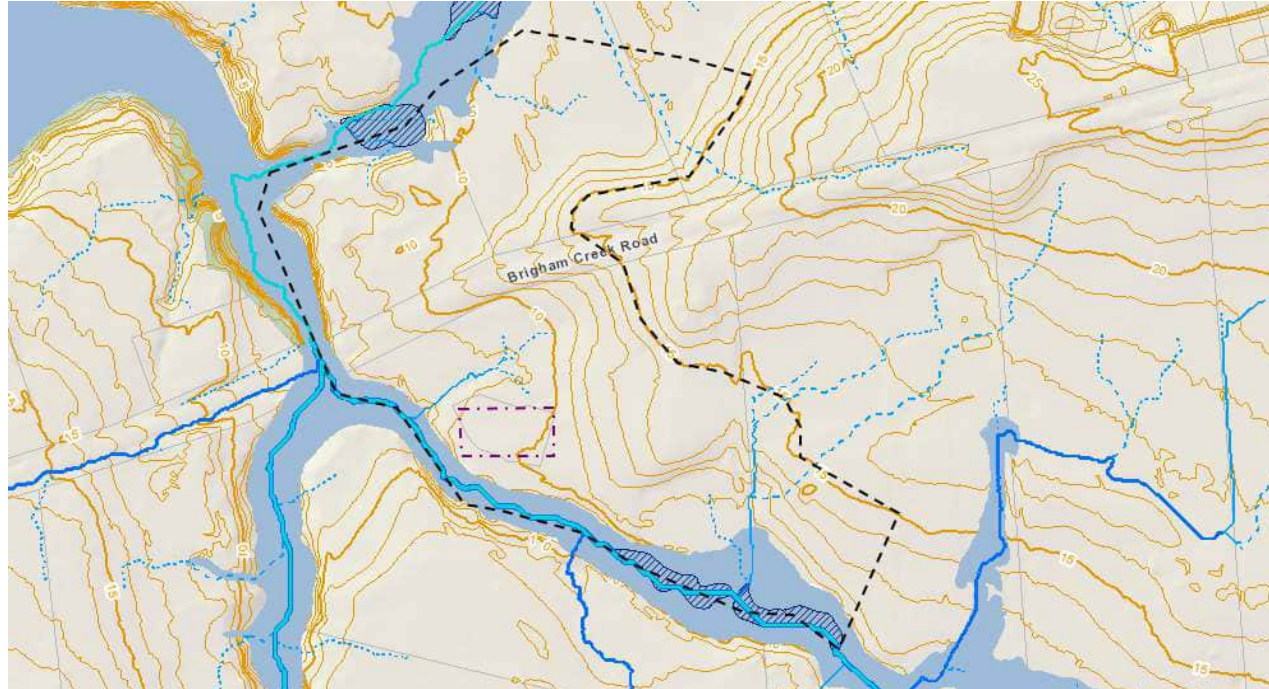


Modelling assumptions

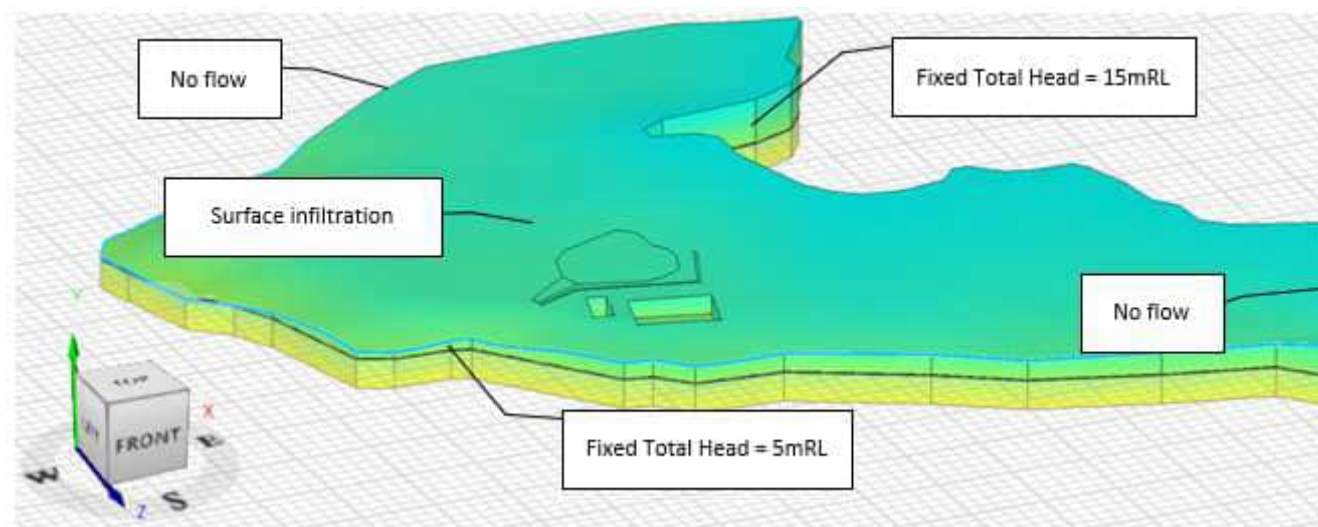
- Recharge modelled as a surface boundary with zero pore water pressure across the wetland region
- Sheet piles are modelled as 1m thick volume elements with $k=4e-11$ m/s (assumed ROXAN Plus or AKILA sealing system as per Arcelor guidance document).
- Soil modelled as $k_x=1e-6$ m/s, $k_v/k_x=0.5$, fully saturated model. Sensitivity checked for an order of magnitude higher and lower
- Rock fractures may yield locally different response
- Hydraulic boundary conditions set to existing known bodies of water and the model calibrated against groundwater monitoring results
- Ground surface recharge (rainfall) modelled as equal to 5% of annual average rainfall.

Modelling assumptions

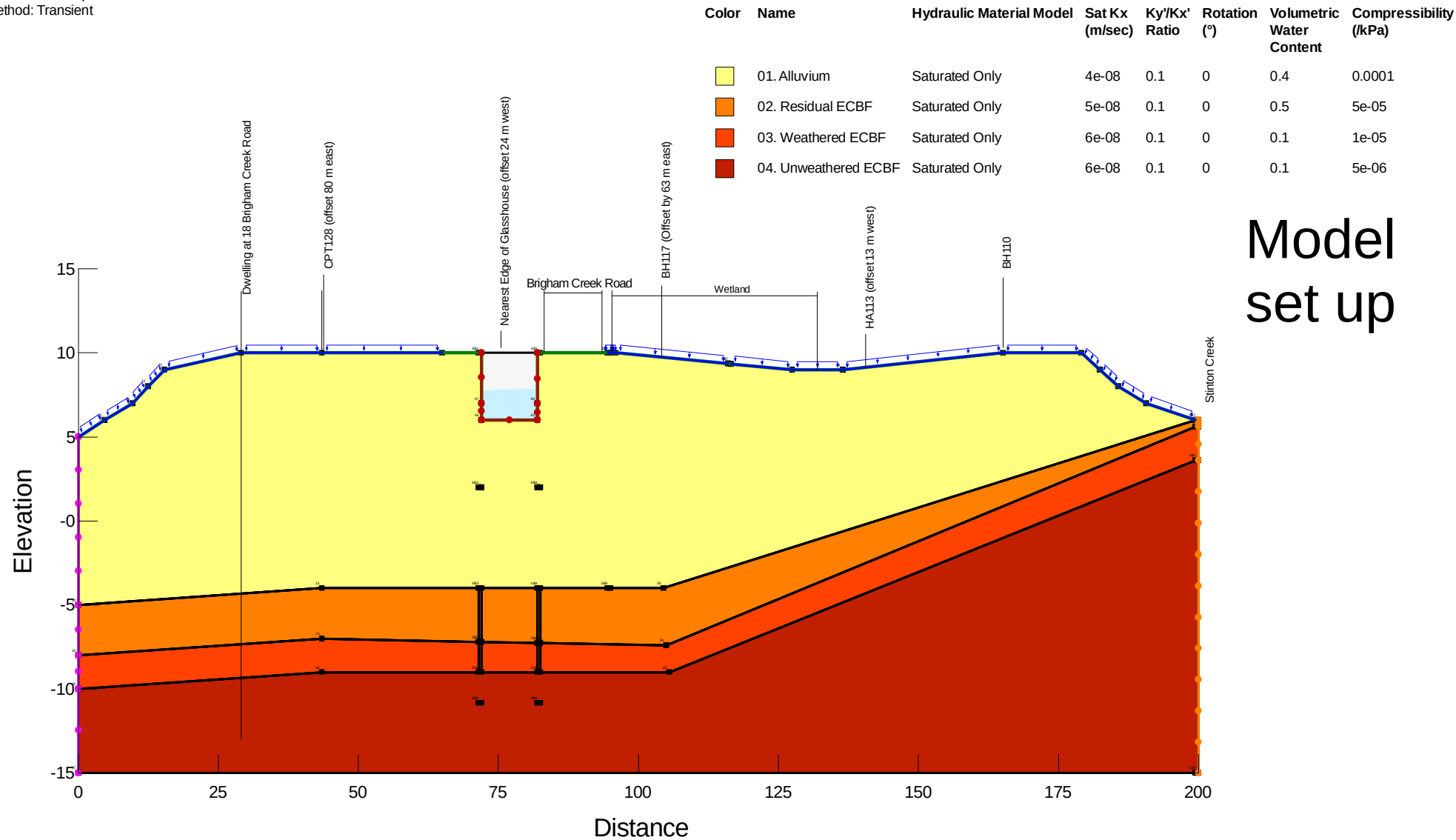
- Recharge modelled as a surface boundary with zero pore water pressure across the wetland region
- Sheet piles are modelled as 1m thick volume elements with $k=4e-11$ m/s (assumed ROXAN Plus or AKILA sealing system as per Arcelor guidance document).
- Soil modelled as $k_x=1e-6$ m/s, $k_v/k_x=0.5$, fully saturated model. Sensitivity checked for an order of magnitude higher and lower
- Rock fractures may yield locally different response
- Hydraulic boundary conditions set to existing known bodies of water and the model calibrated against groundwater monitoring results
- Ground surface recharge (rainfall) modelled as equal to 5% of annual average rainfall.
- No distinction is made between the permeability characteristics of the alluvial soils, East Coast Bays Formation (ECBF) soils or ECBF rock. This is assessed to be suitable for the purposes of groundwater seepage modelling as these materials have similar permeability values.
- The ground permeability model has been based on a fully saturated model which may result in higher water recharge rates than what is required.
- Modelling extents are shown in the figure below. The SEEP3D model lateral boundary extents are shown by the dashed black line. The purple dashed line indicates the approximate location of the proposed pump station



- The ground surface has been modelled as a 3D surface within SEEP3D based on ground elevation contour information. The north-eastern boundary approximately follows the 15 mRL elevation contour, and the south-western boundary follows the stream. The 'side' boundaries have been selected to be approximately perpendicular to the ground elevation contours.
- The hydraulic boundary conditions assumed are presented below:
 - Fixed Total Head = 15 mRL at the uphill boundary face. This is based on an assumed winter phreatic surface at ground level.
 - Fixed Total Head = 5 mRL along the stream boundary. This is based on estimated stream invert level from the ground level contour plan.
 - Surface infiltration rate applied to the ground surface equal to 5% of average annual rainfall ($5\% \times 1380$ mm/year = 2.19×10^{-9} m/s).
 - 'No flow' boundary along model 'sides'.



Analysis Notes:
1. Name: 3.2 Reception Shaft Excavation
2. Method: Transient



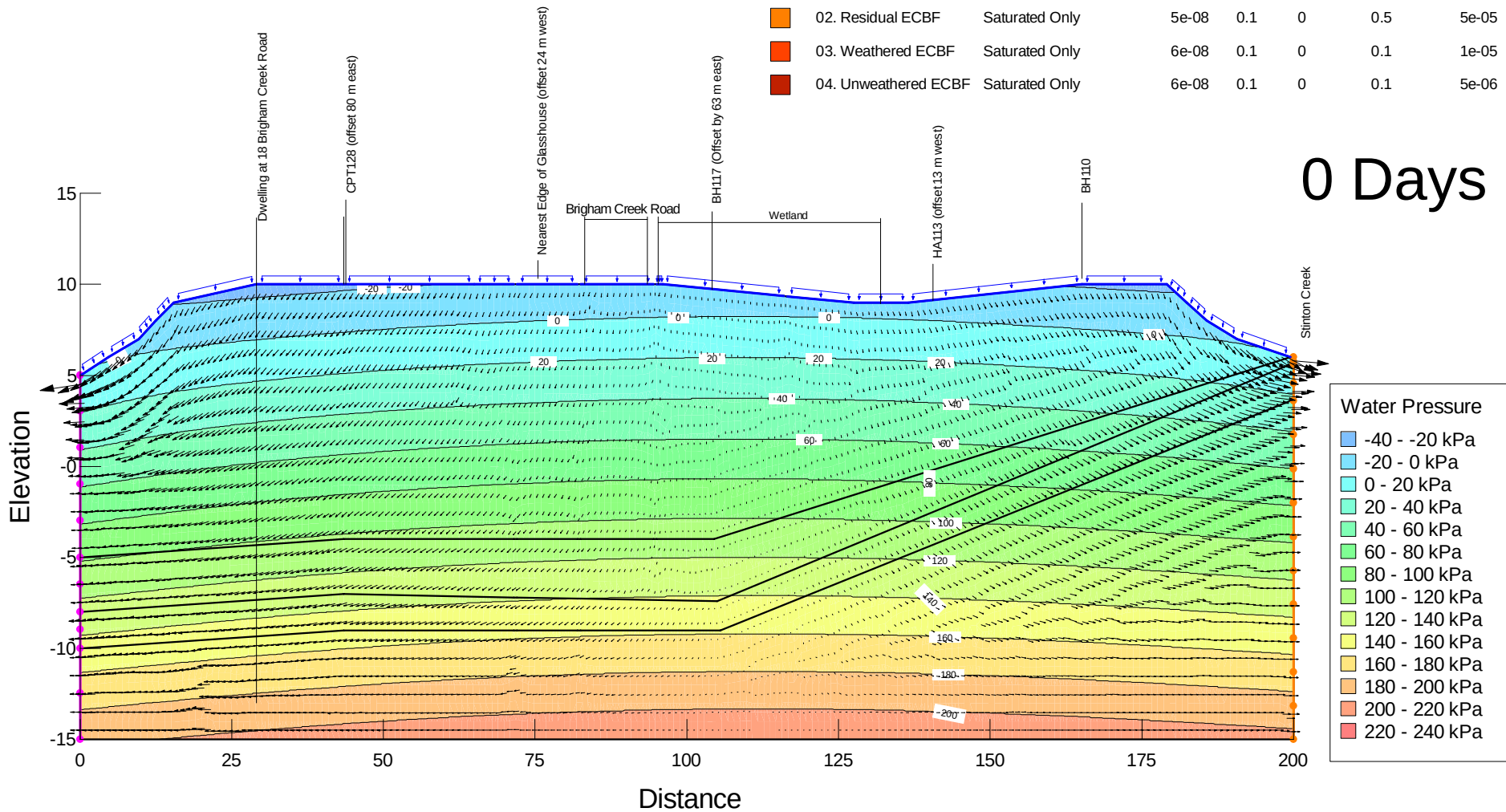
Model
set up

	Title: 20220405_GWDrawdownAssessment_PumpStation edma 20230726 sz 1013050	
	Analysis: 3.2 Reception Shaft Excavation	
	Comments:	Scale: 1:1,000 @ A4
		Analysed by: JROB
		Checked by: EDMA

Analysis Notes:
1. Name: 3.1 Pre construction conditions
2. Method: Steady-State

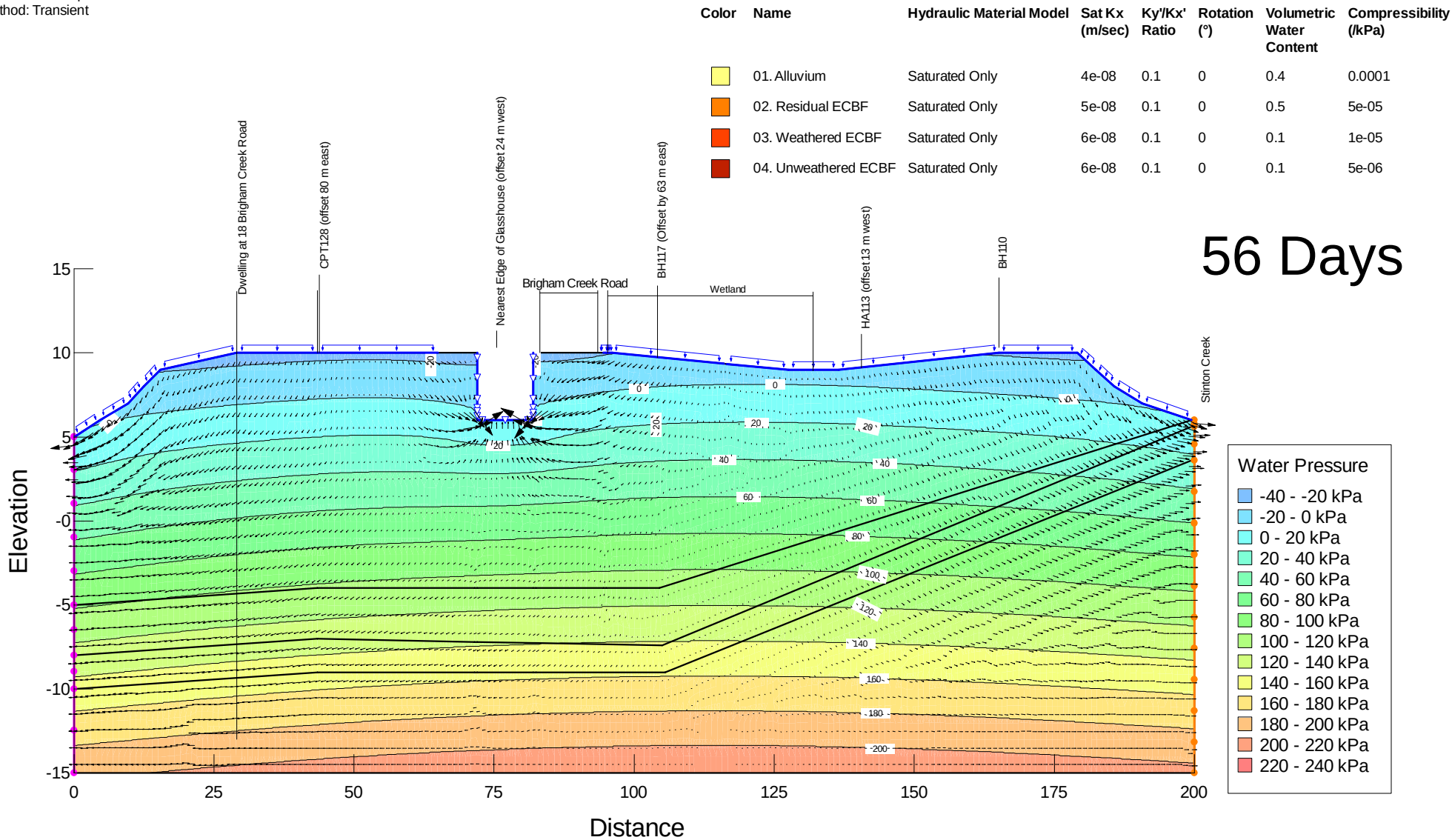
Color	Name	Hydraulic Material Model	Sat Kx (m/sec)	Ky/Kx' Ratio	Rotation (°)	Volumetric Water Content	Compressibility (1/kPa)
	01. Alluvium	Saturated Only	4e-08	0.1	0	0.4	0.0001
	02. Residual ECBF	Saturated Only	5e-08	0.1	0	0.5	5e-05
	03. Weathered ECBF	Saturated Only	6e-08	0.1	0	0.1	1e-05
	04. Unweathered ECBF	Saturated Only	6e-08	0.1	0	0.1	5e-06

0 Days



Directory: P:\1013050\WorkingMaterial\Geotechnical\Groundwater Drawdown Assessment\	Title: 20220405_GWDrawdownAssessment_PumpStation edma 20230726.g	
	Analysis: 3.1 Pre construction conditions	
	Comments:	Analysed by: JROB
Scale: 1:1,000 @ A4		Checked by: EDMA

Analysis Notes:
1. Name: 3.2 Reception Shaft Excavation
2. Method: Transient



Title: 20220405_GWDrawdownAssessment_PumpStation edma 20230726 sz 1013050

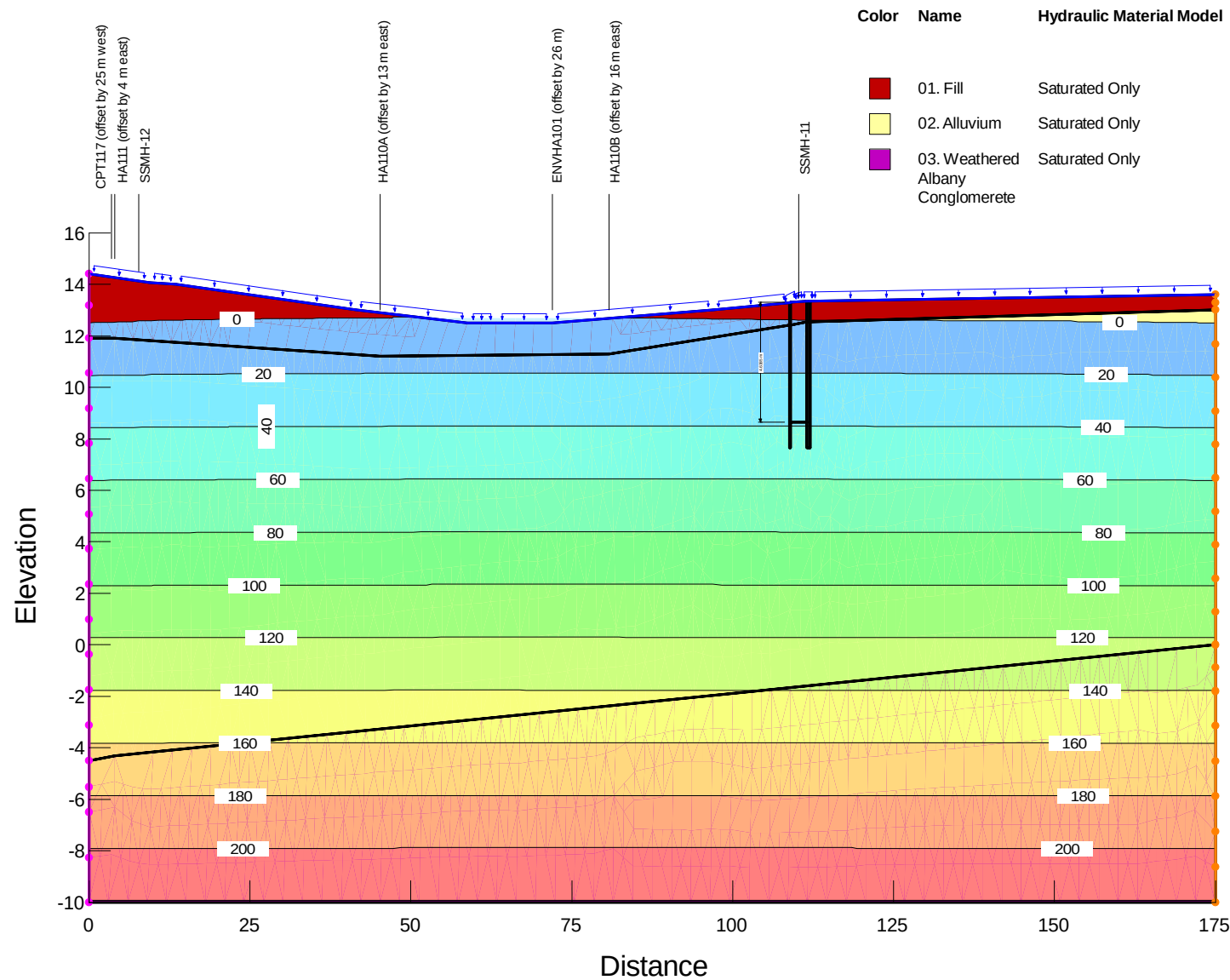
Analysis: 3.2 Reception Shaft Excavation

Analysed by: JROB

Comments:

Scale: 1:1,000 @ A4

Checked by: EDMA



Model Set up

Water Pressure

- 0 - 20 kPa
- 20 - 40 kPa
- 40 - 60 kPa
- 60 - 80 kPa
- 80 - 100 kPa
- 100 - 120 kPa
- 120 - 140 kPa
- 140 - 160 kPa
- 160 - 180 kPa
- 180 - 200 kPa
- 200 - 220 kPa

Title: 20220405_GWDrawdownAssessment_SSMH11 no sheets.gsz Job Number: 1013050

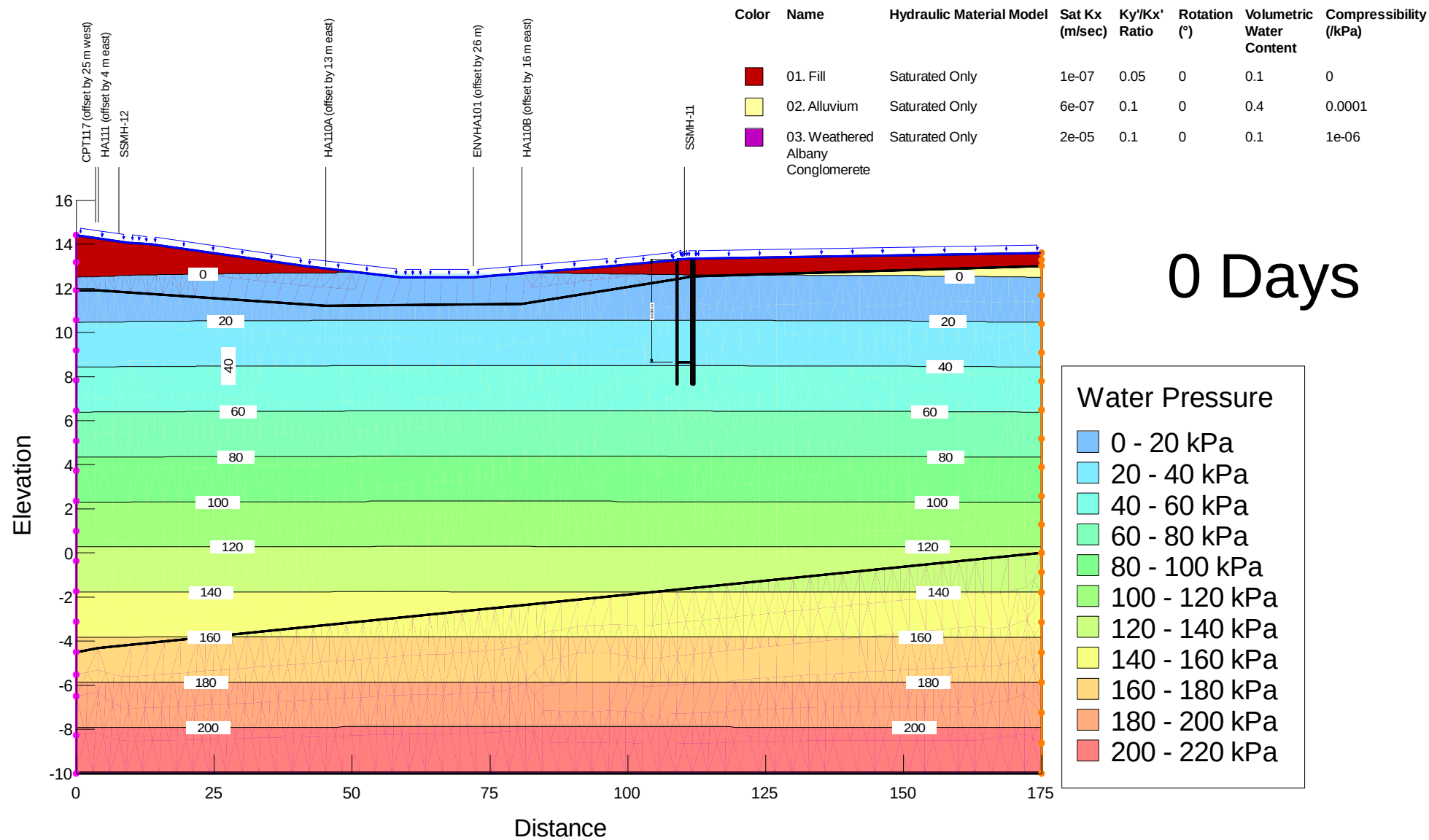
Analysis: Pre-construction conditions

Analysed by: EDMA

Comments:

Scale: 1:1,000 @ A4

Checked by:



0 Days

Title: 20220405_GWDrawdownAssessment_SSMH11 no sheets.gsz Job Number: 1013050

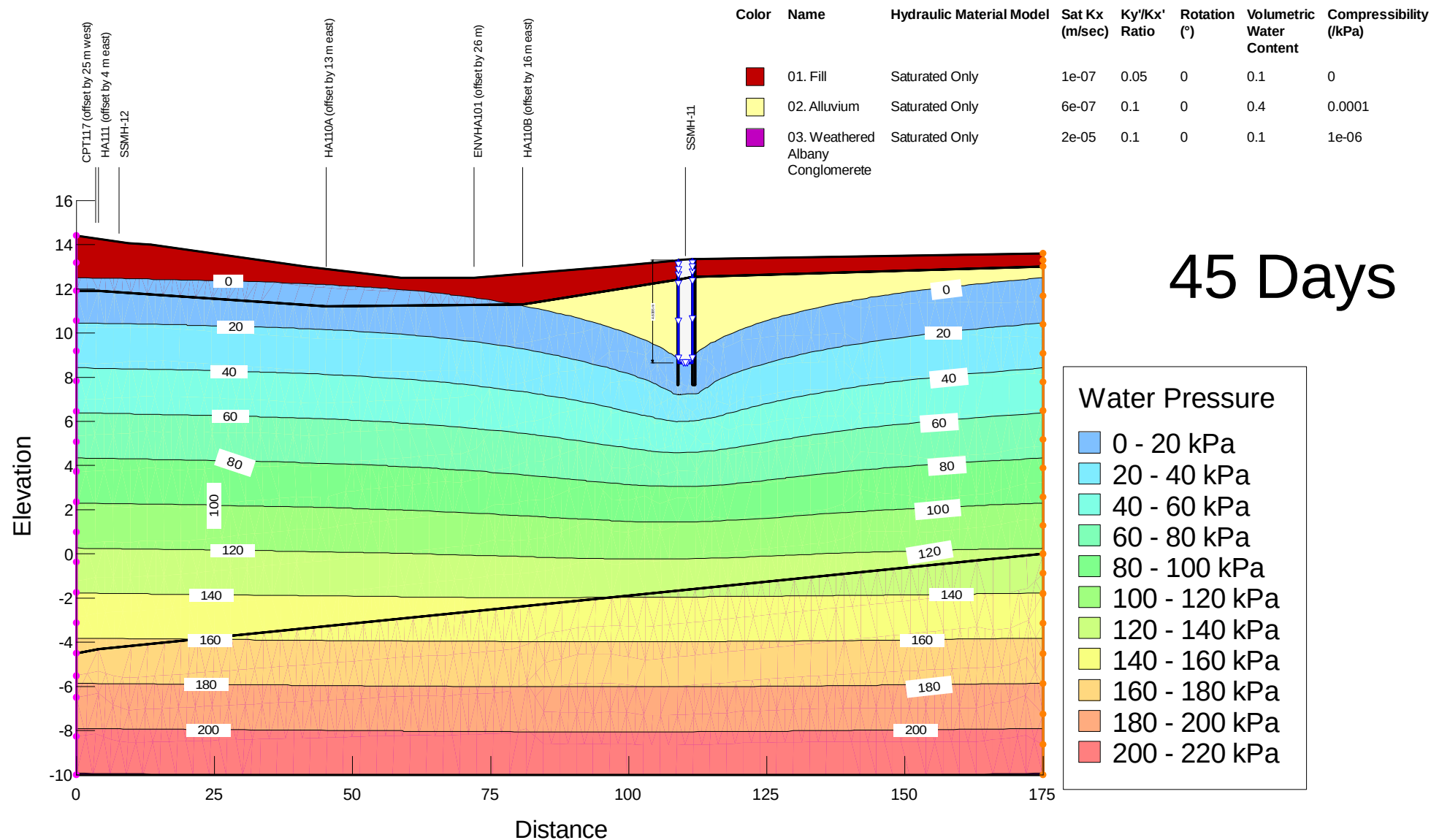
Analysis: Pre-construction conditions

Analysed by: EDMA

Comments:

Scale: 1:1,000 @ A4

Checked by:



Title: 20220405_GWDrawdownAssessment_SSMH11 no sheets.gsz Job Number: 1013050

Analysis: SSMH-11 Excavation

Analysed by: EDMA

Comments:

Scale: 1:1,000 @ A4

Checked by:

Appendix E Wallap outputs and mechanical settlement troughs

Units: kN,m

INPUT DATA

SOIL PROFILE

Stratum		Elevation of		Soil types			
no.	top of stratum	Left side	Right side				
1	10.00	2 TA silt & clay	2 TA silt & clay				
2	7.85	7 TA organic clay	7 TA organic clay				
3	4.45	2 TA silt & clay	2 TA silt & clay				
4	1.45	8 TA sand	8 TA sand				
5	0.40	2 TA silt & clay	2 TA silt & clay				
6	-0.25	8 TA sand	8 TA sand				
7	-1.65	2 TA silt & clay	2 TA silt & clay				
8	-4.00	3 ECBF residual soils	3 ECBF residual soils				

SOIL PROPERTIES

Soil type --		Bulk density	Young's Modulus	At rest coeff.	Consol. state.	Active limit	Passive limit	Cohesion
No. Description (Datum elev.)		kN/m3	Eh, kN/m2 (dEh/dy)	Ko (dKo/dy)	NC/OC (Nu)	Ka (Kac)	Kp (Kpc)	dc/dy)
1	Engineered hardfill	20.00	50000	0.254	OC (0.300)	0.189 (0.000)	7.061 (0.000)	
2	TA silt & clay	17.00	10000	0.531	OC (0.350)	0.320 (1.278)	3.485 (4.674)	1.000d
3	ECBF residual soils	18.00	20000	0.500	OC (0.350)	0.294 (1.222)	3.878 (4.985)	5.000d
4	ECBF Weathered rock	21.00	85000	0.426	OC (0.350)	0.237 (1.089)	5.153 (5.931)	25.00d
5	ECBF UW rock	22.00	400000	0.357	OC (0.250)	0.189 (0.966)	7.061 (7.223)	100.0d
6	Concrete	24.00	500000	0.000	OC (0.490)	1.000 (0.851)	1.000 (2.233)	500.0u
7	TA organic clay	16.00	5000	0.531	OC (0.250)	0.320 (1.278)	3.812 (5.289)	0.0d
8	TA sand	18.00	12000	0.500	OC (0.250)	0.294 (0.000)	3.878 (0.000)	

Additional soil parameters associated with Ka and Kp

		--- parameters for Ka ---			--- parameters for Kp ---		
		Soil	Wall	Back-fill	Soil	Wall	Back-fill
----- Soil type -----		friction angle	adhesion coeff.	fill angle	friction angle	adhesion coeff.	fill angle
No. Description							
1 Engineered hardfill		40.00	0.434	0.00	40.00	0.280	0.00
2 TA silt & clay		28.00	0.469	0.00	28.00	0.306	0.00
3 ECBF residual soils		30.00	0.464	0.00	30.00	0.302	0.00
4 ECBF weathered rock		35.00	0.450	0.00	35.00	0.292	0.00
5 ECBF UW rock		40.00	0.434	0.00	40.00	0.280	0.00
6 Concrete		0.00	0.736	0.00	0.00	0.265	0.00
7 TA organic clay		28.00	0.469	0.00	28.00	0.469	0.00
8 TA sand		30.00	0.464	0.00	30.00	0.302	0.00

parameters not used

GROUND WATER CONDITIONS

Density of water = 9.810 kN/m3					Left side		Right side	
Initial water table elevation					8.00		8.00	
Automatic water pressure balancing at toe of wall : Yes								
Water press.		Left side			Right side			
profile no.	Point no.	Elev. m	Piezo elev. m	Water press. kN/m2	Point no.	Elev. m	Piezo elev. m	Water press kN/m2
1	1	9.50	9.50	0.0	1	5.75	5.75	0.0
2	1	8.00	8.00	0.0	1	5.25	5.25	0.0
3	1	8.00	8.00	0.0	1	7.25	7.25	0.0

WALL PROPERTIES

Type of structure = Fully Embedded Wall
Elevation of toe of wall = 0.00
Maximum finite element length = 0.60 m
Youngs modulus of wall E = 2.0000E+08 kN/m2
Moment of inertia of wall I = 3.2400E-04 m4/m run
(Sumitomo SX18) E.I = 64800 kN.m2/m run
Yield Moment of wall = Not defined

STRUTS and ANCHORS

Prop no.	Elev.	Prop spacing m	Cross-section area sq.m	Youngs modulus kN/m2	Free length m	Inclin -ation (degs)	Pre-stress /prop kN	Strut or Anchor	Allow tension ?	L/R
1	9.00	4.00	0.011400	2.000E+08	10.00	0.00	0	Anchor	n/a	R

SURCHARGE LOADS

Surch -arge no.	Distance from wall	Length parallel to wall	Width perpnd. to wall	Surcharge kn/m2	Equiv. soil type	Partial factor/ Category
1	10.00	0.50(L)	21.00	10.00	15.00	N/A

Note: L = Left side, R = Right side

CONSTRUCTION STAGES

Construction stage no.	Stage description
1	Apply surcharge no.1 at elevation 10.00
2	Apply water pressure profile no.3
3	Excavate to elevation 8.25 on RIGHT side
4	Install strut or anchor no.1 at elevation 9.00
5	Apply water pressure profile no.2
6	Excavate to elevation 5.50 on RIGHT side
7	Fill to elevation 6.00 on RIGHT side with soil type 1
8	Apply water pressure profile no.1

FACTORS OF SAFETY and ANALYSIS OPTIONS

Stability analysis:
Method of analysis - Strength Factor method
Factor on soil strength for calculating wall depth = 1.50

Parameters for undrained strata:
Minimum equivalent fluid density = 5.00 kN/m3
Maximum depth of water filled tension crack = 0.00 m

Bending moment and displacement calculation:
Method - 2-D finite element model
Open Tension Crack analysis? - No
Active limit arching modelled? - No
Non-linear Modulus Parameter (L) = 8.500 m

Boundary conditions:
Length of wall (normal to plane of analysis) = 20.00 m

Width of excavation on Left side of wall = 20.00 m
Width of excavation on Right side of wall = 20.00 m

Distance to rigid boundary on Left side = 30.00 m
Distance to rigid boundary on Right side = 30.00 m

Brigham Creek Road crossing
Driver shaft

Elevation of rigid lower boundary = -30.00

Lower rigid boundary at elevation -30.00 - Rough
Rigid boundary on Left side - Rough
Rigid boundary on Right side - Rough
Wall / soil interface - Smooth

OUTPUT OPTIONS

Stage no.	Stage description	Displacement Bending mom. Shear force	Output options Active, Passive pressures	Graph output
1	Apply surcharge no.1 at elev. 10.00	Yes	Yes	Yes
2	Apply water pressure profile no.3	Yes	Yes	Yes
3	Excav. to elev. 8.25 on RIGHT side	Yes	Yes	Yes
4	Install prop no.1 at elev. 9.00	Yes	Yes	Yes
5	Apply water pressure profile no.2	Yes	Yes	Yes
6	Excav. to elev. 5.50 on RIGHT side	Yes	Yes	Yes
7	Fill to elev. 6.00 on RIGHT side	Yes	Yes	Yes
8	Apply water pressure profile no.1	Yes	Yes	Yes
*	Summary output	Yes	-	Yes

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Brigham Creek Road
crossing
Driver shaft

Units: kN,m

Stage No. 1 Apply surcharge no.1 at elevation 10.00

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

		FoS for toe		Toe elev. for			
		elev. = 0.00		FoS = 1.500			
Stage	Ground level	Prop	Factor	Moment	Toe	Wall	Direction
No.	Act.	Pass.	Elev.	of	elev.	Penetr	of
				Safety	at elev.	-ation	failure
1	10.00	10.00	Cant.	Conditions not suitable for FoS calc.			

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options
Length of wall perpendicular to section = 20.00m
2-D finite element model. Active limit arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.05
 Right side = 1.05

Rigid boundaries: Left side 30.00 from wall Rough boundary
 Right side 30.00 from wall Rough boundary
Lower rigid boundary at elevation -30.00 Rough boundary

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m
1	10.00	-1.18	0.003	-1.00E-04	0.0	-0.0	
2	9.50	-1.80	0.003	-1.00E-04	-0.7	-0.1	
3	9.00	-0.53	0.003	-9.75E-05	-1.3	-0.6	
4	8.63	-0.25	0.003	-9.26E-05	-1.5	-1.1	
5	8.25	-0.13	0.003	-8.46E-05	-1.5	-1.7	
6	8.00	-0.18	0.003	-7.75E-05	-1.6	-2.0	
7	7.85	-0.14	0.003	-7.25E-05	-1.6	-2.3	
		0.61	0.003	-7.25E-05	-1.6	-2.3	
8	7.25	0.83	0.003	-4.74E-05	-1.2	-3.1	
9	6.93	0.82	0.003	-3.09E-05	-0.9	-3.5	
10	6.60	0.80	0.003	-1.30E-05	-0.6	-3.7	
11	6.00	0.82	0.003	2.24E-05	-0.2	-3.9	
12	5.75	0.80	0.003	3.76E-05	0.0	-4.0	
13	5.50	0.81	0.003	5.28E-05	0.2	-3.9	
14	5.25	0.81	0.003	6.77E-05	0.4	-3.8	
15	4.85	0.82	0.003	9.07E-05	0.8	-3.6	
16	4.45	0.73	0.003	1.11E-04	1.1	-3.2	
		-0.10	0.003	1.11E-04	1.1	-3.2	
17	4.03	-0.22	0.003	1.31E-04	1.0	-2.8	
18	3.60	-0.13	0.003	1.48E-04	0.9	-2.4	
19	3.00	0.02	0.002	1.67E-04	0.9	-1.8	
20	2.40	0.20	0.002	1.81E-04	1.0	-1.3	
21	1.93	0.40	0.002	1.89E-04	1.1	-0.8	
22	1.45	0.88	0.002	1.93E-04	1.4	-0.2	
		-2.34	0.002	1.93E-04	1.4	-0.2	
23	0.93	-1.76	0.002	1.93E-04	0.3	0.2	
24	0.40	-1.67	0.002	1.92E-04	-0.6	0.1	
		1.28	0.002	1.92E-04	-0.6	0.1	
25	0.00	0.93	0.002	1.91E-04	-0.1	0.0	

(continued)

Stage No.1 Apply surcharge no.1 at elevation 10.00

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m
26	-0.25	2.30	0.002	0	0.3	0.0	
		-0.32	0.002	0	0.3	0.0	
27	-1.65	-1.52	0.002	0	-1.0	0.0	
		1.09	0.002	0	-1.0	0.0	
28	-4.00	1.14	0.001	0	1.6	0.0	
		-1.87	0.001	0	1.6	0.0	
29	-5.60	-0.01	0.001	0	0.1	0.0	
30	-7.20	0.05	0.001	0	0.1	0.0	
31	-9.60	-0.01	0.001	0	0.2	0.0	
32	-12.00	-0.01	0.001	0	0.2	0.0	
33	-14.40	-0.01	0.000	0	0.1	0.0	
34	-16.80	-0.01	0.000	0	0.1	0.0	
35	-19.20	-0.01	0.000	0	0.1	0.0	
36	-21.60	-0.01	0.000	0	0.1	0.0	
37	-24.00	-0.00	0.000	0	0.1	0.0	
38	-26.40	-0.01	0.000	0	0.0	0.0	
39	-28.20	-0.00	0.000	0	0.0	0.0	
40	-30.00	-0.03	0.000	0	0.0	0.0	

		LEFT side				Total earth	Adjusted soil
		Effective stresses					
Node	Y	Water	Vertic	Active	Passive	Earth	

		LEFT side				Total earth	Adjusted soil
		Effective stresses					
Node	Y	Water	Vertic	Active	Passive	Earth	

		RIGHT side				Total earth	Adjusted soil
		Effective stresses					
Node	Y	Water	Vertic	Active	Passive	Earth	

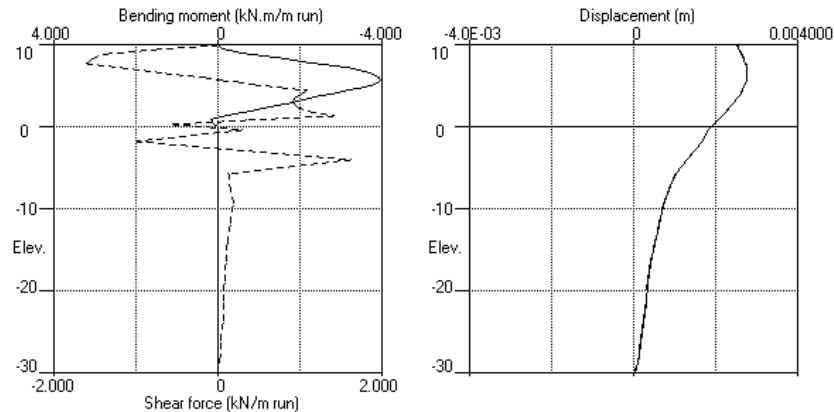
		RIGHT side				Total earth	Adjusted soil
		Effective stresses					
Node	Y	Water	Vertic	Active	Passive	Earth	

TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
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Whenupai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

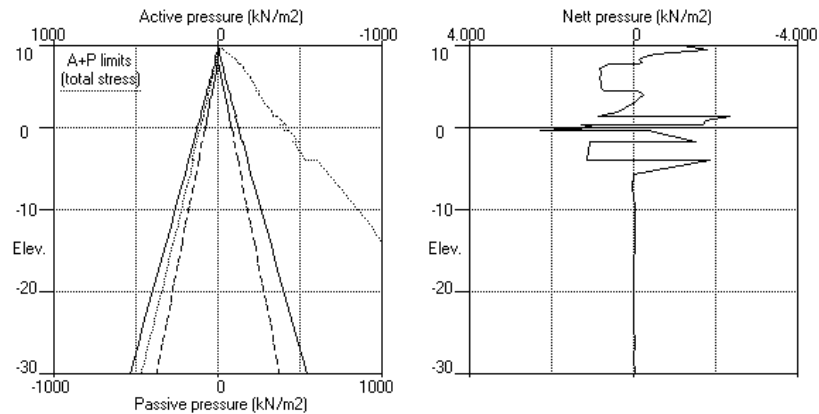
Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m

Stage No.1 Apply surcharge no.1 at elev. 10.00



Stage No.1 Apply surcharge no.1 at elev. 10.00



TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenupai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m

Stage No. 2 Apply water pressure profile no.3

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Prop Pass.	Prop Elev.	FoS for toe		Toe elev. for		Direction of failure
				Factor	Moment of equil.	Toe elev.	Wall Penetr.	
2	10.00	10.00	Cant.	0.00	1.500	0.00	1.500	Conditions not suitable for FoS calc.

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m

2-D finite element model. Active limit arching not modelled.

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

All soil moduli were factored to take account of

3-D effects due to the finite length of wall:

Modulus factors - Left side = 1.05

Right side = 1.05

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

Lower rigid boundary at elevation -30.00

Rough boundary

Rough boundary

Rough boundary

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	10.00	-1.19	0.003	-2.15E-04	0.0	-0.0	
2	9.50	-2.52	0.003	-2.14E-04	-0.9	-0.1	
3	9.00	-1.98	0.004	-2.11E-04	-2.1	-0.8	
4	8.63	-2.30	0.004	-2.04E-04	-2.9	-1.7	
5	8.25	-2.65	0.004	-1.91E-04	-3.8	-2.9	
6	8.00	-3.06	0.004	-1.78E-04	-4.5	-3.9	
7	7.85	-2.63	0.004	-1.68E-04	-4.9	-4.6	
		-0.02	0.004	-1.68E-04	-4.9	-4.6	
8	7.25	3.84	0.004	-1.13E-04	-3.8	-7.3	
9	6.93	3.48	0.004	-7.36E-05	-2.6	-8.4	
10	6.60	3.17	0.004	-3.01E-05	-1.5	-9.0	
11	6.00	2.77	0.004	5.49E-05	0.3	-9.4	
12	5.75	2.59	0.004	9.08E-05	0.9	-9.2	
13	5.50	2.46	0.004	1.25E-04	1.6	-8.9	
14	5.25	2.35	0.004	1.59E-04	2.2	-8.4	
15	4.85	2.16	0.004	2.07E-04	3.1	-7.4	
16	4.45	1.86	0.004	2.49E-04	3.9	-6.0	
		-1.57	0.004	2.49E-04	3.9	-6.0	
17	4.03	-1.62	0.004	2.83E-04	3.2	-4.5	
18	3.60	-1.28	0.003	3.08E-04	2.6	-3.3	
19	3.00	-0.93	0.003	3.33E-04	1.9	-2.0	
20	2.40	-0.56	0.003	3.47E-04	1.5	-1.0	
21	1.93	-0.20	0.003	3.52E-04	1.3	-0.4	
22	1.45	0.41	0.003	3.52E-04	1.3	0.2	
		-2.74	0.003	3.52E-04	1.3	0.2	
23	0.93	-2.04	0.003	3.50E-04	0.1	0.5	
24	0.40	-1.62	0.002	3.46E-04	-0.9	0.3	
		1.29	0.002	3.46E-04	-0.9	0.3	
25	0.00	1.88	0.002	3.46E-04	-0.2	0.0	

Brigham Creek
Road crossing
Driver shaft

Stage No.2 Apply water pressure profile no.3

(continued)

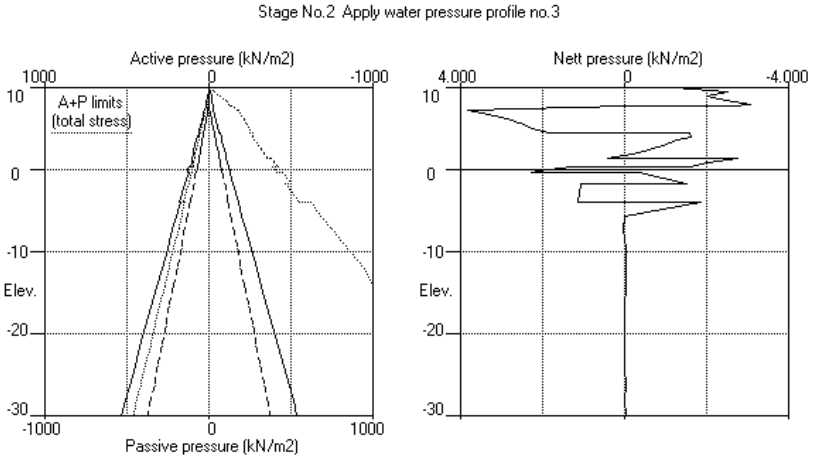
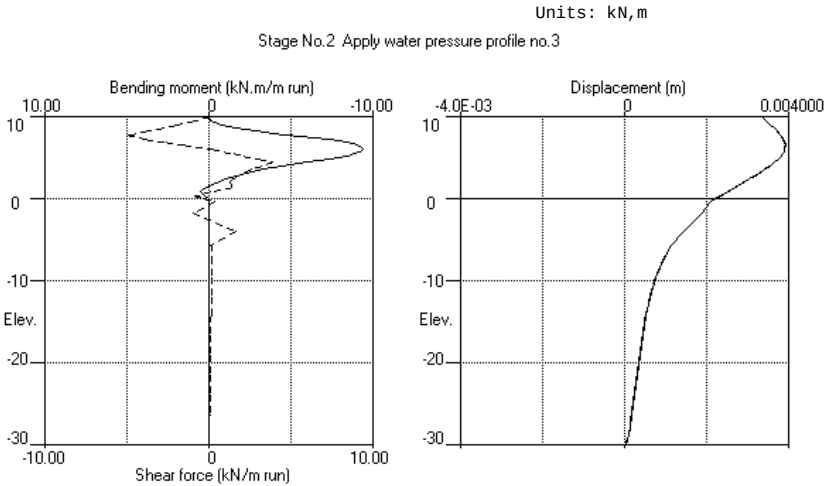
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
26	-0.25	2.30	0.002	0	0.3	0.0	
		-0.32	0.002	0	0.3	0.0	
27	-1.65	-1.52	0.002	0	-1.0	0.0	
		1.09	0.002	0	-1.0	0.0	
28	-4.00	1.14	0.001	0	1.6	0.0	
		-1.87	0.001	0	1.6	0.0	
29	-5.60	-0.01	0.001	0	0.1	0.0	
30	-7.20	0.05	0.001	0	0.1	0.0	
31	-9.60	-0.01	0.001	0	0.2	0.0	
32	-12.00	-0.01	0.001	0	0.2	0.0	
33	-14.40	-0.01	0.001	0	0.1	0.0	
34	-16.80	-0.01	0.000	0	0.1	0.0	
35	-19.20	-0.01	0.000	0	0.1	0.0	
36	-21.60	-0.01	0.000	0	0.1	0.0	
37	-24.00	-0.00	0.000	0	0.1	0.0	
38	-26.40	-0.01	0.000	0	0.0	0.0	
39	-28.20	-0.00	0.000	0	0.0	0.0	
40	-30.00	-0.03	0.000	0	0.0	0.0	

LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil

LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil

RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil

RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil



TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m
Stage No. 3 Excavate to elevation 8.25 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

FoS for toe		Toe elev. for	
elev. = 0.00		FoS = 1.500	
Stage	Ground level	Prop	Fo
No.	Act.	Pass.	Elev.
		Factor	
		of	
		Safety	
		at elev.	
		of	
		equilib.	
		Toe	
		Wall	
		Penetr	
		-ation	
		Direction	
		of	
		failure	
3	10.00	8.25	Cant.
			2.144
			0.72
			4.26
			3.99
			L to R

BENDING MOMENT AND DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m

2-D finite element model. Active limit arching not modelled.

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

All soil moduli were factored to take account of

3-D effects due to the finite length of wall:

Modulus factors - Left side = 1.05

Right side = 1.05

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Lower rigid boundary at elevation -30.00

Rough boundary
Rough boundary
Rough boundary

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m
1	10.00	0.00	0.029	2.80E-03	0.0	0.0	
2	9.50	2.32	0.028	2.80E-03	0.6	0.3	
3	9.00	6.33	0.026	2.79E-03	2.7	1.2	
4	8.63	8.95	0.025	2.78E-03	5.6	2.8	
5	8.25	11.38	0.024	2.76E-03	9.4	5.6	
		6.70	0.024	2.76E-03	9.4	5.6	
6	8.00	-6.57	0.024	2.73E-03	9.4	8.2	
7	7.85	-13.60	0.023	2.71E-03	7.9	9.5	
		-8.42	0.023	2.71E-03	7.9	9.5	
8	7.25	-3.60	0.021	2.61E-03	4.3	13.0	
9	6.93	-2.91	0.021	2.54E-03	3.3	14.2	
10	6.60	-2.46	0.020	2.47E-03	2.4	15.1	
11	6.00	-1.91	0.018	2.32E-03	1.1	16.1	
12	5.75	-0.81	0.018	2.26E-03	0.7	16.3	
13	5.50	-0.21	0.017	2.20E-03	0.6	16.4	
14	5.25	0.47	0.017	2.13E-03	0.6	16.6	
15	4.85	1.10	0.016	2.03E-03	1.0	16.9	
16	4.45	0.95	0.015	1.92E-03	1.4	17.3	
		-7.21	0.015	1.92E-03	1.4	17.3	
17	4.03	-5.54	0.014	1.81E-03	-1.3	17.3	
18	3.60	-3.04	0.014	1.70E-03	-3.2	16.2	
19	3.00	-0.84	0.013	1.56E-03	-4.3	13.7	
20	2.40	1.07	0.012	1.45E-03	-4.3	10.9	
21	1.93	2.76	0.011	1.38E-03	-3.4	9.0	
22	1.45	4.06	0.010	1.31E-03	-1.7	7.7	
		-7.53	0.010	1.31E-03	-1.7	7.7	
23	0.93	-5.74	0.010	1.26E-03	-5.2	5.7	
24	0.40	-1.83	0.009	1.23E-03	-7.2	2.2	
		8.70	0.009	1.23E-03	-7.2	2.2	

Run ID. Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Date: 4-05-2022
Checked :

Stage No.3 Excavate to elevation 8.25 on RIGHT side

Node no.	Y coord	Nett pressure	Wall disp.	Wall rotation	Shear force	Bending moment	Prop forces
		kN/m2	m	rad.	kN/m	kN.m/m	kN/m
25	0.00	16.83	0.009	1.22E-03	-2.1	-0.0	
26	-0.25	8.90	0.008	0	1.1	0.0	
		-1.46	0.008	0	1.1	0.0	
27	-1.65	-6.65	0.008	0	-4.6	0.0	
		4.26	0.008	0	-4.6	0.0	
28	-4.00	5.42	0.007	0	6.8	0.0	
		-8.26	0.007	0	6.8	0.0	
29	-5.60	-0.00	0.005	0	0.2	0.0	
30	-7.20	0.12	0.005	0	0.3	0.0	
31	-9.60	-0.01	0.004	0	0.4	0.0	
32	-12.00	-0.01	0.004	0	0.4	0.0	
33	-14.40	-0.01	0.003	0	0.4	0.0	
34	-16.80	-0.01	0.003	0	0.3	0.0	
35	-19.20	-0.01	0.003	0	0.3	0.0	
36	-21.60	-0.01	0.002	0	0.3	0.0	
37	-24.00	-0.01	0.002	0	0.3	0.0	
38	-26.40	-0.06	0.002	0	0.2	0.0	
39	-28.20	-0.00	0.001	0	0.1	0.0	
40	-30.00	-0.13	0.000	0	0.0	0.0	

		LEFT side					Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth		
		LEFT side					Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth		
		RIGHT side					Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth		
		RIGHT side					Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth		

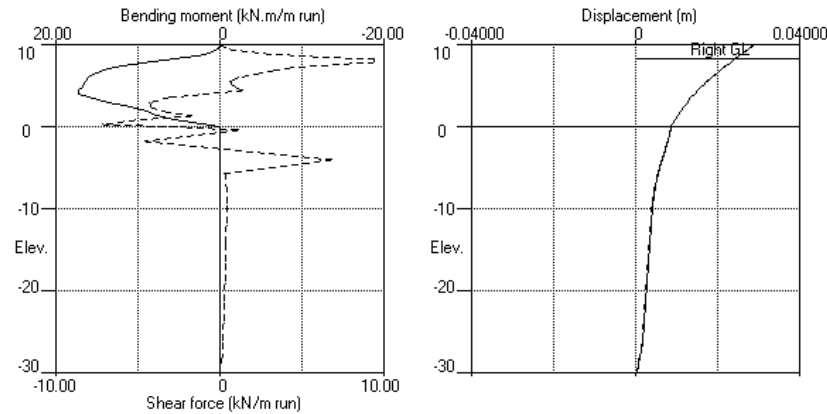
Brigham Creek
Road crossing
Driver shaft

TONKIN and TAYLOR GROUP LTD.
 Program: WALLAP Version 6.07 Revision A55.B74.R58
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 Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
 Whenuapai - Brigham Creek Road crossing - Drive shaft
 Sheet pile STU1800 w 250UC89 (v3)

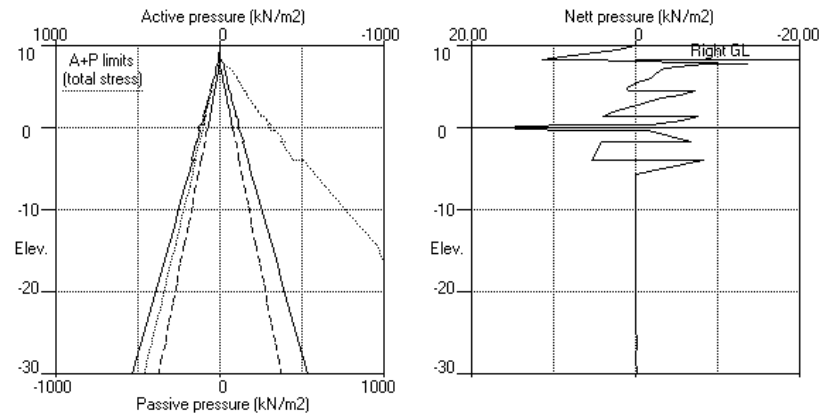
Sheet No.
 Job No. 1013050
 Made by : op
 Date: 4-05-2022
 Checked :

Units: kN,m

Stage No.3 Excav. to elev. 8.25 on RIGHT side



Stage No.3 Excav. to elev. 8.25 on RIGHT side



TONKIN and TAYLOR GROUP LTD.
 Program: WALLAP Version 6.07 Revision A55.B74.R58
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 Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
 Whenuapai - Brigham Creek Road crossing - Drive shaft
 Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
 Job No. 1013050
 Made by : op
 Date: 4-05-2022
 Checked :

Units: kN,m

Stage No. 5 Apply water pressure profile no.2

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
 Factor of safety on soil strength

Stage No.	Ground level Act.	Pass.	Prop Elev.	FoS for toe elev. = 0.00	Moment of equilib. at elev.	Toe elev. for FoS = 1.500	Wall Penetr-ation	Direction of failure
				Factor of Safety				
5	10.00	8.25	9.00	4.512	n/a	7.13	1.12	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options
 Length of wall perpendicular to section = 20.00m
 2-D finite element model. Active limit arching not modelled.
 Soil deformations are elastic until the active or passive limit is reached
 Open Tension Crack analysis - No
 All soil moduli were factored to take account of
 3-D effects due to the finite length of wall:
 Modulus factors - Left side = 1.05
 Right side = 1.05

Rigid boundaries: Left side 30.00 from wall
 Right side 30.00 from wall
 Lower rigid boundary at elevation -30.00
 Rough boundary
 Rough boundary
 Rough boundary

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	10.00	3.77	0.029	2.20E-03	0.0	0.0	
2	9.50	5.05	0.028	2.19E-03	2.2	0.8	
3	9.00	7.90	0.026	2.18E-03	5.4	2.8	-9.3
		7.90	0.026	2.18E-03	-3.9	2.8	
4	8.63	9.49	0.026	2.17E-03	-0.6	2.0	
5	8.25	11.38	0.025	2.15E-03	3.3	2.6	
		9.99	0.025	2.15E-03	3.3	2.6	
6	8.00	-4.50	0.024	2.14E-03	4.0	3.7	
7	7.85	-13.01	0.024	2.13E-03	2.7	4.3	
		-8.21	0.024	2.13E-03	2.7	4.3	
8	7.25	-4.53	0.023	2.09E-03	-1.1	4.6	
9	6.93	-2.44	0.022	2.07E-03	-2.3	4.0	
10	6.60	-0.47	0.021	2.05E-03	-2.7	3.2	
11	6.00	2.48	0.020	2.03E-03	-2.1	1.6	
12	5.75	3.96	0.020	2.02E-03	-1.3	1.2	
13	5.50	5.72	0.019	2.02E-03	-0.1	1.0	
14	5.25	7.74	0.019	2.01E-03	1.6	1.1	
15	4.85	7.48	0.018	2.00E-03	4.6	2.4	
16	4.45	6.45	0.017	1.98E-03	7.4	4.8	
		-6.54	0.017	1.98E-03	7.4	4.8	
17	4.03	-7.16	0.016	1.94E-03	4.5	7.3	
18	3.60	-4.76	0.015	1.89E-03	1.9	8.5	
19	3.00	-2.63	0.014	1.81E-03	-0.3	8.7	
20	2.40	-0.71	0.013	1.73E-03	-1.3	8.0	
21	1.93	1.09	0.012	1.68E-03	-1.2	7.3	
22	1.45	2.70	0.012	1.62E-03	-0.3	6.8	
		-8.66	0.012	1.62E-03	-0.3	6.8	
23	0.93	-6.72	0.011	1.58E-03	-4.3	5.4	
24	0.40	-2.83	0.010	1.54E-03	-6.8	2.1	
		7.74	0.010	1.54E-03	-6.8	2.1	

Brigham Creek
 Road crossing
 Driver shaft

Run ID: Whenuapai-BCRcross-DriveShaft_v3 | Sheet No.
 Whenuapai - Brigham Creek Road crossing - Drive shaft | Date: 4-05-2022
 Sheet pile STU1800 w 250UC89 (v3) | Checked :

TONKIN and TAYLOR GROUP LTD.
 Program: WALLAP Version 6.07 Revision A55.B74.R58
 Licensed from GEOSOLVE
 Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
 Whenuapai - Brigham Creek Road crossing - Drive shaft
 Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
 Job No. 1013050
 Made by : op
 Date: 4-05-2022
 Checked :

Brigham Creek
 Road crossing
 Driver shaft

Stage No.5 Apply water pressure profile no.2

(continued)

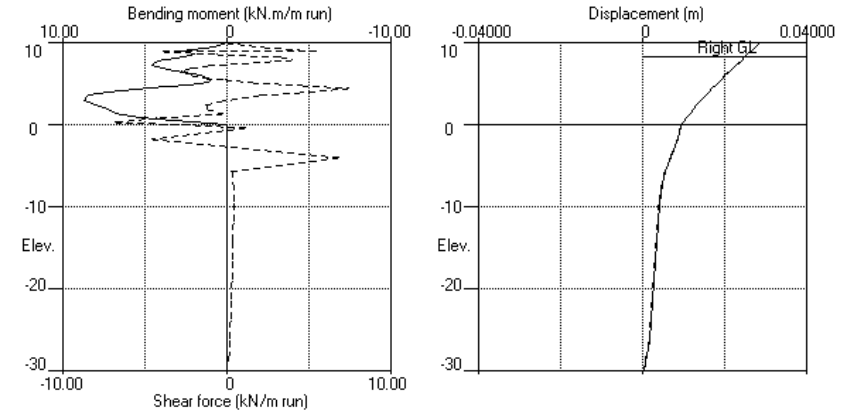
Node no.	Y coord	Nett pressure kN/m ²	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
25	0.00	16.25	0.009	1.54E-03	-2.0	-0.0	
26	-0.25	8.90	0.009	0	1.1	0.0	
		-1.46	0.009	0	1.1	0.0	
27	-1.65	-6.65	0.008	0	-4.6	0.0	
		4.26	0.008	0	-4.6	0.0	
28	-4.00	5.42	0.007	0	6.8	0.0	
		-8.26	0.007	0	6.8	0.0	
29	-5.60	-0.00	0.006	0	0.2	0.0	
30	-7.20	0.12	0.005	0	0.3	0.0	
31	-9.60	-0.01	0.004	0	0.4	0.0	
32	-12.00	-0.01	0.004	0	0.4	0.0	
33	-14.40	-0.01	0.003	0	0.4	0.0	
34	-16.80	-0.01	0.003	0	0.3	0.0	
35	-19.20	-0.01	0.003	0	0.3	0.0	
36	-21.60	-0.01	0.002	0	0.3	0.0	
37	-24.00	-0.01	0.002	0	0.3	0.0	
38	-26.40	-0.06	0.002	0	0.2	0.0	
39	-28.20	-0.00	0.001	0	0.1	0.0	
40	-30.00	-0.13	0.000	0	0.0	0.0	

At elev. 9.00 Prop force = 9.3 kN/m run

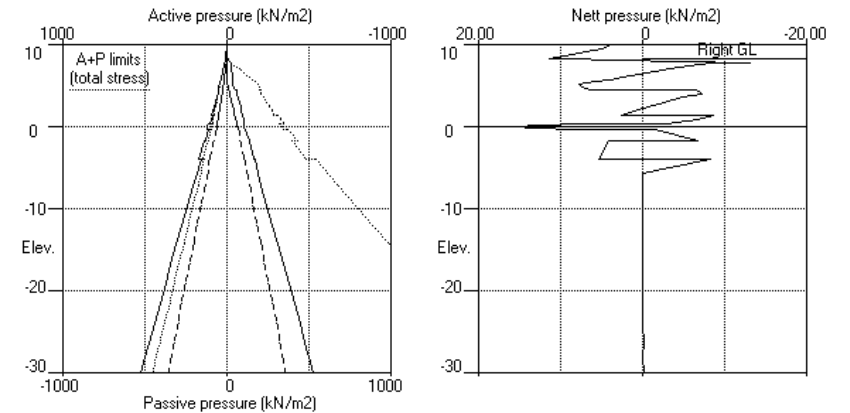
LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil
LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil
RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil
RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Adjusted soil

Units: kN,m

Stage No.5 Apply water pressure profile no.2



Stage No.5 Apply water pressure profile no.2



TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m
Stage No. 6 Excavate to elevation 5.50 on RIGHT side

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe Factor of Safety	Toe elev. for Moment at elev. n/a	Toe elev. for FoS = 1.500	Wall Penetr-ation ***	Direction of failure L to R
6	10.00	5.50	9.00	1.292	n/a	***	***	L to R

Legend: *** Result not found

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options

Length of wall perpendicular to section = 20.00m
2-D finite element model. Active limit arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.05
Right side = 1.04

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Lower rigid boundary at elevation -30.00

Rough boundary
Rough boundary
Rough boundary

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	10.00	4.67	0.023	-4.55E-03	0.0	0.0	
2	9.50	36.57	0.026	-4.55E-03	10.3	0.9	
3	9.00	26.67	0.028	-4.60E-03	26.1	10.9	-101.1
		26.67	0.028	-4.60E-03	-75.0	10.9	
4	8.63	17.10	0.030	-4.59E-03	-66.8	-15.2	
5	8.25	11.38	0.031	-4.43E-03	-61.4	-39.0	
6	8.00	12.92	0.033	-4.25E-03	-58.4	-53.8	
7	7.85	14.62	0.033	-4.12E-03	-56.3	-62.4	
		15.90	0.033	-4.12E-03	-56.3	-62.4	
8	7.25	22.40	0.035	-3.40E-03	-44.8	-92.9	
9	6.93	25.87	0.036	-2.90E-03	-37.0	-106.3	
10	6.60	29.32	0.037	-2.34E-03	-28.0	-116.9	
11	6.00	35.64	0.038	-1.20E-03	-8.5	-128.0	
12	5.75	38.25	0.039	-7.13E-04	0.7	-129.0	
13	5.50	40.86	0.039	-2.18E-04	10.6	-127.6	
14	5.25	28.22	0.039	2.66E-04	19.2	-123.8	
15	4.85	21.30	0.039	1.00E-03	29.1	-114.1	
16	4.45	14.35	0.038	1.66E-03	36.3	-100.8	
		10.80	0.038	1.66E-03	36.3	-100.8	
17	4.03	2.62	0.037	2.27E-03	39.1	-84.4	
18	3.60	-5.58	0.036	2.76E-03	38.5	-67.6	
19	3.00	-11.57	0.034	3.29E-03	33.3	-45.6	
20	2.40	-10.56	0.032	3.63E-03	26.7	-27.7	
21	1.93	-8.91	0.030	3.79E-03	22.1	-16.3	
22	1.45	-6.18	0.029	3.87E-03	18.5	-6.9	
		-22.66	0.029	3.87E-03	18.5	-6.9	
23	0.93	-19.32	0.027	3.90E-03	7.5	-0.3	

Run ID. Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Date: 4-05-2022
Checked :

(continued)
Stage No.6 Excavate to elevation 5.50 on RIGHT side

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
24	0.40	-16.64	0.024	3.90E-03	-2.0	0.8	
		-0.37	0.024	3.90E-03	-2.0	0.8	
25	0.00	6.31	0.023	3.90E-03	-0.8	-0.0	
26	-0.25	19.02	0.022	0	2.4	0.0	
		-3.25	0.022	0	2.4	0.0	
27	-1.65	-14.67	0.019	0	-10.2	0.0	
		9.13	0.019	0	-10.2	0.0	
28	-4.00	12.19	0.015	0	14.9	0.0	
		-18.26	0.015	0	14.9	0.0	
29	-5.60	0.01	0.013	0	0.3	0.0	
30	-7.20	0.21	0.011	0	0.5	0.0	
31	-9.60	0.01	0.010	0	0.7	0.0	
32	-12.00	-0.00	0.009	0	0.7	0.0	
33	-14.40	-0.01	0.008	0	0.7	0.0	
34	-16.80	-0.01	0.007	0	0.7	0.0	
35	-19.20	-0.02	0.006	0	0.7	0.0	
36	-21.60	-0.02	0.006	0	0.6	0.0	
37	-24.00	-0.02	0.005	0	0.6	0.0	
38	-26.40	-0.13	0.004	0	0.4	0.0	
39	-28.20	-0.01	0.003	0	0.3	0.0	
40	-30.00	-0.31	0.000	0	0.0	0.0	
At elev.	9.00				Prop force =	101.1 kN/m run	

LEFT side							
Node	Y	Water	Vertic	Effective stresses Active	Passive	Earth	Adjusted soil
LEFT side							
Node	Y	Water	Vertic	Effective stresses Active	Passive	Earth	Adjusted soil
RIGHT side							
Node	Y	Water	Vertic	Effective stresses Active	Passive	Earth	Adjusted soil
RIGHT side							
Node	Y	Water	Vertic	Effective stresses Active	Passive	Earth	Adjusted soil

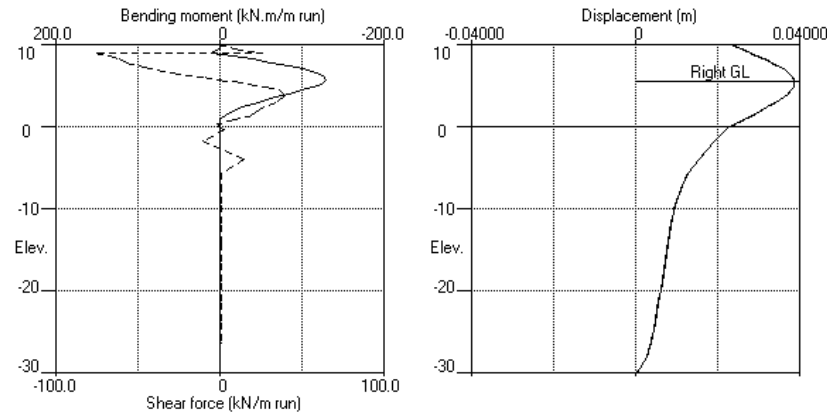
Brigham Creek
Road crossing
Driver shaft

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Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

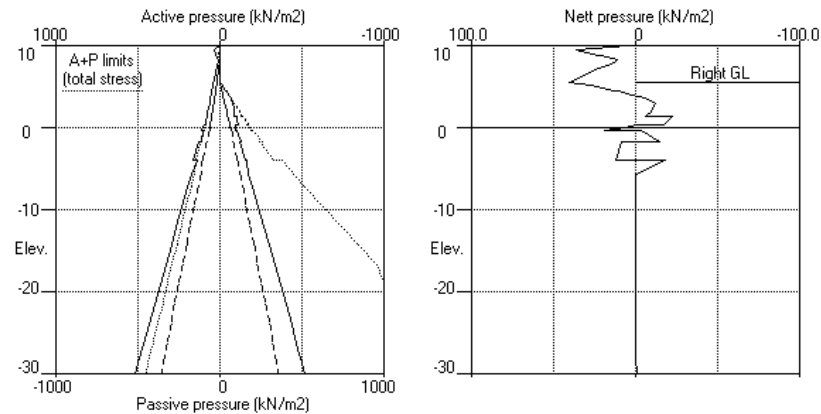
Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m

Stage No.6 Excav. to elev. 5.50 on RIGHT side



Stage No.6 Excav. to elev. 5.50 on RIGHT side



TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
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Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)

Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m

Stage No. 7 Fill to elevation 6.00 on RIGHT side with soil type 1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe elev. = 0.00	Moment of equilib. at elev.	Toe elev. for FoS = 1.500	Wall Penetr -ation	Direction of failure
				Factor of Safety				
7	10.00	6.00	9.00	1.719	n/a	1.18	4.82	L to R

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options

Length of wall perpendicular to section = 20.00m

2-D finite element model. Active limit arching not modelled.

Soil deformations are elastic until the active or passive limit is reached

Open Tension Crack analysis - No

All soil moduli were factored to take account of

3-D effects due to the finite length of wall:

Modulus factors - Left side = 1.05

Right side = 1.04

Rigid boundaries: Left side 30.00 from wall

Right side 30.00 from wall

Lower rigid boundary at elevation -30.00

Rough boundary

Rough boundary

Rough boundary

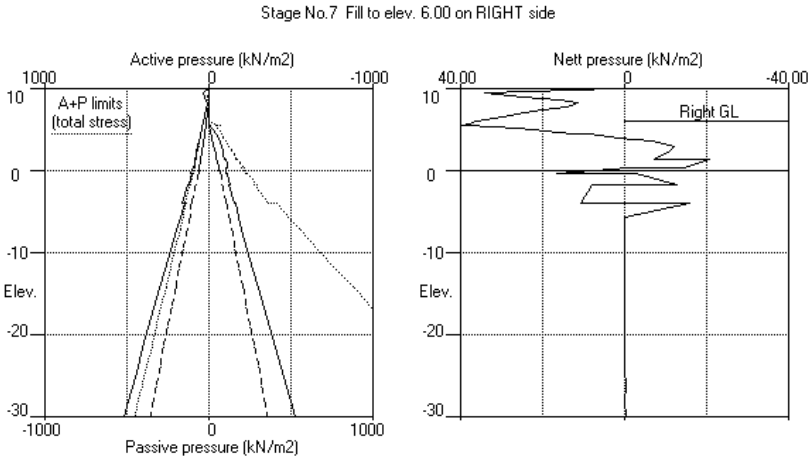
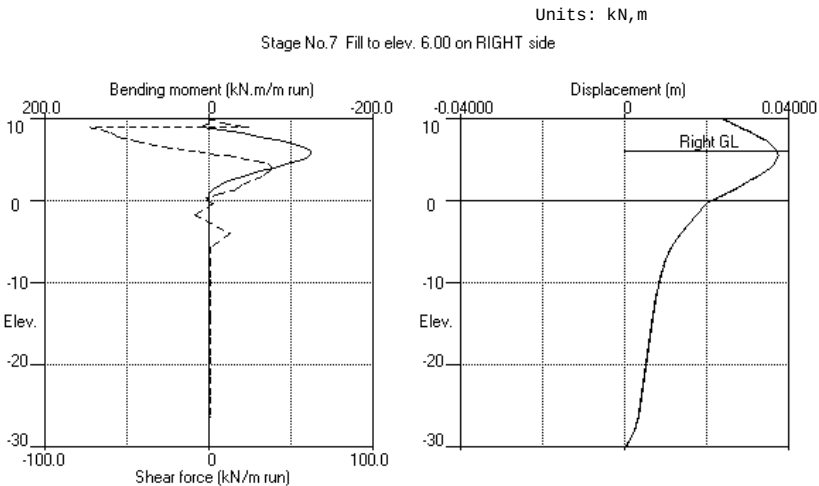
Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	10.00	2.04	0.024	-4.17E-03	0.0	0.0	
2	9.50	34.41	0.026	-4.17E-03	9.1	0.5	
3	9.00	25.08	0.028	-4.21E-03	24.0	9.7	-96.7
		25.08	0.028	-4.21E-03	-72.7	9.7	
4	8.63	16.02	0.030	-4.20E-03	-65.0	-15.7	
5	8.25	11.38	0.031	-4.04E-03	-59.9	-38.8	
6	8.00	12.92	0.032	-3.86E-03	-56.8	-53.3	
7	7.85	14.67	0.033	-3.73E-03	-54.8	-61.6	
		15.92	0.033	-3.73E-03	-54.8	-61.6	
8	7.25	22.56	0.035	-3.02E-03	-43.2	-91.2	
9	6.93	26.18	0.036	-2.53E-03	-35.3	-104.0	
10	6.60	29.77	0.036	-1.98E-03	-26.2	-114.1	
11	6.00	36.22	0.037	-8.85E-04	-6.4	-124.1	
12	5.75	38.01	0.037	-4.05E-04	2.9	-124.5	
13	5.50	39.74	0.037	7.08E-05	12.6	-122.6	
		38.43	0.037	7.08E-05	12.6	-122.6	
14	5.25	26.28	0.037	5.35E-04	20.7	-118.4	
15	4.85	19.51	0.037	1.23E-03	29.8	-108.2	
16	4.45	12.75	0.036	1.86E-03	36.3	-94.8	
		8.88	0.036	1.86E-03	36.3	-94.8	
17	4.03	1.32	0.035	2.43E-03	38.4	-78.6	
18	3.60	-6.42	0.034	2.89E-03	37.4	-62.2	
19	3.00	-12.13	0.032	3.37E-03	31.8	-41.0	
20	2.40	-11.00	0.030	3.67E-03	24.8	-24.2	
21	1.93	-9.33	0.029	3.81E-03	20.0	-13.7	
22	1.45	-7.06	0.027	3.87E-03	16.1	-5.3	
		-20.56	0.027	3.87E-03	16.1	-5.3	
23	0.93	-17.62	0.025	3.90E-03	6.1	0.3	
24	0.40	-14.27	0.023	3.89E-03	-2.3	1.0	
		-1.02	0.023	3.89E-03	-2.3	1.0	

Brigham Creek
Road crossing
Driver shaft

(continued)
Stage No.7 Fill to elevation 6.00 on RIGHT side with soil type 1

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
25	0.00	7.62	0.021	3.89E-03	-0.9	-0.0	
26	-0.25	16.73	0.020	0	2.1	0.0	
		-2.84	0.020	0	2.1	0.0	
27	-1.65	-12.83	0.018	0	-8.9	0.0	
		8.03	0.018	0	-8.9	0.0	
28	-4.00	10.64	0.014	0	13.1	0.0	
		-15.97	0.014	0	13.1	0.0	
29	-5.60	0.01	0.011	0	0.3	0.0	
30	-7.20	0.20	0.010	0	0.5	0.0	
31	-9.60	0.00	0.009	0	0.7	0.0	
32	-12.00	-0.01	0.008	0	0.7	0.0	
33	-14.40	-0.01	0.007	0	0.7	0.0	
34	-16.80	-0.01	0.006	0	0.6	0.0	
35	-19.20	-0.02	0.005	0	0.6	0.0	
36	-21.60	-0.02	0.005	0	0.6	0.0	
37	-24.00	-0.02	0.004	0	0.5	0.0	
38	-26.40	-0.11	0.003	0	0.4	0.0	
39	-28.20	-0.01	0.002	0	0.3	0.0	
40	-30.00	-0.28	0.000	0	0.0	0.0	
At elev. 9.00		Prop force = 96.7 kN/m run					

LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Total earth
Adjusted soil							
LEFT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Total earth
Adjusted soil							
RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Total earth
Adjusted soil							
RIGHT side							
Effective stresses							
Node	Y	Water	Vertic	Active	Passive	Earth	Total earth
Adjusted soil							



TONKIN and TAYLOR GROUP LTD.
Program: WALLAP Version 6.07 Revision A55.B74.R58
Licensed from GEOSOLVE
Data filename/Run ID: Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)
Sheet No.
Job No. 1013050
Made by : op
Date: 4-05-2022
Checked :

Units: kN,m
Stage No. 8 Apply water pressure profile no.1

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

Stage No.	Ground level Act.	Ground level Pass.	Prop Elev.	FoS for toe Factor of Safety	Toe elev. for Moment of equilib. at elev.	Toe Wall Penetr-ation	Direction of failure
8	10.00	6.00	9.00	1.437	n/a	***	L to R

Legend: *** Result not found

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall
Analysis options

Length of wall perpendicular to section = 20.00m
2-D finite element model. Active limit arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.05
Right side = 1.04

Rigid boundaries: Left side 30.00 from wall
Right side 30.00 from wall
Lower rigid boundary at elevation -30.00
Rough boundary
Rough boundary
Rough boundary

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
1	10.00	4.67	0.023	-4.81E-03	0.0	0.0	
2	9.50	36.99	0.026	-4.82E-03	10.4	0.9	
3	9.00	27.99	0.028	-4.86E-03	26.7	11.1	-113.2
		27.99	0.028	-4.86E-03	-86.5	11.1	
4	8.63	18.97	0.030	-4.84E-03	-77.7	-19.2	
5	8.25	17.66	0.032	-4.65E-03	-70.8	-46.9	
6	8.00	20.46	0.033	-4.43E-03	-66.1	-63.9	
7	7.85	22.13	0.034	-4.27E-03	-62.9	-73.5	
		23.40	0.034	-4.27E-03	-62.9	-73.5	
8	7.25	29.75	0.036	-3.44E-03	-46.9	-106.7	
9	6.93	33.14	0.037	-2.87E-03	-36.7	-120.3	
10	6.60	36.50	0.038	-2.24E-03	-25.4	-130.4	
11	6.00	42.67	0.039	-1.00E-03	-1.6	-138.7	
12	5.75	34.45	0.039	-4.67E-04	8.0	-137.8	
13	5.50	32.64	0.039	5.80E-05	16.4	-134.7	
		41.38	0.039	5.80E-05	16.4	-134.7	
14	5.25	26.96	0.039	5.67E-04	24.9	-129.5	
15	4.85	19.91	0.039	1.33E-03	34.3	-117.6	
16	4.45	12.85	0.038	2.00E-03	40.8	-102.3	
		8.03	0.038	2.00E-03	40.8	-102.3	
17	4.03	0.06	0.037	2.62E-03	42.6	-84.3	
18	3.60	-7.84	0.036	3.11E-03	40.9	-66.2	
19	3.00	-13.59	0.034	3.62E-03	34.5	-43.2	
20	2.40	-12.41	0.031	3.93E-03	26.7	-25.0	
21	1.93	-10.62	0.030	4.07E-03	21.2	-13.8	
22	1.45	-8.00	0.028	4.14E-03	16.8	-4.9	
		-22.31	0.028	4.14E-03	16.8	-4.9	

Run ID. Whenuapai-BCRcross-DriveShaft_v3
Whenuapai - Brigham Creek Road crossing - Drive shaft
Sheet pile STU1800 w 250UC89 (v3)
Sheet No.
Date: 4-05-2022
Checked :

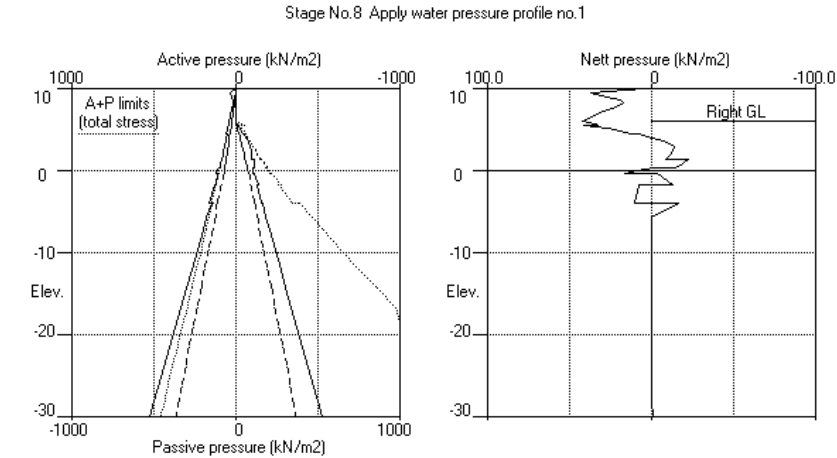
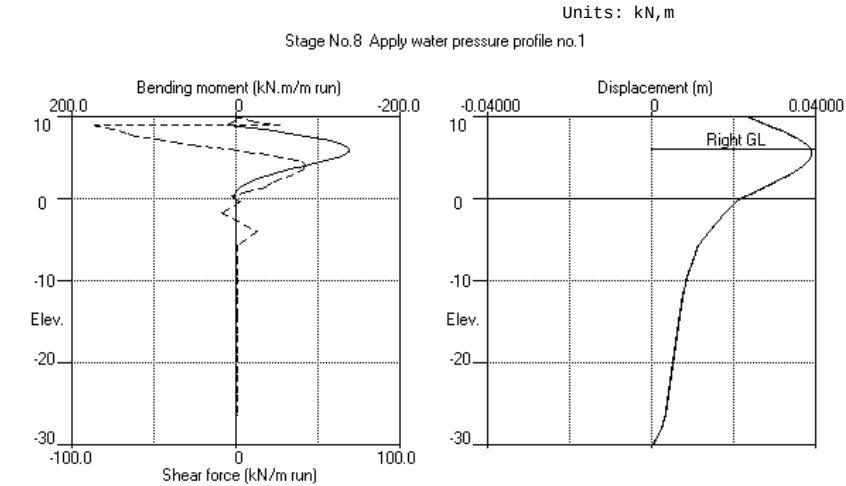
Brigham Creek
Road crossing
Driver shaft

Stage No.8 Apply water pressure profile no.1

(continued)

Node no.	Y coord	Nett pressure kN/m2	Wall disp. m	Wall rotation rad.	Shear force kN/m	Bending moment kN.m/m	Prop forces kN/m
23	0.93	-18.73	0.025	4.16E-03	6.0	0.7	
24	0.40	-14.50	0.023	4.15E-03	-2.7	1.2	
		-1.24	0.023	4.15E-03	-2.7	1.2	
25	0.00	9.09	0.022	4.15E-03	-1.1	-0.0	
26	-0.25	16.73	0.021	0	2.1	0.0	
		-2.84	0.021	0	2.1	0.0	
27	-1.65	-12.83	0.018	0	-8.9	0.0	
		8.03	0.018	0	-8.9	0.0	
28	-4.00	10.64	0.014	0	13.1	0.0	
		-15.97	0.014	0	13.1	0.0	
29	-5.60	0.01	0.011	0	0.3	0.0	
30	-7.20	0.20	0.010	0	0.5	0.0	
31	-9.60	0.00	0.009	0	0.7	0.0	
32	-12.00	-0.01	0.008	0	0.7	0.0	
33	-14.40	-0.01	0.007	0	0.7	0.0	
34	-16.80	-0.01	0.006	0	0.6	0.0	
35	-19.20	-0.02	0.005	0	0.6	0.0	
36	-21.60	-0.02	0.005	0	0.6	0.0	
37	-24.00	-0.02	0.004	0	0.5	0.0	
38	-26.40	-0.11	0.003	0	0.4	0.0	
39	-28.20	-0.01	0.002	0	0.3	0.0	
40	-30.00	-0.28	0.000	0	0.0	0.0	
At elev. 9.00		Prop force = 113.2 kN/m run					

LEFT side							
		Effective stresses				Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth	
LEFT side							
		Effective stresses				Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth	
RIGHT side							
		Effective stresses				Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth	
RIGHT side							
		Effective stresses				Total earth	Adjusted soil
Node	Y	Water	Vertic	Active	Passive	Earth	



Units: kN,m

Summary of results

STABILITY ANALYSIS of Fully Embedded Wall according to Strength Factor method
Factor of safety on soil strength

<u>Stage</u> <u>No.</u>	<u>Ground</u> <u>Act.</u>	<u>level</u> <u>Pass.</u>	<u>Prop</u> <u>Elev.</u>	FoS for toe elev. = 0.00		Toe elev. for FoS = 1.500		<u>Direction</u> <u>of</u> <u>failure</u>
				<u>Factor</u> <u>of</u> <u>Safety</u>	<u>Moment</u> <u>at elev.</u> <u>of equil.</u>	<u>Toe</u> <u>elev.</u>	<u>Wall</u> <u>Penetr</u> <u>-ation</u>	
1	10.00	10.00	Cant.	Conditions not suitable for FoS calc.				
2	10.00	10.00	Cant.	Conditions not suitable for FoS calc.				
3	10.00	8.25	Cant.	2.144	0.72	4.26	3.99	L to R
4	10.00	8.25		No analysis at this stage				
5	10.00	8.25	9.00	4.512	n/a	7.13	1.12	L to R
6	10.00	5.50	9.00	1.292	n/a	***	***	L to R
7	10.00	6.00	9.00	1.719	n/a	1.18	4.82	L to R
8	10.00	6.00	9.00	1.437	n/a	***	***	L to R

Legend: *** Result not found

Summary of results

Units: kN,m

BENDING MOMENT and DISPLACEMENT ANALYSIS of Fully Embedded Wall

Analysis options
Length of wall perpendicular to section = 20.00m
2-D finite element model. Active limit arching not modelled.
Soil deformations are elastic until the active or passive limit is reached
Open Tension Crack analysis - No
All soil moduli were factored to take account of
3-D effects due to the finite length of wall:
Modulus factors - Left side = 1.05
Right side = 1.04

Rigid boundaries: Left side 30.00 from wall Rough boundary
Right side 30.00 from wall Rough boundary
Lower rigid boundary at elevation -30.00 Rough boundary

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
1	10.00	0.029	0.000	0.0	-0.0	0.0	0.0
2	9.50	0.028	0.000	0.9	-0.1	10.4	-0.9
3	9.00	0.028	0.000	11.1	-0.8	26.7	-86.5
4	8.63	0.030	0.000	2.8	-19.2	5.6	-77.7
5	8.25	0.032	0.000	5.6	-46.9	9.4	-70.8
6	8.00	0.033	0.000	8.2	-63.9	9.4	-66.1
7	7.85	0.034	0.000	9.5	-73.5	7.9	-62.9
8	7.25	0.036	0.000	13.0	-106.7	4.3	-46.9
9	6.93	0.037	0.000	14.2	-120.3	3.3	-37.0
10	6.60	0.038	0.000	15.1	-130.4	2.4	-28.0
11	6.00	0.039	0.000	16.1	-138.7	1.1	-8.5
12	5.75	0.039	0.000	16.3	-137.8	8.0	-1.3
13	5.50	0.039	0.000	16.4	-134.7	16.4	-0.1
14	5.25	0.039	0.000	16.6	-129.5	24.9	0.0
15	4.85	0.039	0.000	16.9	-117.6	34.3	0.0
16	4.45	0.038	0.000	17.3	-102.3	40.8	0.0
17	4.03	0.037	0.000	17.3	-84.4	42.6	-1.3
18	3.60	0.036	0.000	16.2	-67.6	40.9	-3.2
19	3.00	0.034	0.000	13.7	-45.6	34.5	-4.3
20	2.40	0.032	0.000	10.9	-27.7	26.7	-4.3
21	1.93	0.030	0.000	9.0	-16.3	22.1	-3.4
22	1.45	0.029	0.000	7.7	-6.9	18.5	-1.7
23	0.93	0.027	0.000	5.7	-0.3	7.5	-5.2
24	0.40	0.024	0.000	2.2	0.0	0.0	-7.2
25	0.00	0.023	0.000	0.0	-0.0	0.0	-2.1
26	-0.25	0.022	0.000	0.0	0.0	2.4	0.0
27	-1.65	0.019	0.000	0.0	0.0	0.0	-10.2
28	-4.00	0.015	0.000	0.0	0.0	14.9	0.0
29	-5.60	0.013	0.000	0.0	0.0	0.3	0.0
30	-7.20	0.011	0.000	0.0	0.0	0.5	0.0
31	-9.60	0.010	0.000	0.0	0.0	0.7	0.0
32	-12.00	0.009	0.000	0.0	0.0	0.7	0.0
33	-14.40	0.008	0.000	0.0	0.0	0.7	0.0
34	-16.80	0.007	0.000	0.0	0.0	0.7	0.0
35	-19.20	0.006	0.000	0.0	0.0	0.7	0.0
36	-21.60	0.006	0.000	0.0	0.0	0.6	0.0
37	-24.00	0.005	0.000	0.0	0.0	0.6	0.0
38	-26.40	0.004	0.000	0.0	0.0	0.4	0.0
39	-28.20	0.003	0.000	0.0	0.0	0.3	0.0

Brigham Creek
Road crossing
Driver shaft

Bending moment, shear force and displacement envelopes

Node no.	Y coord	Displacement		Bending moment		Shear force	
		maximum	minimum	maximum	minimum	maximum	minimum
		m	m	kN.m/m	kN.m/m	kN/m	kN/m
40	-30.00	0.000	0.000	0.0	0.0	0.0	0.0

Maximum and minimum bending moment and shear force at each stage

Stage no.	Bending moment				Shear force			
	maximum	elev.	minimum	elev.	maximum	elev.	minimum	elev.
	kN.m/m		kN.m/m		kN/m		kN/m	
1	0.2	0.93	-4.0	5.75	1.6	-4.00	-1.6	7.85
2	0.5	0.93	-9.4	6.00	3.9	4.45	-4.9	7.85
3	17.3	4.45	-0.0	0.00	9.4	8.00	-7.2	0.40
4	No calculation at this stage							
5	8.7	3.00	-0.0	0.00	7.4	4.45	-6.8	0.40
6	10.9	9.00	-129.0	5.75	39.1	4.03	-75.0	9.00
7	9.7	9.00	-124.5	5.75	38.4	4.03	-72.7	9.00
8	11.1	9.00	-138.7	6.00	42.6	4.03	-86.5	9.00

Maximum and minimum displacement at each stage

Stage no.	Displacement				Stage description
	maximum	elev.	minimum	elev.	
	m		m		
1	0.003	6.60	0.000	10.00	Apply surcharge no.1 at elev. 10.00
2	0.004	6.60	0.000	10.00	Apply water pressure profile no.3
3	0.029	10.00	0.000	10.00	Excav. to elev. 8.25 on RIGHT side
4	No calculation at this stage				Install prop no.1 at elev. 9.00
5	0.029	10.00	0.000	10.00	Apply water pressure profile no.2
6	0.039	5.50	0.000	10.00	Excav. to elev. 5.50 on RIGHT side
7	0.037	5.50	0.000	10.00	Fill to elev. 6.00 on RIGHT side
8	0.039	5.50	0.000	10.00	Apply water pressure profile no.1

Prop forces at each stage (horizontal components)

Stage no.	Anchor no. 1 --- at elev. 9.00	
	kN/m run	kN/prop
5	9.31	37.25
6	101.10	404.42
7	96.71	386.85
8	113.18	452.72

Appendix F Construction methodology



Sheet Pile Wall -
if required

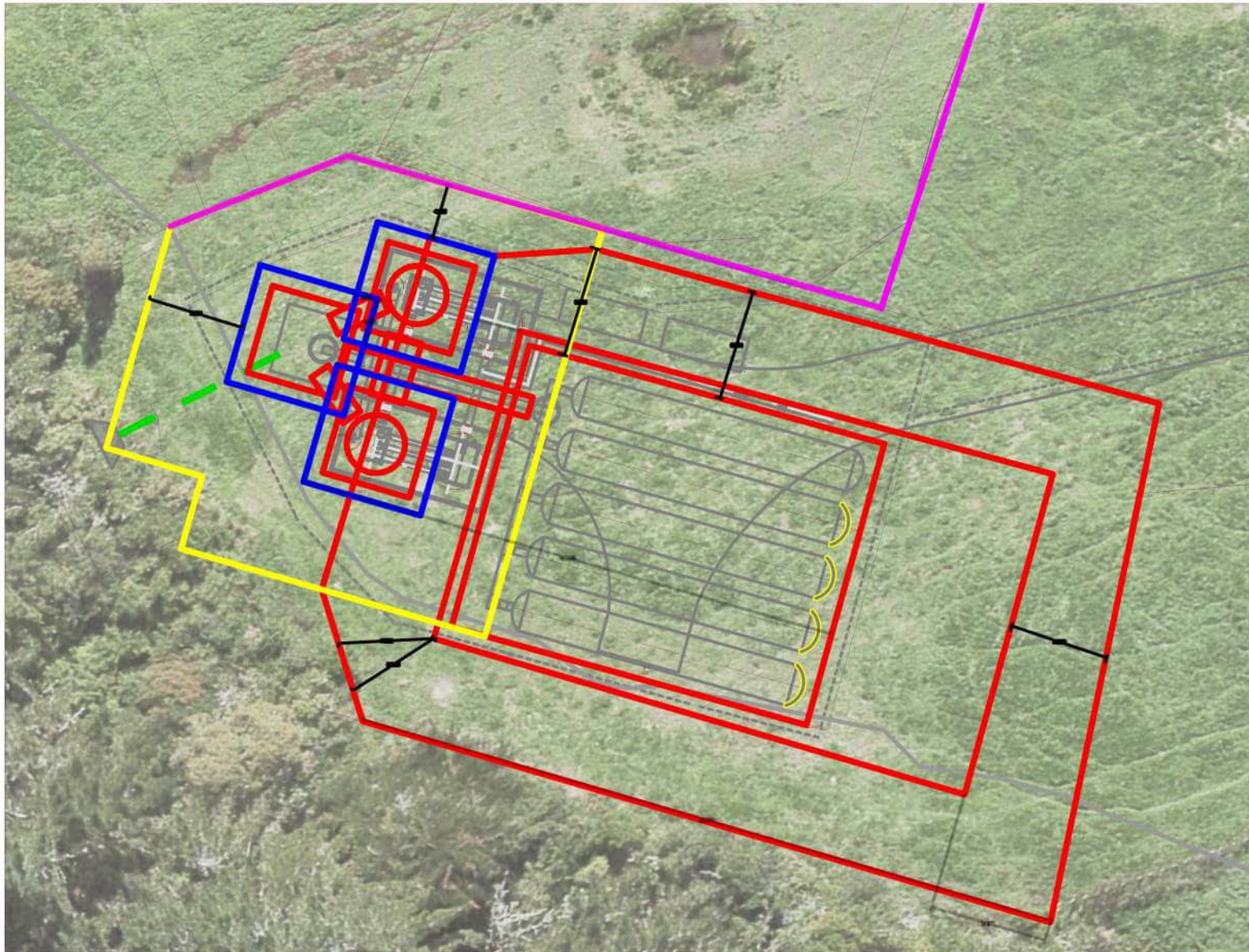
Hard Stand Area

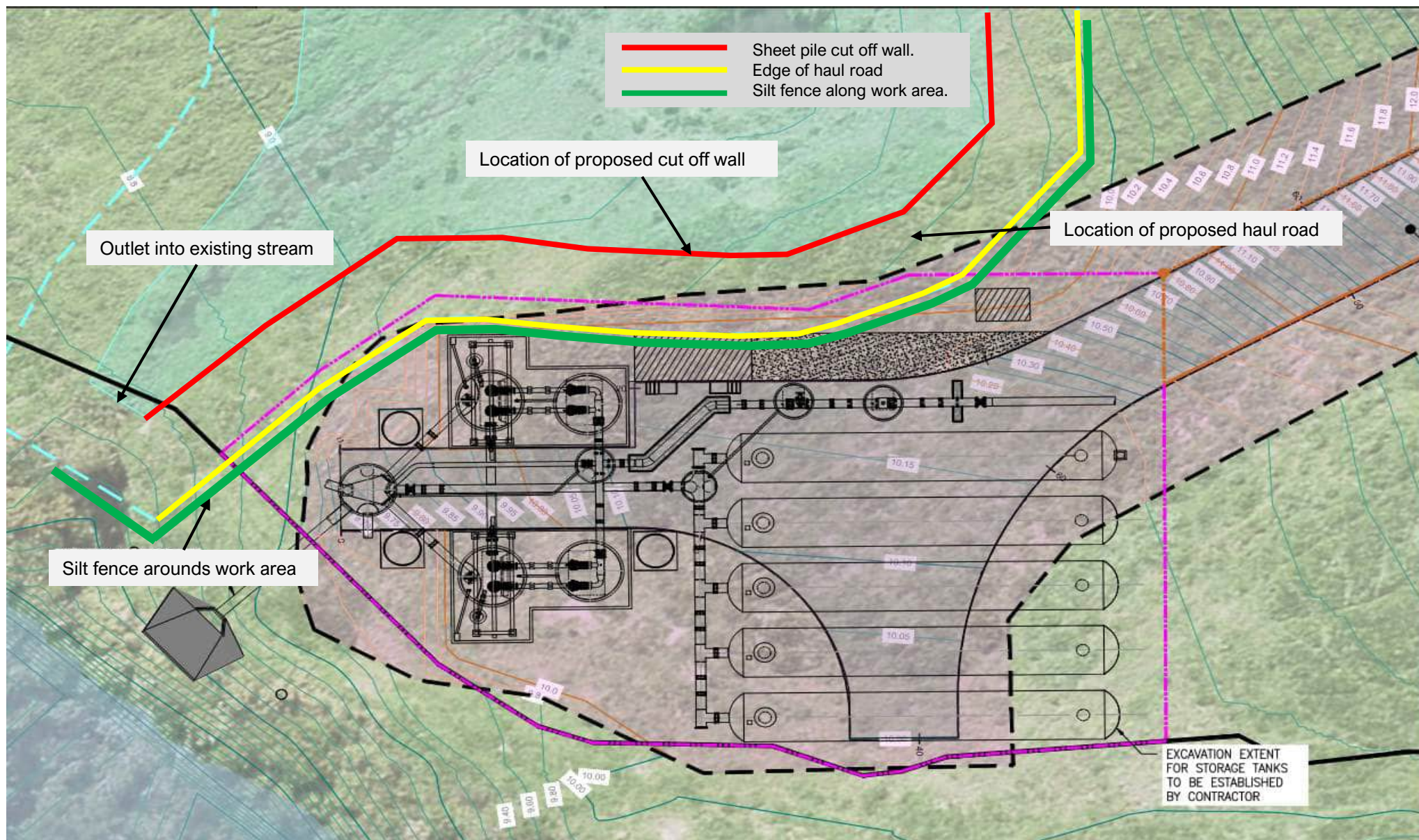
Dual Slide Rail
System

Batter

Overburden

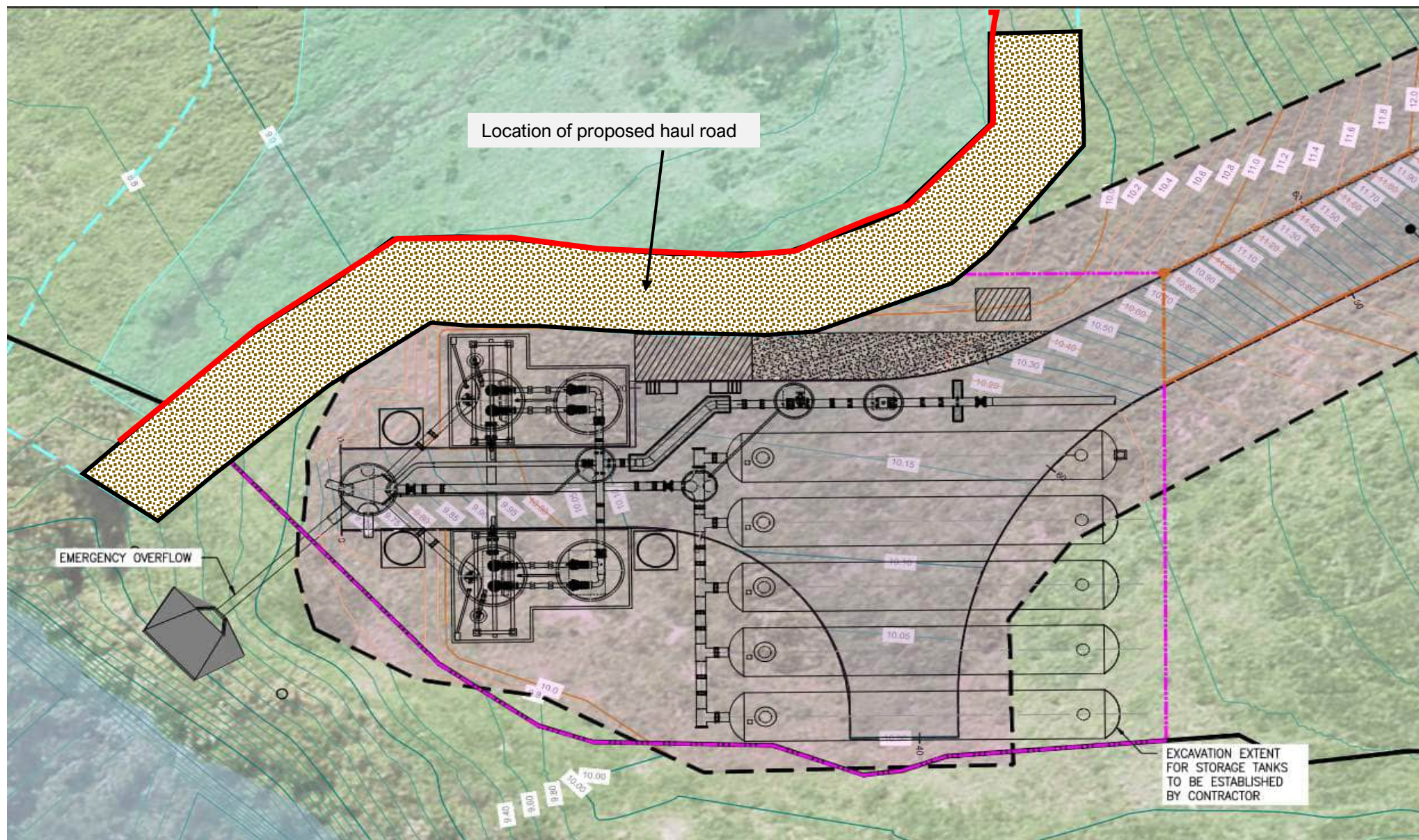
Storage Tank
Excavation





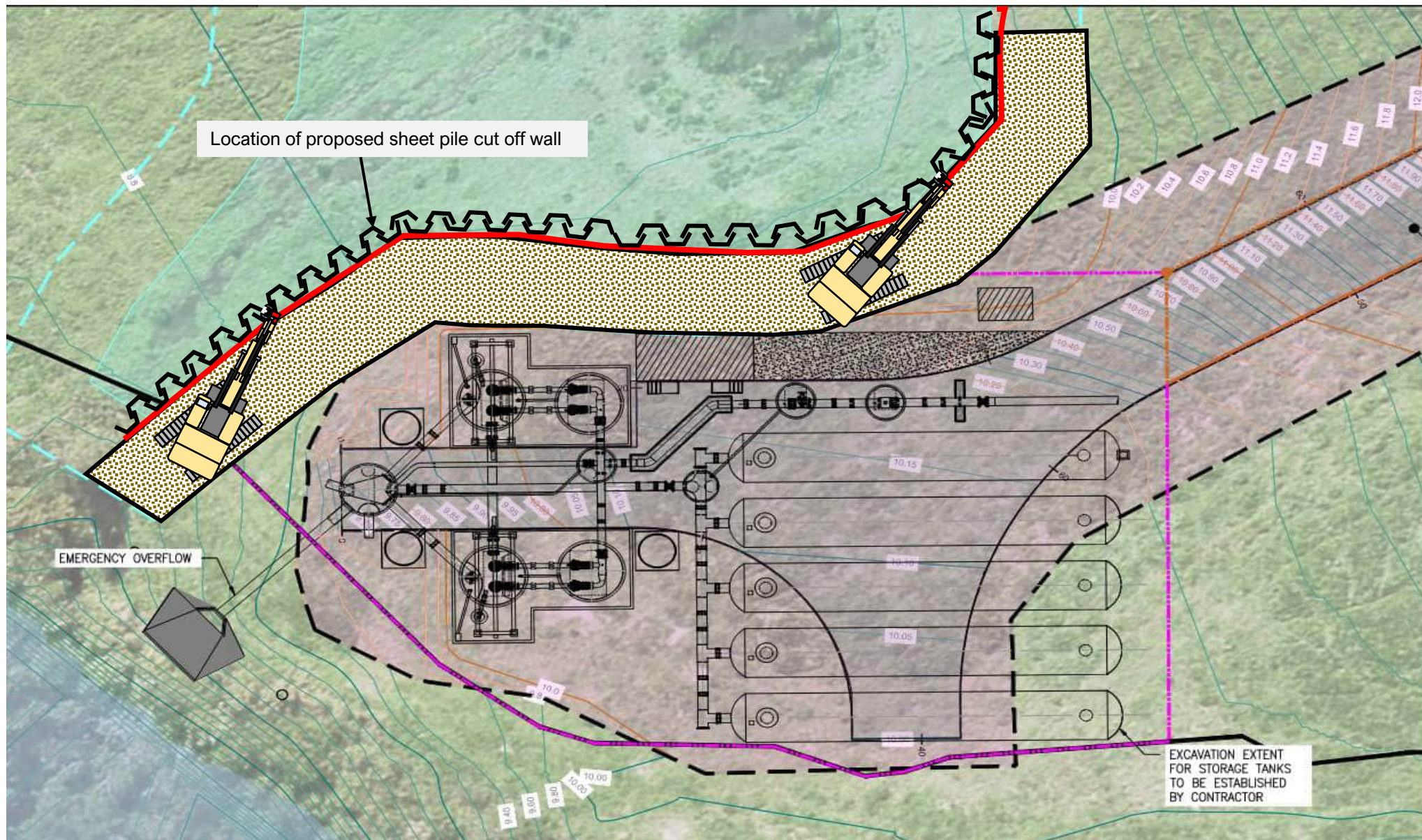
Mark out location of sheet pile cut off wall.

- Agree the outline of the Wet lands area including run off area towards the existing stream.
- Install silt fence along the edge of the proposed haul road.



Placement of haul road.

- To construct the haul road, the existing top soil will be removed and stockpiled for reinstatement, after all works are completed.
- Bidum cloth will be placed over exposed ground, next a 200mm layer of compacted hard fill will placed onto of cloth.
- Then a layer of geo-grid will be placed on top of the existing hardfill and a final 200mm layer of compacted hard fill will be placed on top of geogrid.



Installation of sheet pile cut off wall.

- Wall will consist of 6 meter long sheet piles, these will be clutched together where possible due to the curves of the outline.
- The sheets will be driven through the existing clay material and into the existing sand stone layer, by approximately 0.5 to 1 meter, depending on existing ground conditions.
- The haul road will stay in place until the project has been completed and the sheet pile wall will be removed.

10.00 m

STAGE ONE INLET MANHOLE AND WET WELLS

INLET
MANHOLE

WET WELL
ONE

WET WELL
TWO

INLET
MANHOLE

WET WELL
ONE / TWO

8.75 m

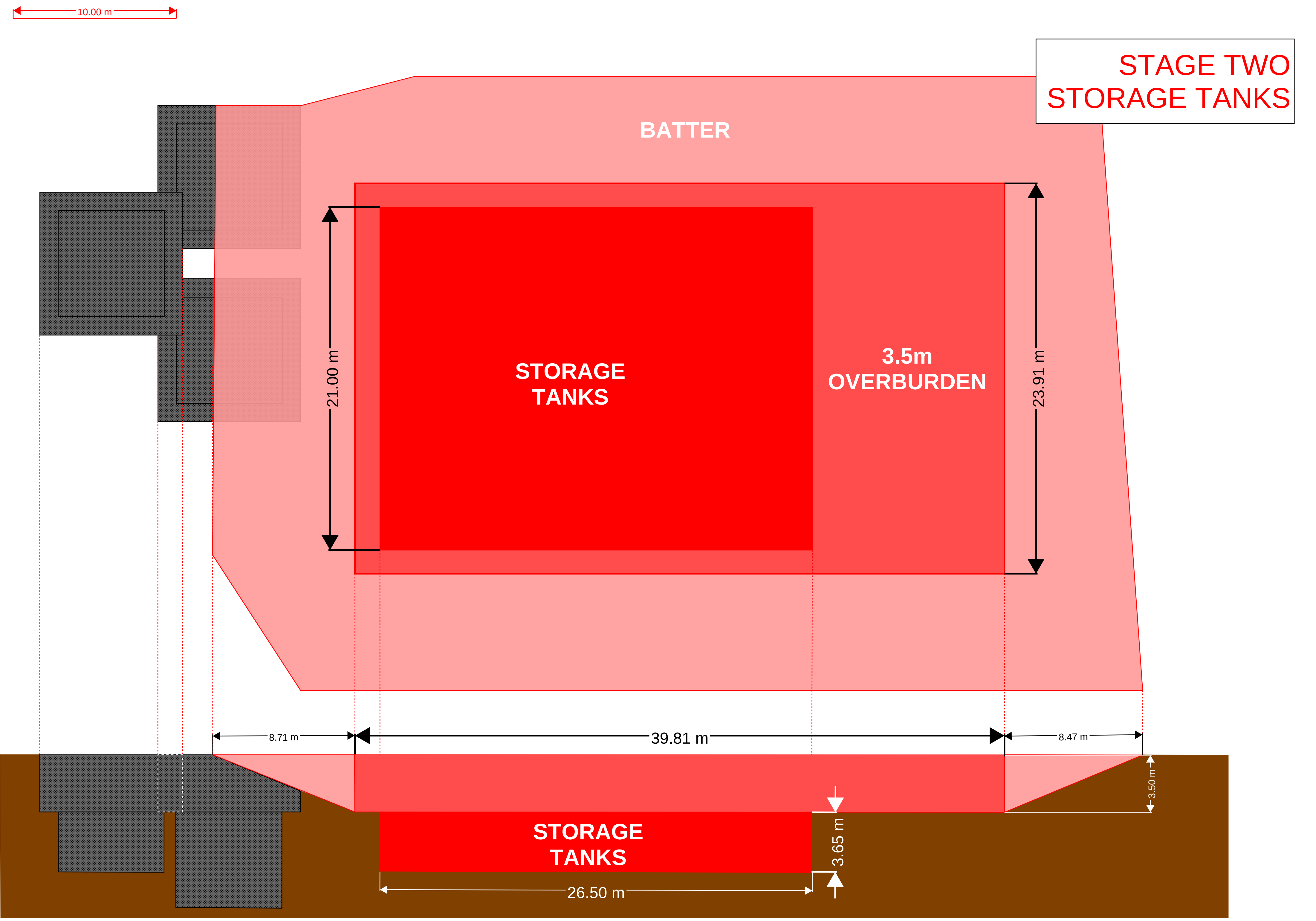
8.75 m

3.50 m
3.80 m

6.50 m

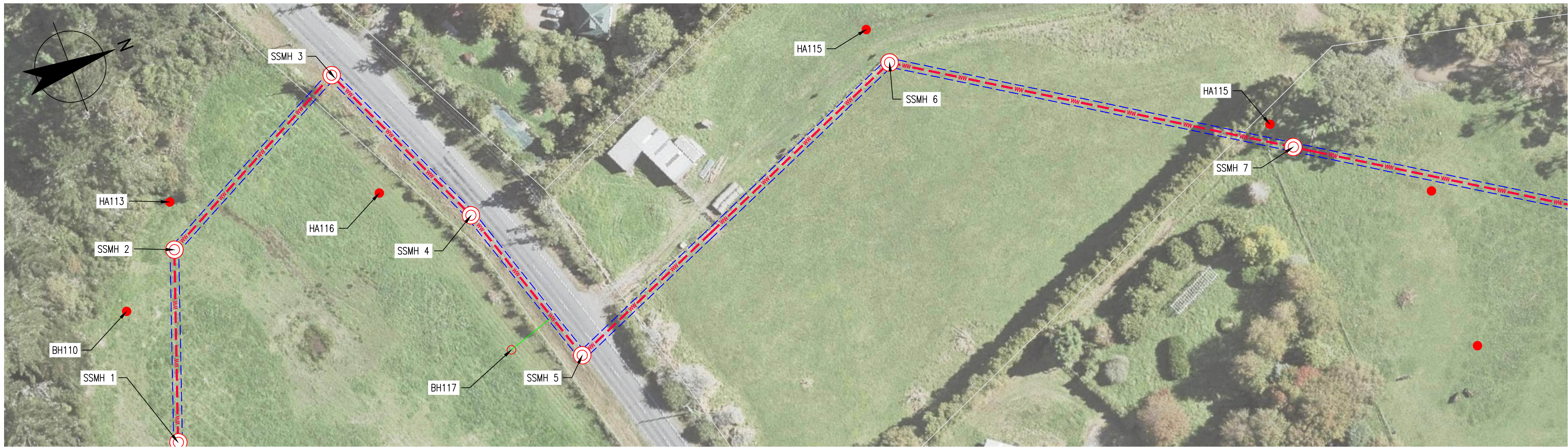
6.50 m

6.00 m

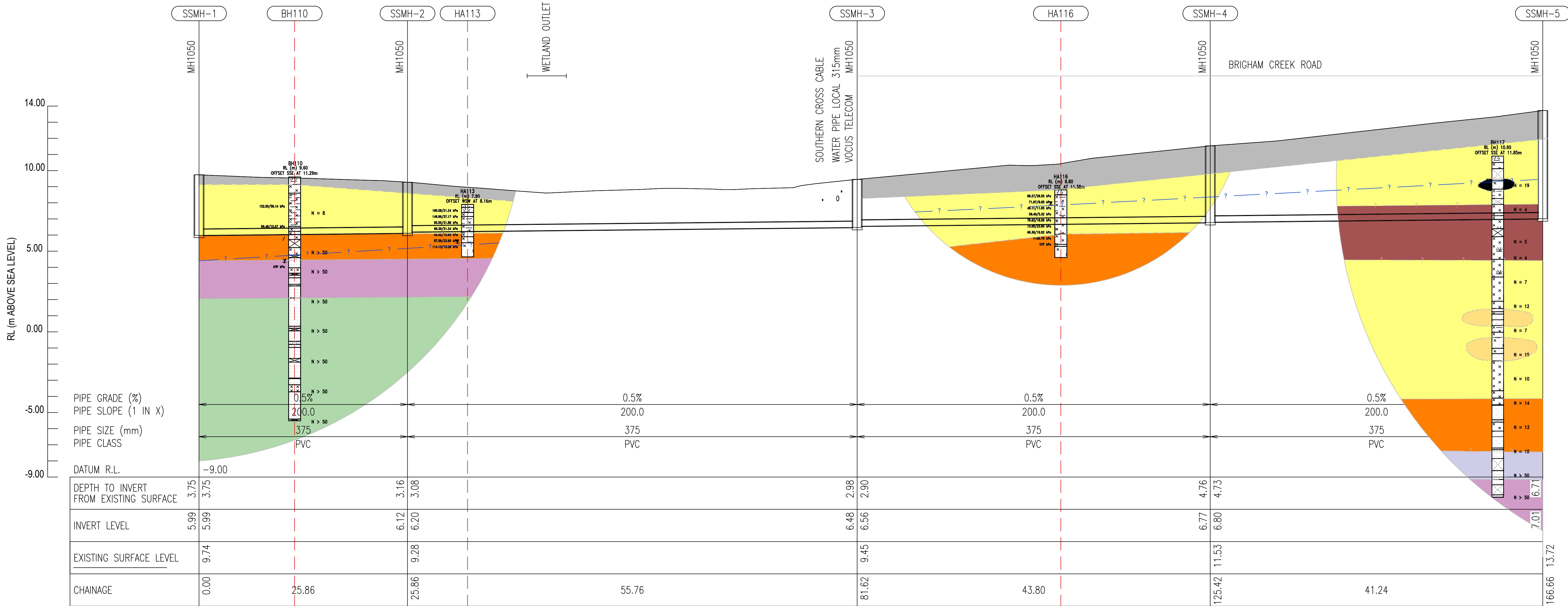
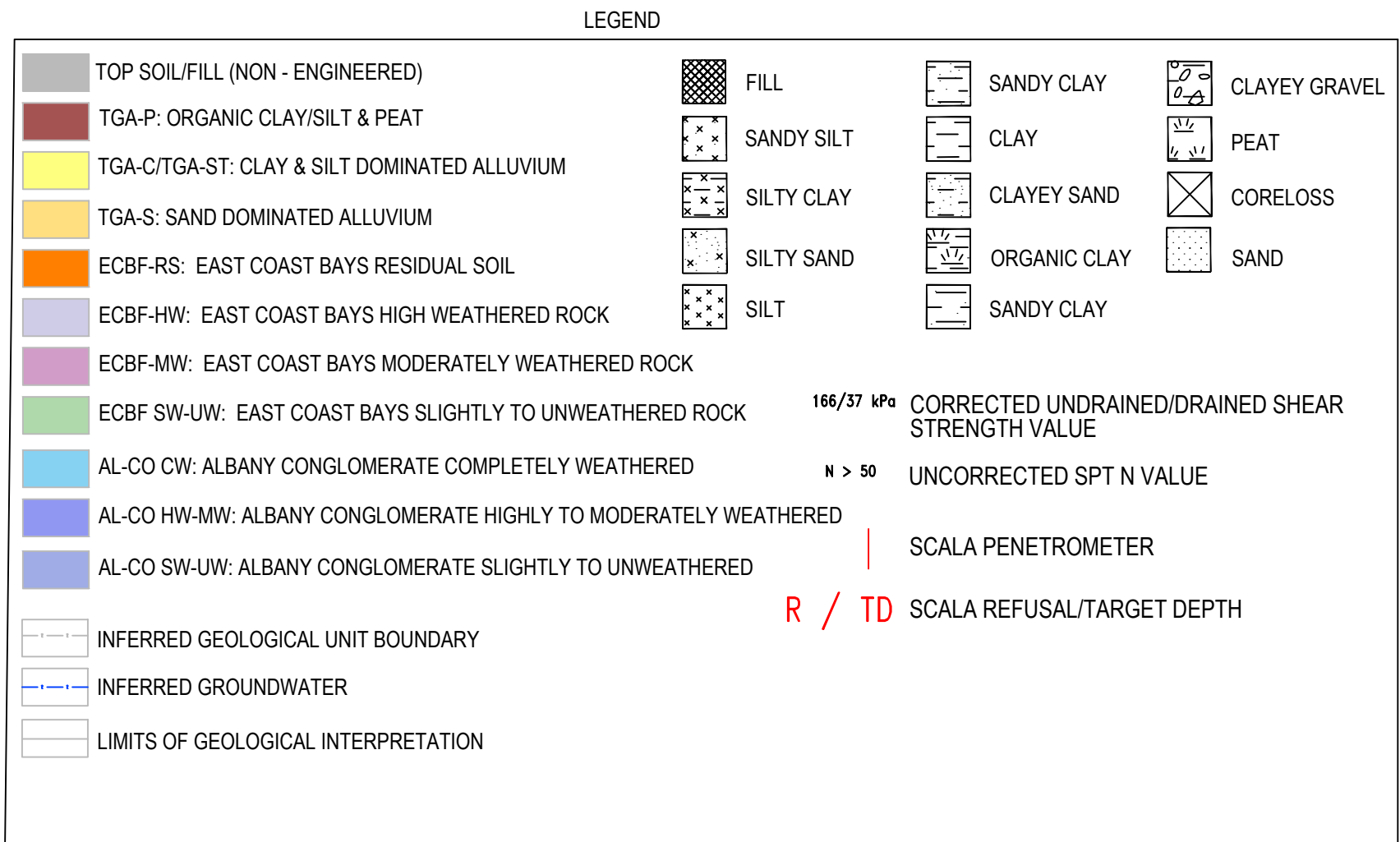


Appendix G Geological long section from GIR

Appendix D – Geological long sections

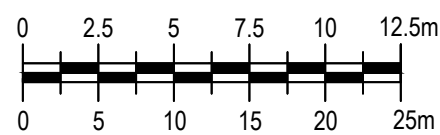


PLAN
SCALE 1:250



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Drafting Check			
Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



Level 3, GHD Centre
27 Napier Street, Freemans Bay
Auckland 1011 New Zealand
T 64 9 370 8000 F 64 9 370 8001
E aklmail@ghd.com W www.ghd.com



Project No.
12508391

Client
WATERCARE

Project
WHENUAPAI REDHILLS

Status

Drawing
Title

GEOTECHNICAL LONG SECTION
SHEET 1 OF 6

Status

Code

Drawing No.
12508391-C101

Size
A1

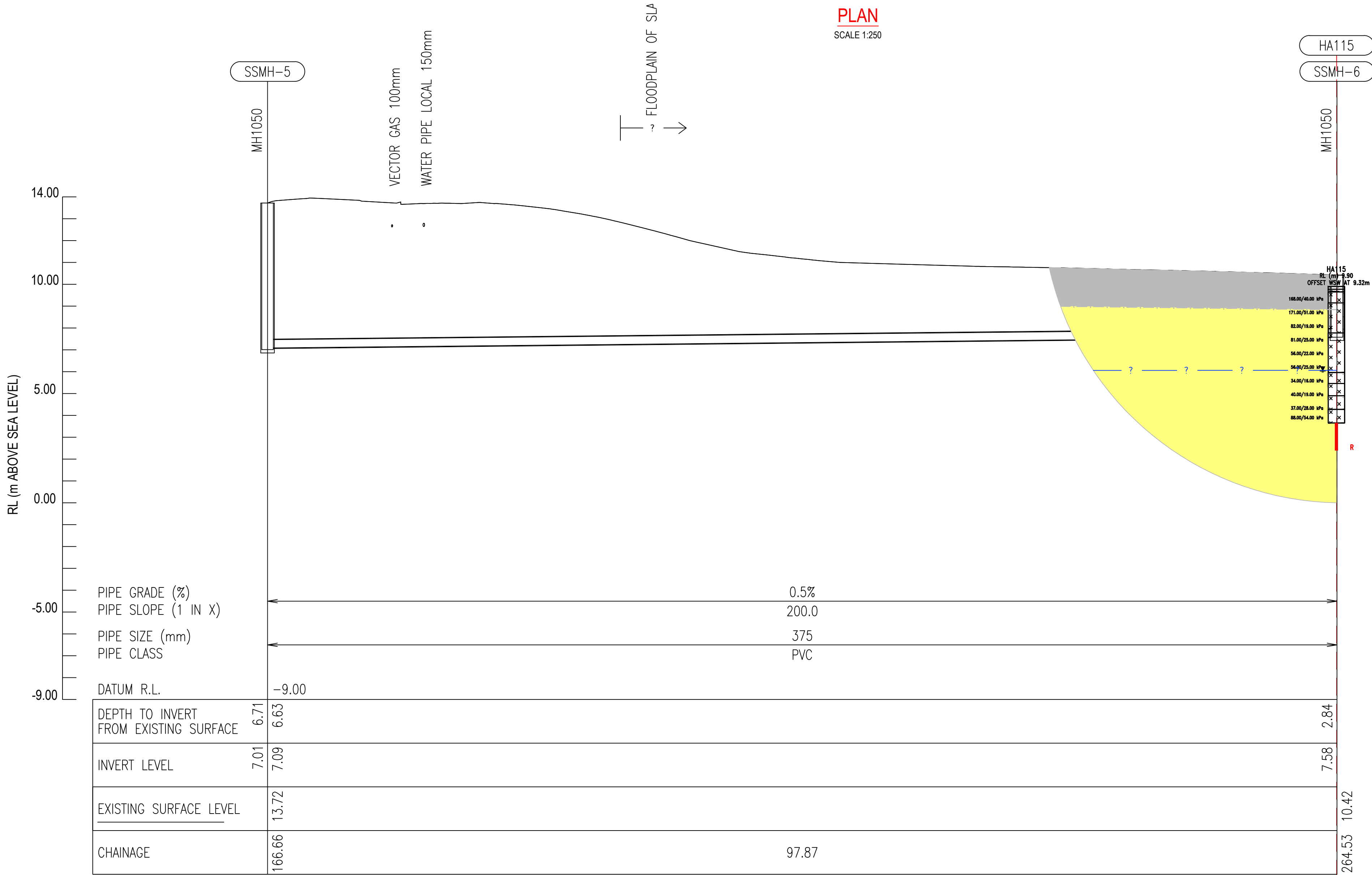
Rev
A

Plot Date: 23 March 2021 - 3:00 PM
Plotted by: Paige Boyed

File Name: \\ghdnet\ghd\NZ\Auckland\Projects\5112508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C101_C106 - PB EDIT.dwg



LEGEND							
	TOP SOIL/FILL (NON - ENGINEERED)		FILL		SANDY CLAY		CLAYEY GRAVEL
	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED				SCALA PENETROMETER		
				R / TD	SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						



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Author	Drafting Check			
Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m
0 5 10 15 20 25m



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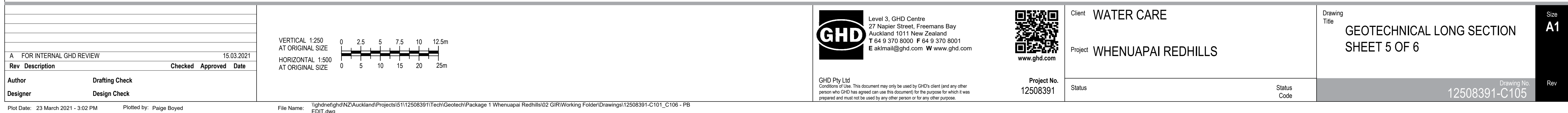
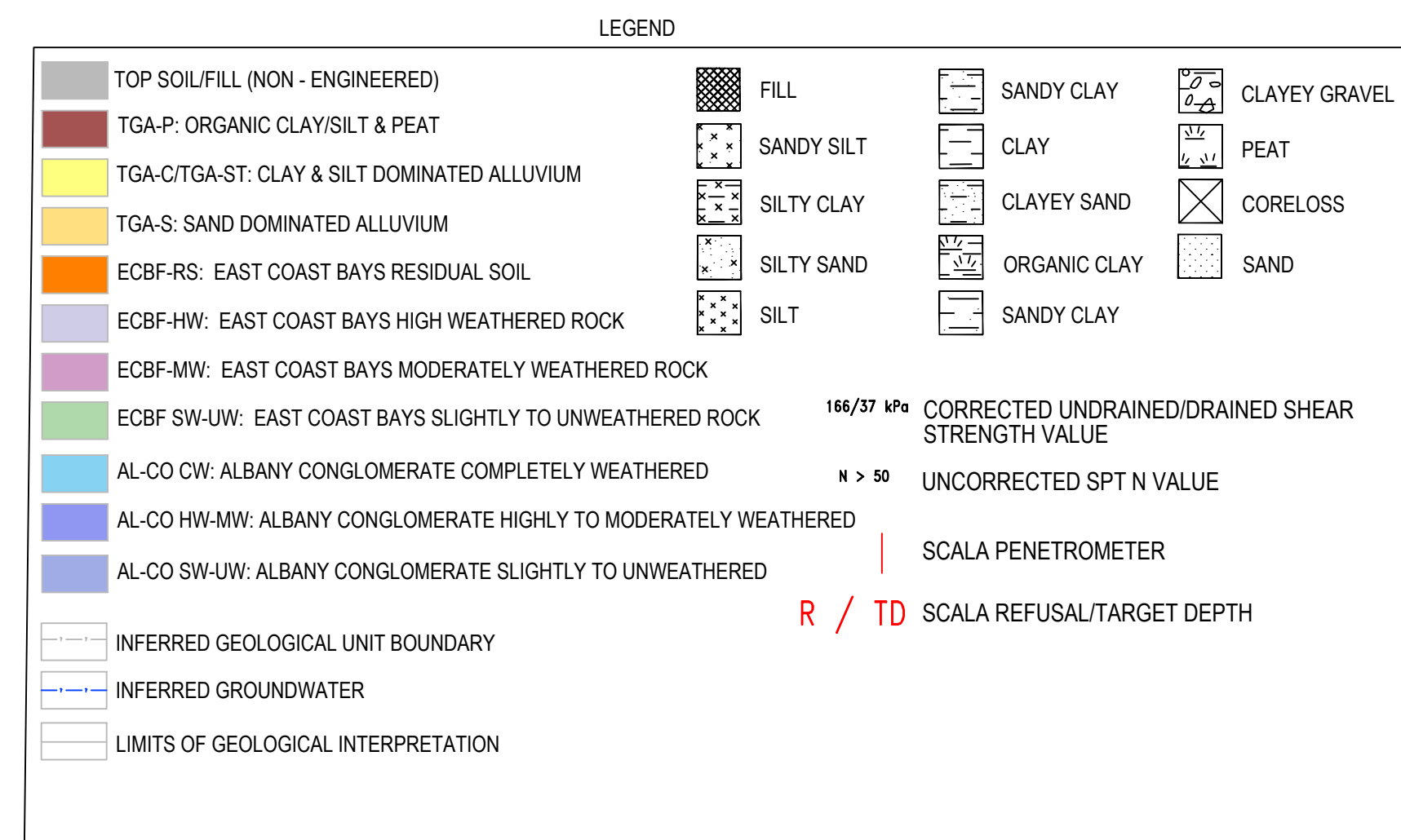


Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	Status Code

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 2 OF 6
Drawing No.	12508391-C102

Size
A1
Rev
A

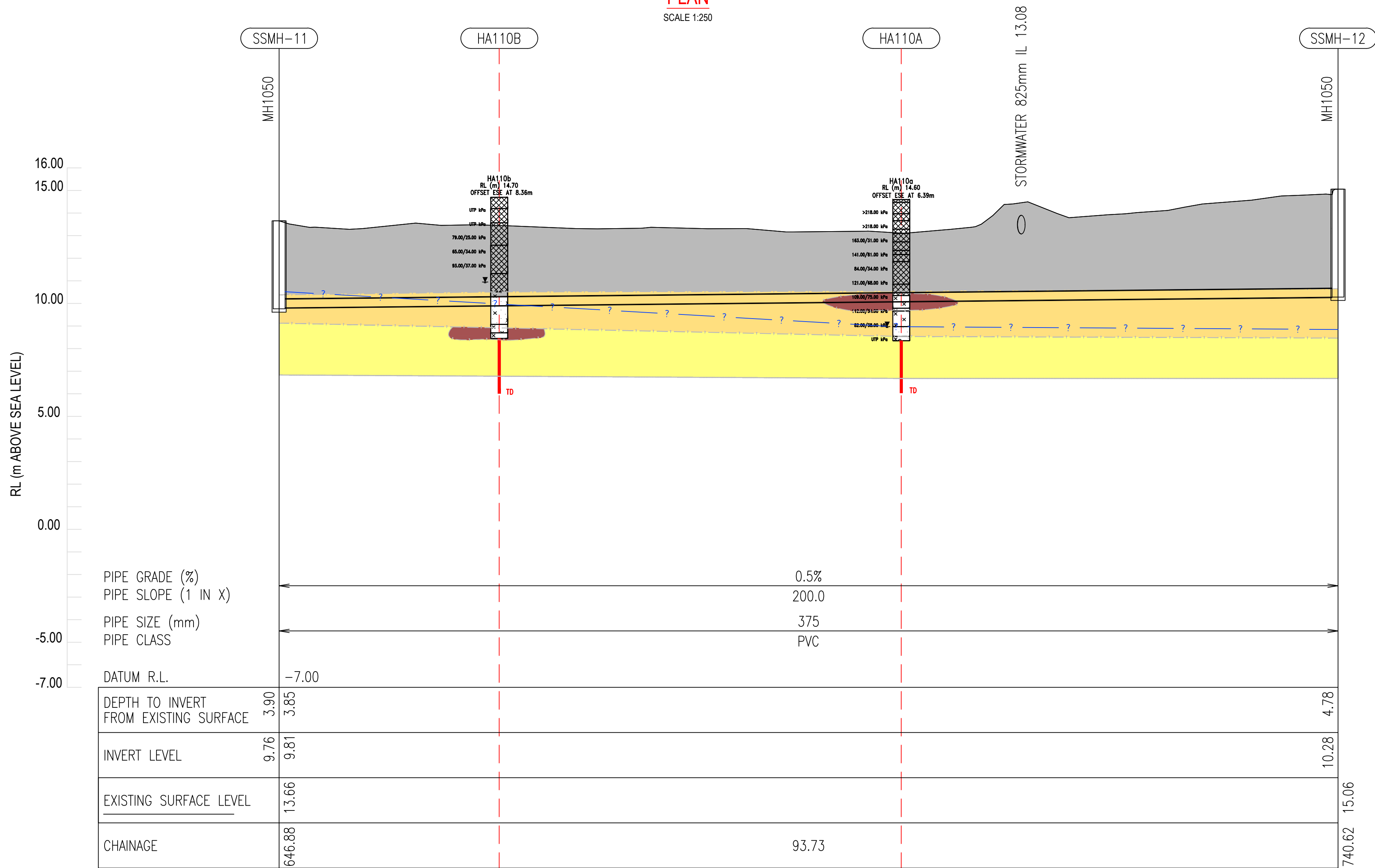




LEGEND							
	TOP SOIL/FILL (NON - ENGINEERED)		FILL		SANDY CLAY		CLAYEY GRAVEL
	TGA-P: ORGANIC CLAYS/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED				SCALA PENETROMETER		
				R / TD	SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

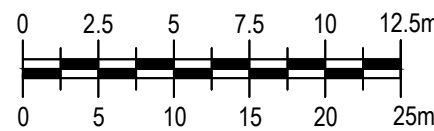
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SCALE 1:250



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Designing			
Designer	Designing			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



File Name: \\ghdnet\ghd\NZ\Auckland\Projects\5112508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C101_C106 - PB EDIT.dwg



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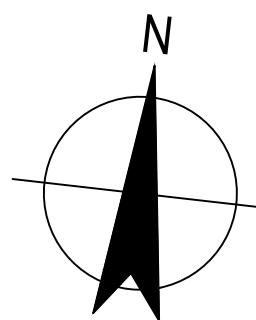


Project No.
12508391

Client	WATERCARE
Project	WHENUAPAI REDHILLS
Status	

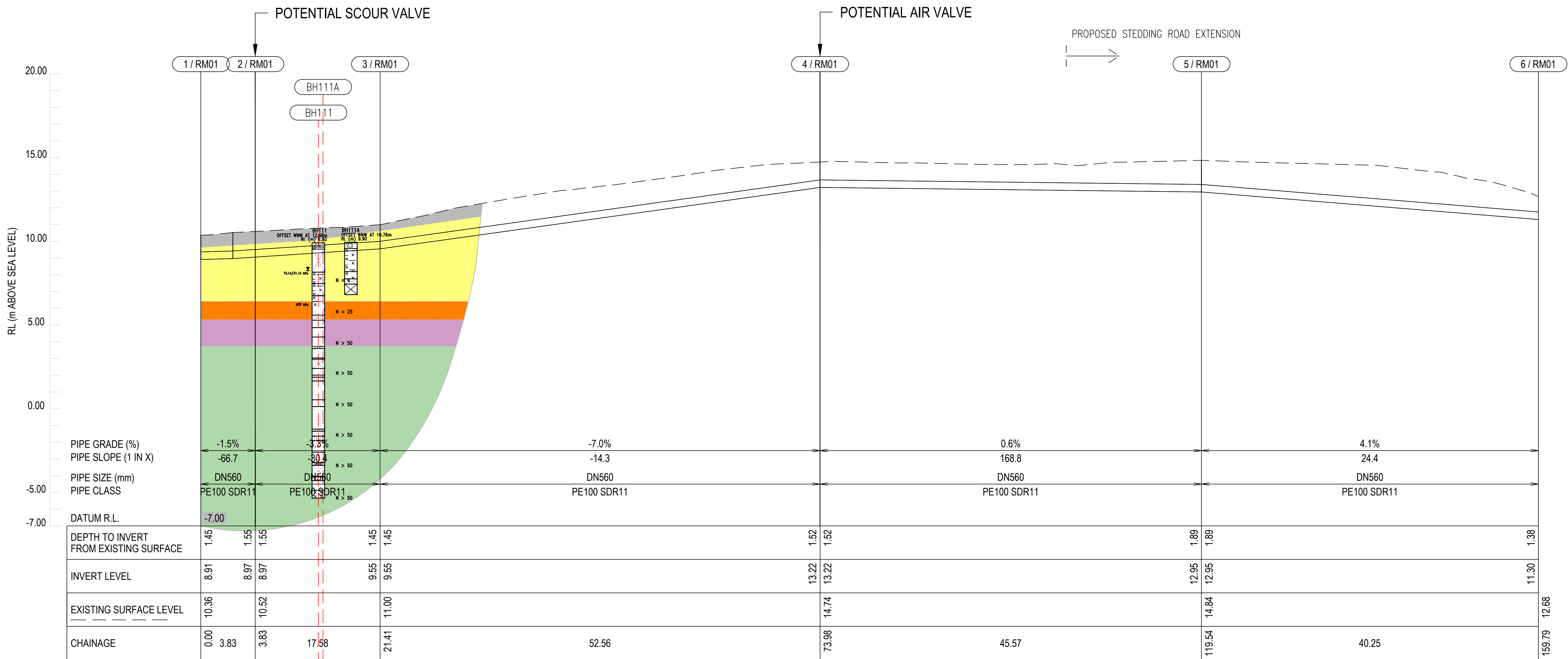
Drawing Title	GEOTECHNICAL LONG SECTION SHEET 6 OF 6
Drawing No.	12508391-C106

Size
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Rev
A



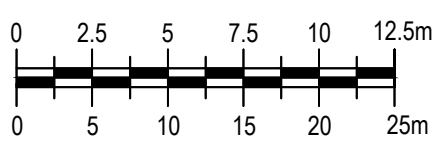
PLAN
NOT TO SCALE

LEGEND							
	TOP SOIL/FILL (NON - ENGINEERED)		FILL		SANDY CLAY		CLAYEY GRAVEL
	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED				SCALA PENETROMETER		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED				SCALA REFUSAL/TARGET DEPTH		
				R / TD			
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						



Rev	Description	Checked	Approved	Date
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Author	Drafting Check			
Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



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Project No.
12508391

Client WATER CARE
Project WHENUAPAI REDHILLS

Status

Status

Code

Drawing Title
GEOTECHNICAL LONG SECTION
SHEET 1 OF 14

Drawing No.
12508391-C201

Size
A1

Rev
A



LEGEND							
	TOP SOIL/FILL (NON - ENGINEERED)		FILL		SANDY CLAY		CLAYEY GRAVEL
	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED						
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED						
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

166/37 kPa

CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE

N > 50

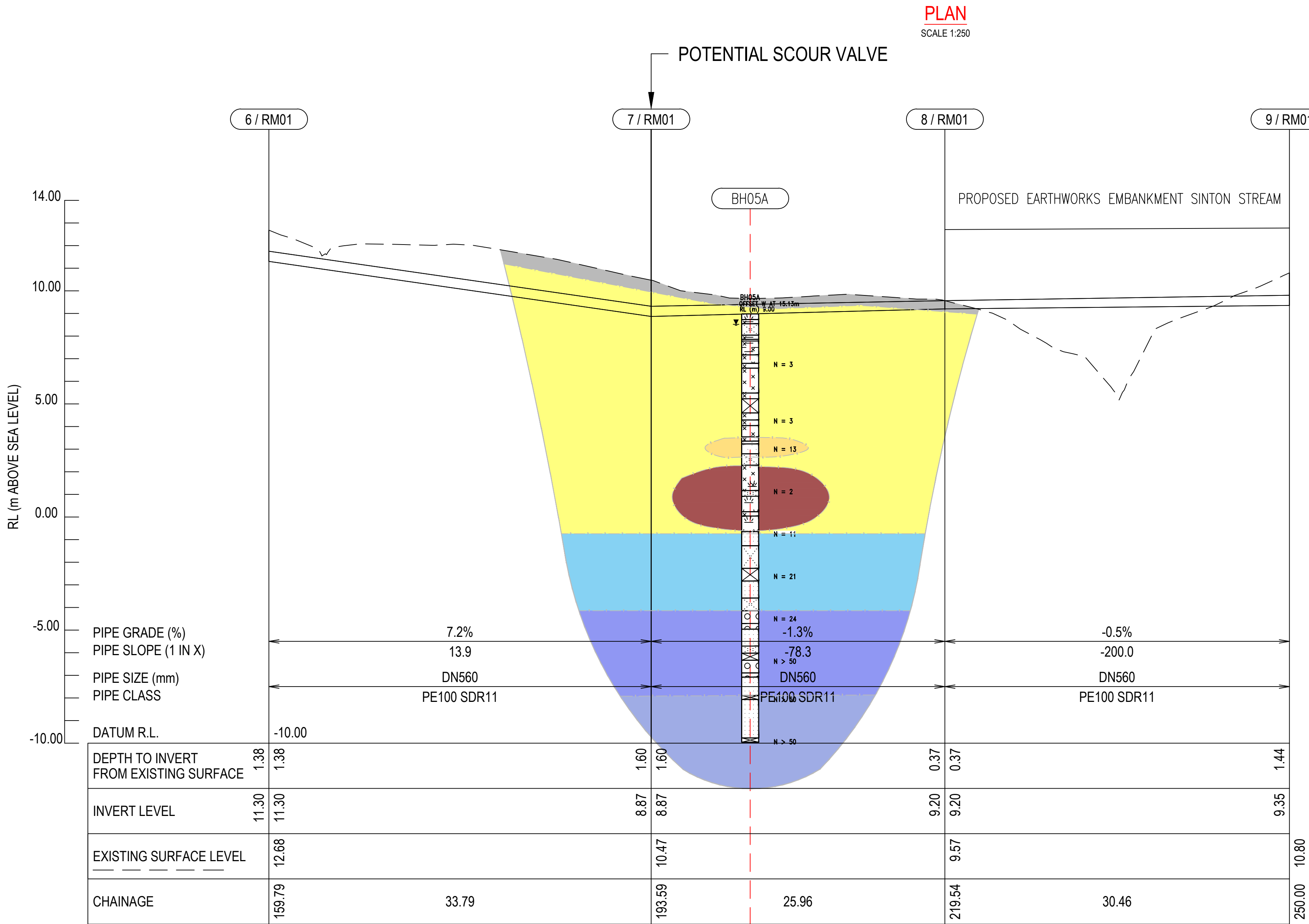
UNCORRECTED SPT N VALUE

|

SCALA PENETROMETER

R / TD

SCALA REFUSAL/TARGET DEPTH



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Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE

0 2.5 5 7.5 10 12.5m
0 5 10 15 20 25m



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Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	Status Code

Drawing Title
GEOTECHNICAL LONG SECTION
SHEET 2 OF 14

Drawing No.
12508391-C202

Size
A1

Rev
A

LEGEND

TOP SOIL/FILL (NON - ENGINEERED)

TGA-P: ORGANIC CLAY/SILT & PEAT

TGA-S: SAND DOMINATED ALLUVIUM

ECBF-RS: EAST COAST BAYS RESIDUAL SOIL

ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK

ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK

ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK

AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED

AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED

AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED

INFERRED GEOLOGICAL UNIT BOUNDARY

INFERRED GROUNDWATER

LIMITS OF GEOLOGICAL INTERPRETATION

FILL

SANDY SILT

SILT

SANDY CLAY

SILT

CLAY

CLAYEY SAND

ORGANIC CLAY

SANDY CLAY

CLAYEY GRAVEL

PEAT

CORELOSS

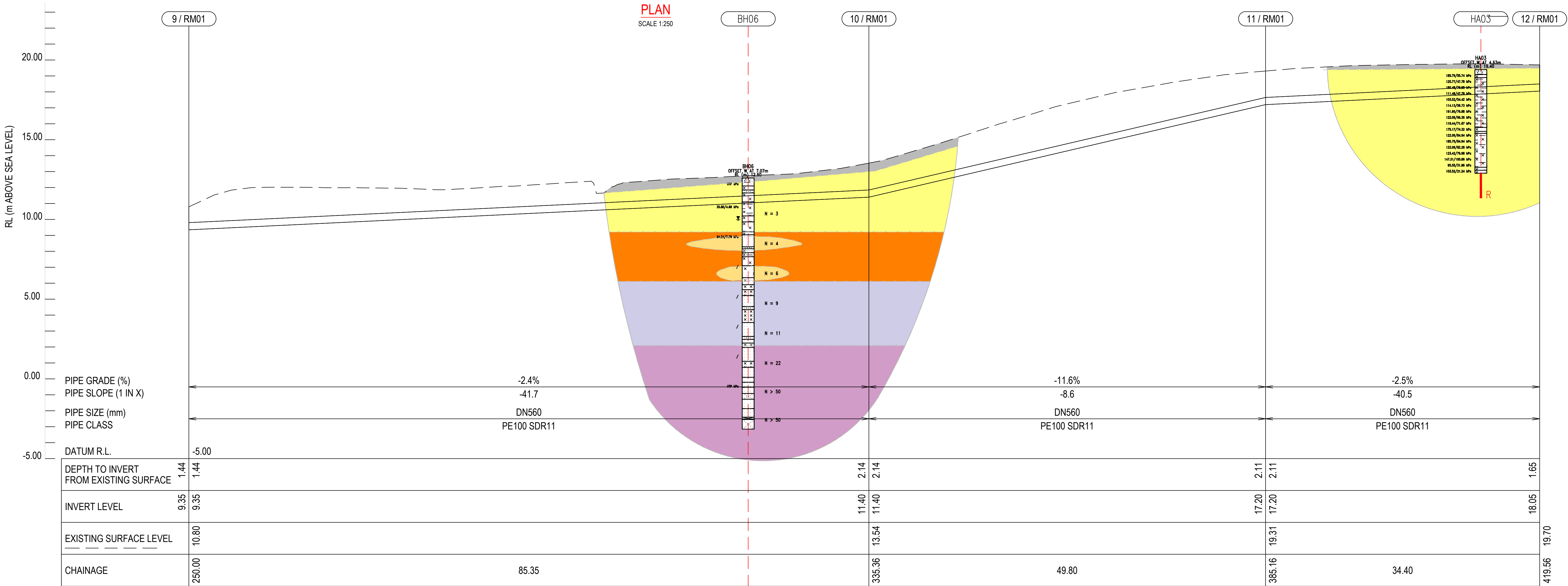
SAND

100/27 kPa

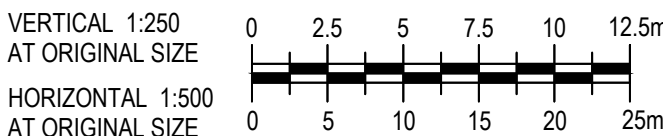
UNCORRECTED SPT N VALUE

SCALA PENETROMETER

SCALA REFUSAL/TARGET DEPTH



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Project No.
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Client
WATER CARE

Project
WHENUAPAI REDHILLS

Status

Status Code

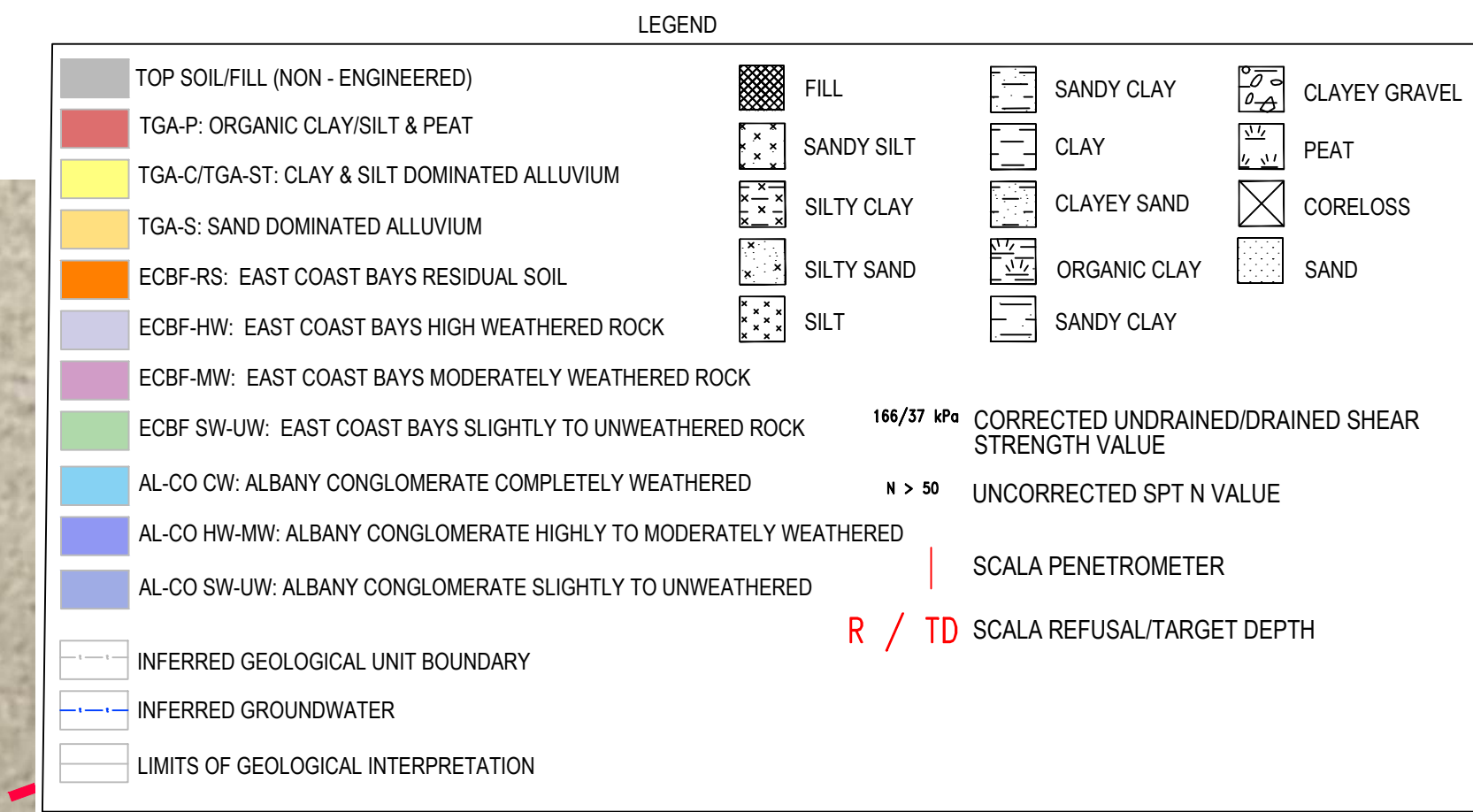
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GEOTECHNICAL LONG SECTION
SHEET 3 OF 14

Drawing No.
12508391-C203

Size
A1

Rev
A



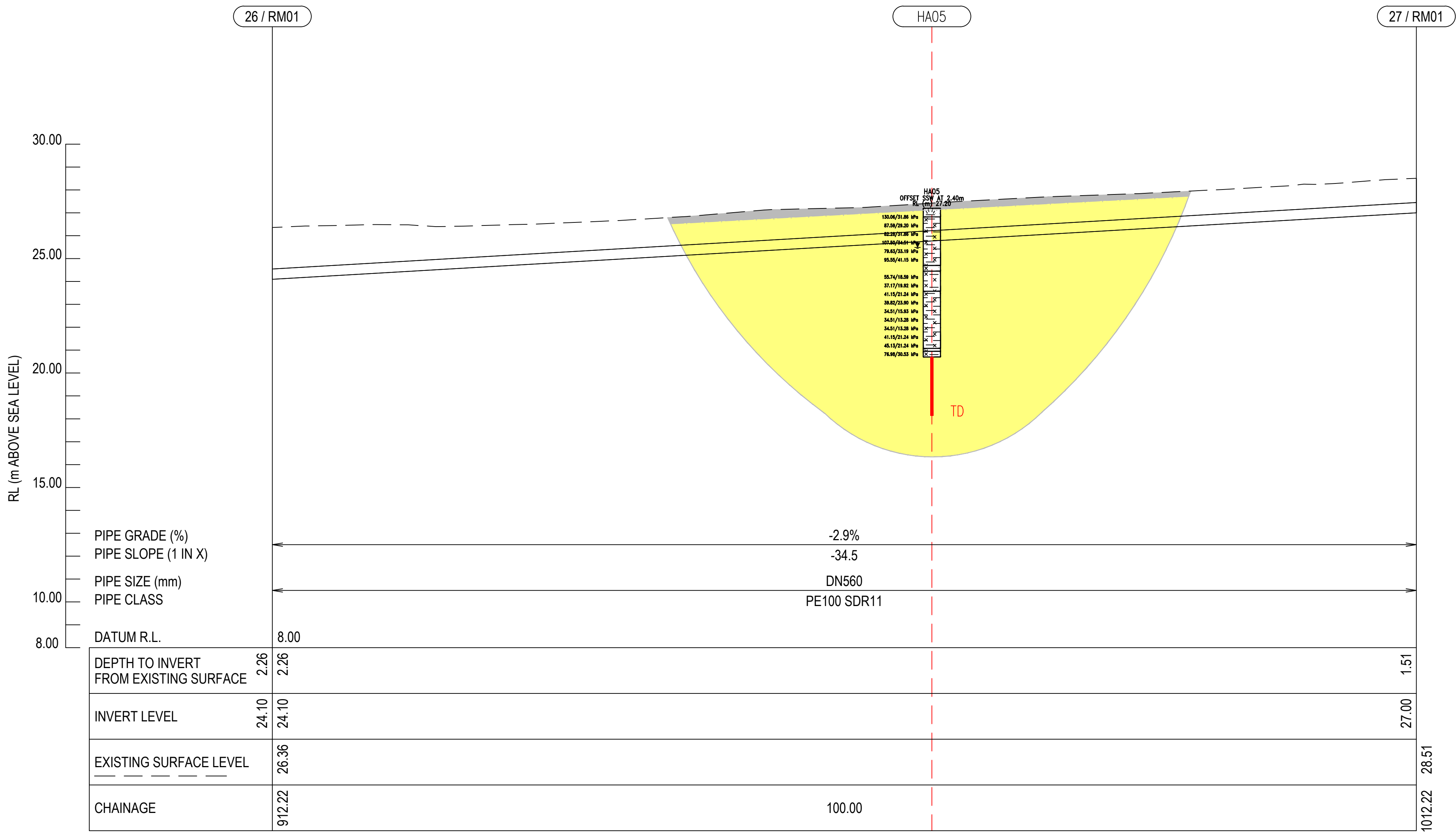


PLAN

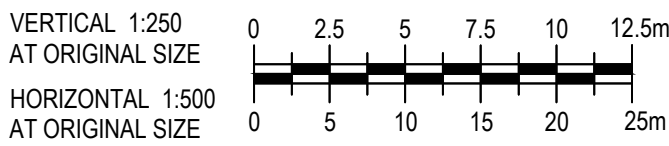
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LEGEND			
TOP SOIL/FILL (NON - ENGINEERED)	FILL	SANDY CLAY	CLAYEY GRAVEL
TGA-P: ORGANIC CLAY/SILT & PEAT	SANDY SILT	CLAY	PEAT
TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM	SILTY CLAY	CLAYEY SAND	CORELOSS
TGA-S: SAND DOMINATED ALLUVIUM	SILTY SAND	ORGANIC CLAY	SAND
ECBF-RS: EAST COAST BAYS RESIDUAL SOIL	SILT	SANDY CLAY	
ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK			
ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK			
ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			
AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			
AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			
AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED			
INFERRED GEOLOGICAL UNIT BOUNDARY			
INFERRED GROUNDWATER			
LIMITS OF GEOLOGICAL INTERPRETATION			

CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE	UNCORRECTED SPT N VALUE
SCALA PENETROMETER	SCALA REFUSAL/TARGET DEPTH



Rev	Description	Checked	Approved	Date
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Author	Designer	Drafting Check	Design Check	



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Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title
GEOTECHNICAL LONG SECTION
SHEET 7 OF 14

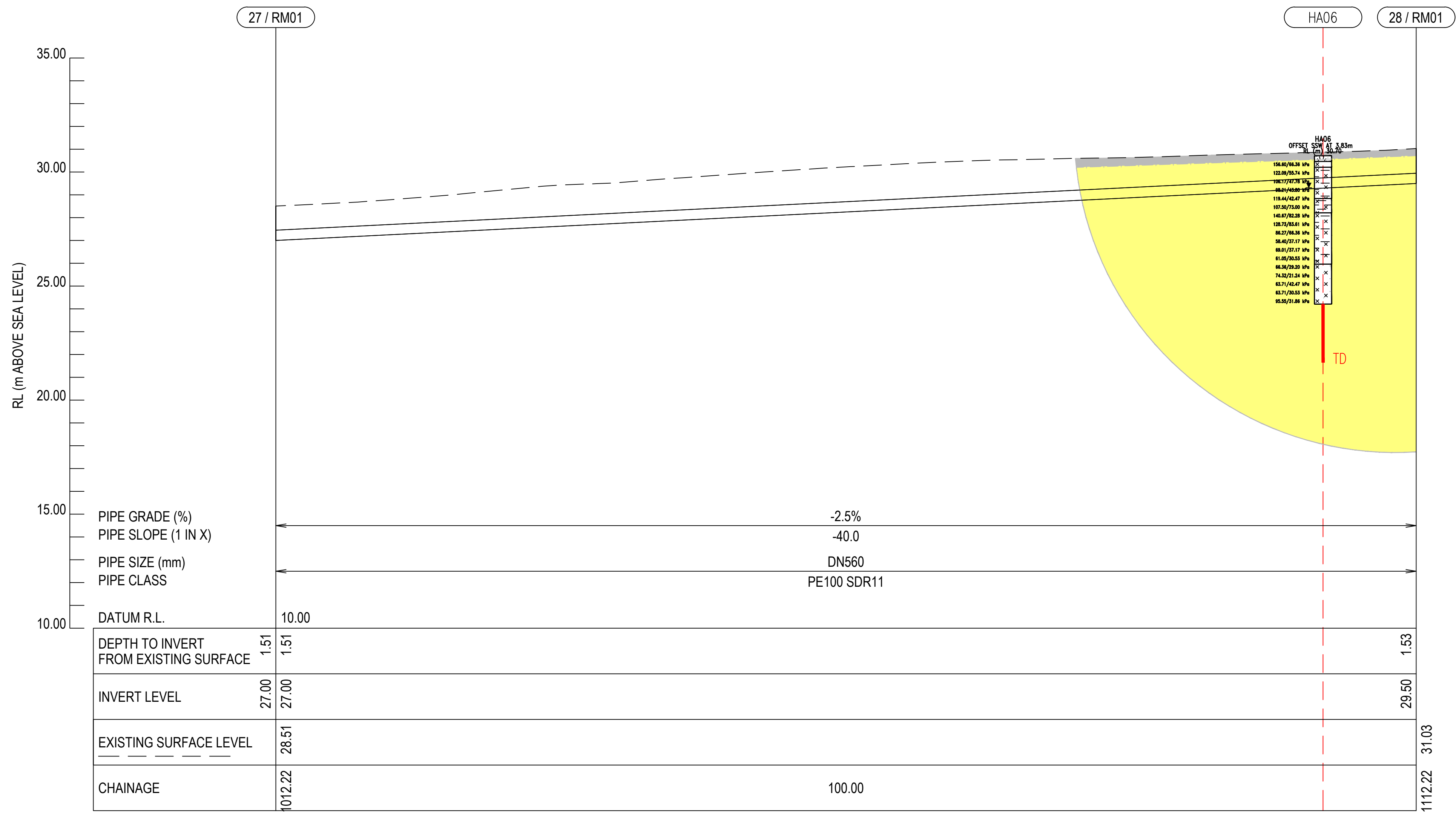
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Size
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Rev
A



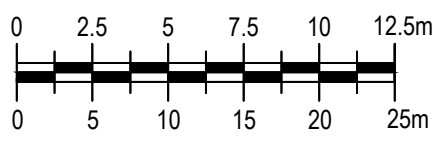
PLAN
SCALE 1:250

LEGEND							
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	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			166/57 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE		
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			N > 50	UNCORRECTED SPT N VALUE		
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED				SCALA PENETROMETER		
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED			R / TD	SCALA REFUSAL/TARGET DEPTH		
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						



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Designer	Design Check			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



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Project No.
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Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title
GEOTECHNICAL LONG SECTION
SHEET 8 OF 14

Drawing No.
12508391-C208

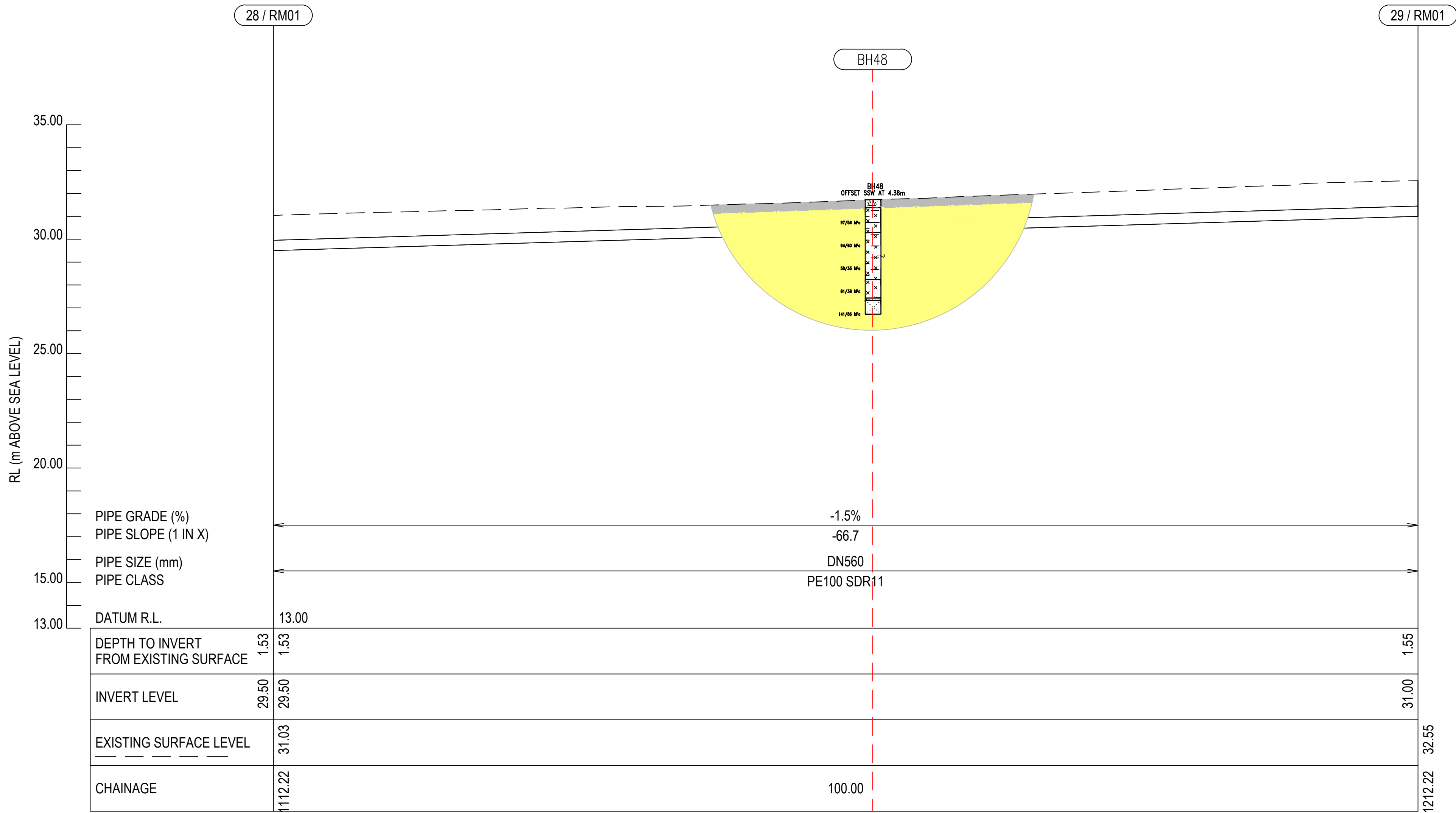
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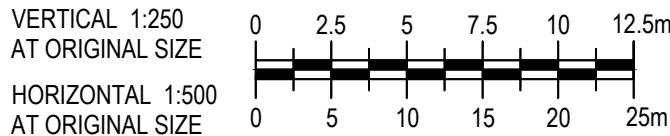
PLAN
SCALE 1:250

LEGEND					
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	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK				
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK				
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK				
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED				
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED				
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED				
	INFERRED GEOLOGICAL UNIT BOUNDARY				
	INFERRED GROUNDWATER				
	LIMITS OF GEOLOGICAL INTERPRETATION				

	166/27 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
	N > 50	UNCORRECTED SPT N VALUE
		SCALA PENETROMETER
	R / TD	SCALA REFUSAL/TARGET DEPTH



Author	Drafting Check
Designer	Design Check



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Project No.
12508391

Client
WATER CARE
Project
WHENUAPAI REDHILLS

Drawing Title
GEOTECHNICAL LONG SECTION
SHEET 9 OF 14

Drawing No.
12508391-C209

Size
A1

Rev
A

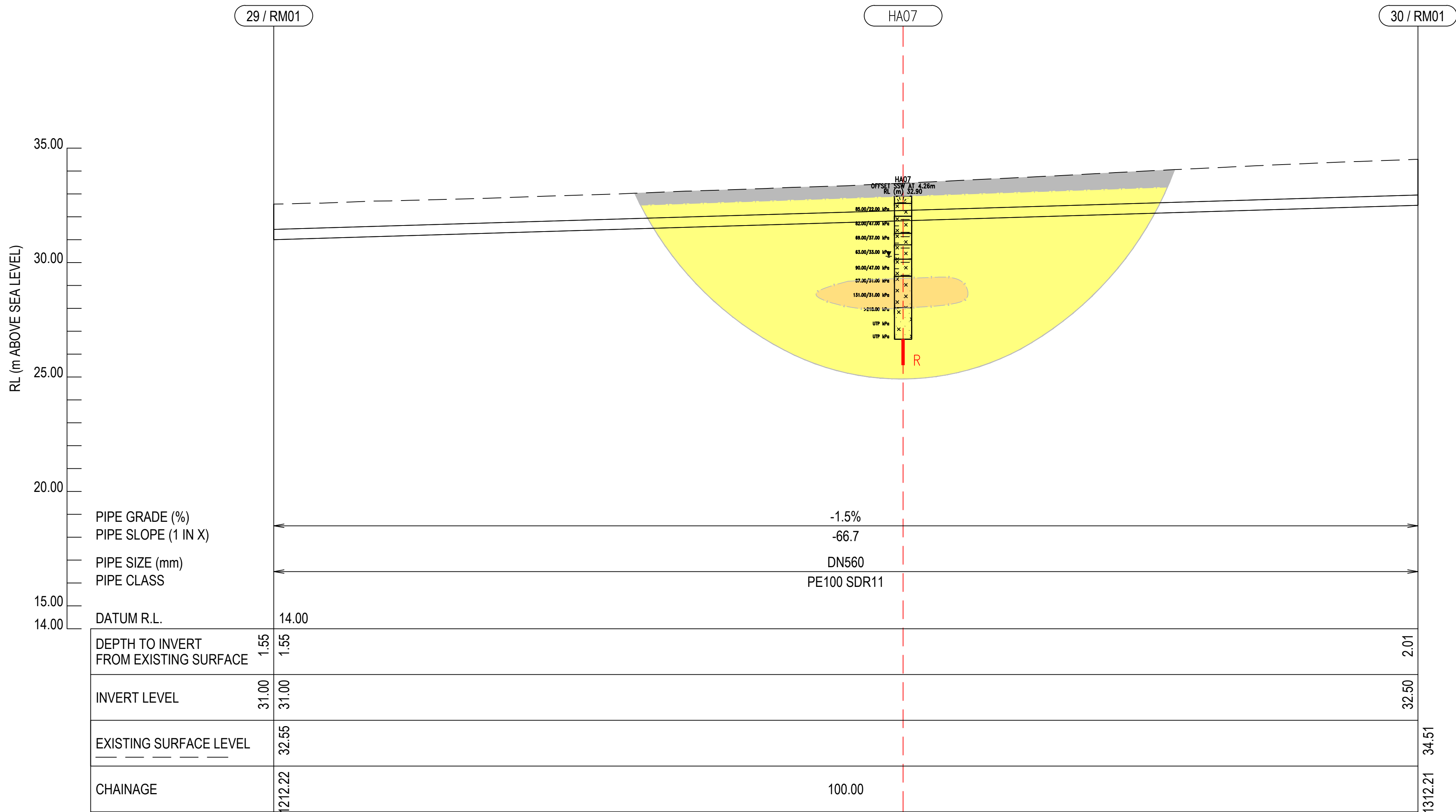


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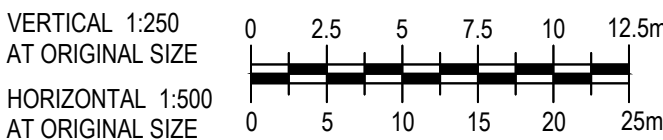
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LEGEND							
	TOP SOIL/FILL (NON - ENGINEERED)		FILL		SANDY CLAY		CLAYEY GRAVEL
	TGA-P: ORGANIC CLAY/SILT & PEAT		SANDY SILT		CLAY		PEAT
	TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM		SILTY CLAY		CLAYEY SAND		CORELOSS
	TGA-S: SAND DOMINATED ALLUVIUM		SILTY SAND		ORGANIC CLAY		SAND
	ECBF-RS: EAST COAST BAYS RESIDUAL SOIL		SILT		SANDY CLAY		
	ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK						
	ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK						
	ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK						
	AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED						
	AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED						
	AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED						
	INFERRED GEOLOGICAL UNIT BOUNDARY						
	INFERRED GROUNDWATER						
	LIMITS OF GEOLOGICAL INTERPRETATION						

		166/37 kPa	CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE
	N > 50		UNCORRECTED SPT N VALUE
			SCALA PENETROMETER
R / TD			SCALA REFUSAL/TARGET DEPTH



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Designer	Design Check			



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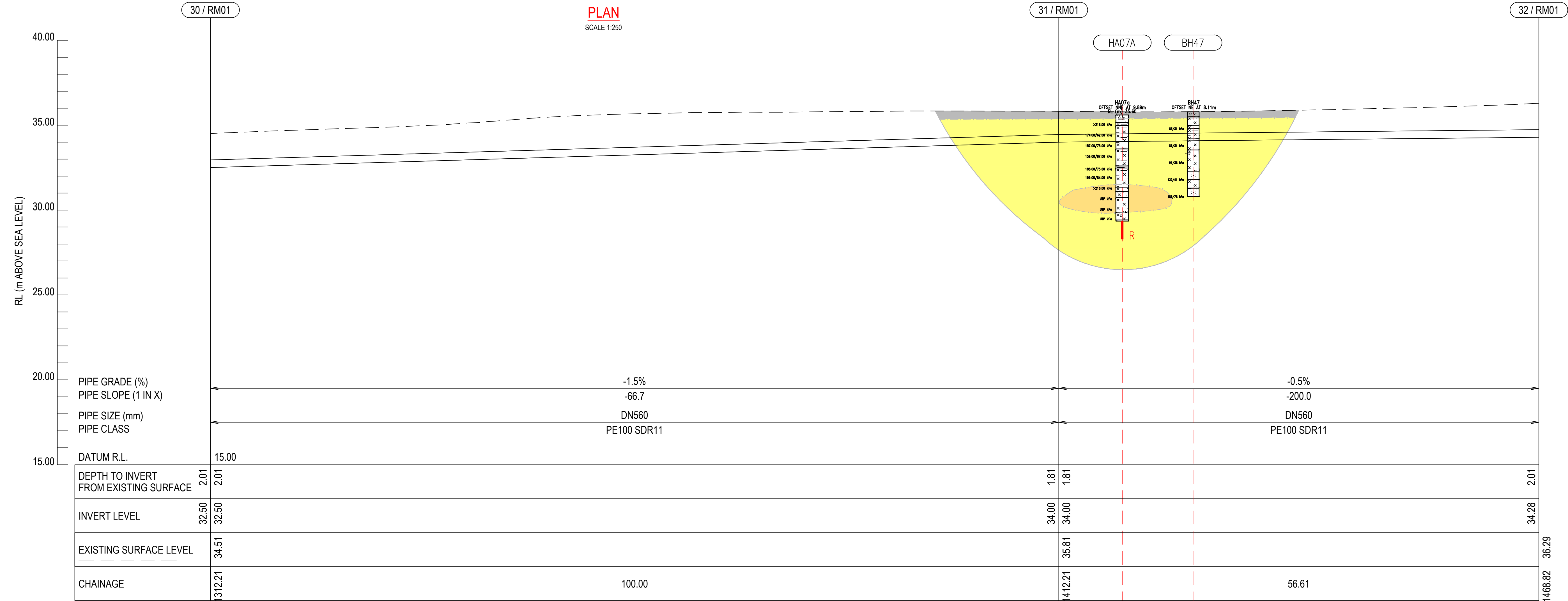
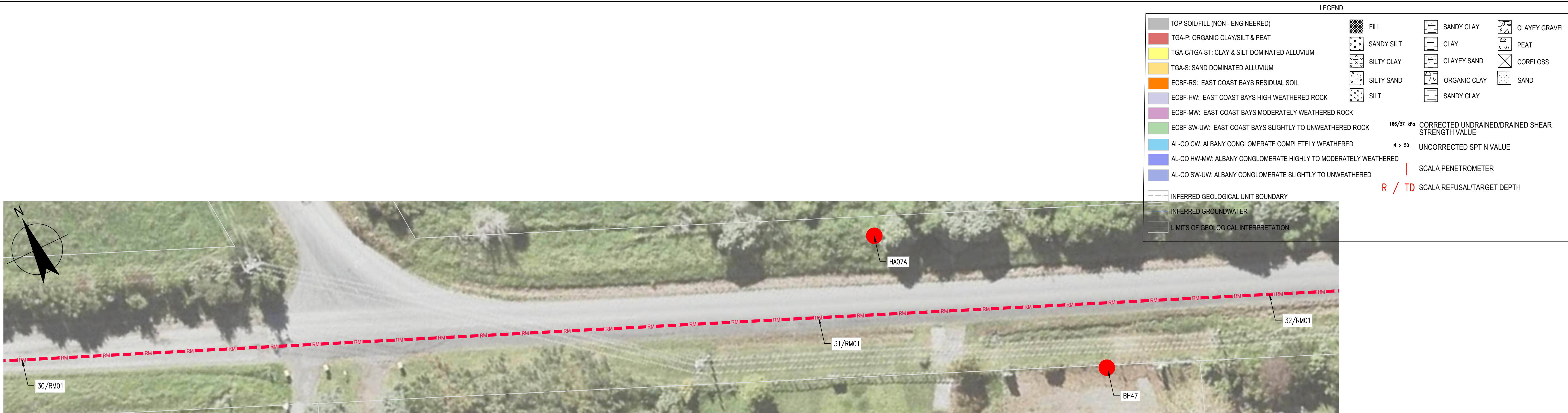
Project No.
12508391

Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	Status Code

Drawing Title
**GEOTECHNICAL LONG SECTION
SHEET 10 OF 14**

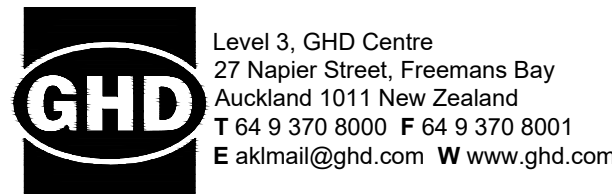
Drawing No.
12508391-C210

Size
A1
Rev
A



Rev	Description	Checked	Approved	Date
A	FOR INTERNAL GHD REVIEW			15.03.2021
Author	Designing			
Designer	Designing			

VERTICAL 1:250
AT ORIGINAL SIZE
HORIZONTAL 1:500
AT ORIGINAL SIZE



Project No.
12508391

Client
WATER CARE
Project
WHENUAPAI REDHILLS

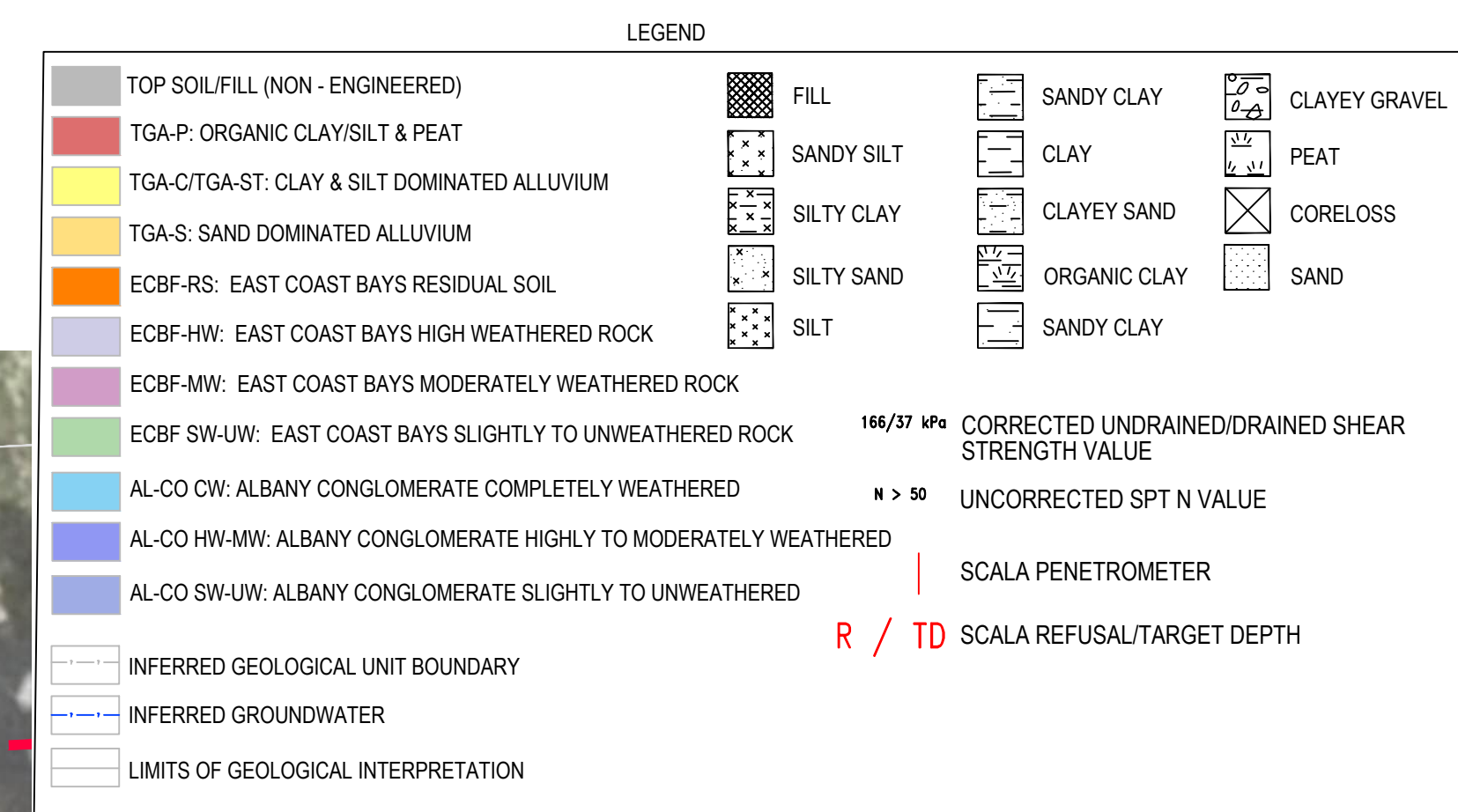
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Status
Code

Drawing
Title
GEOTECHNICAL LONG SECTION
SHEET 11 OF 14

Drawing No.
12508391-C211

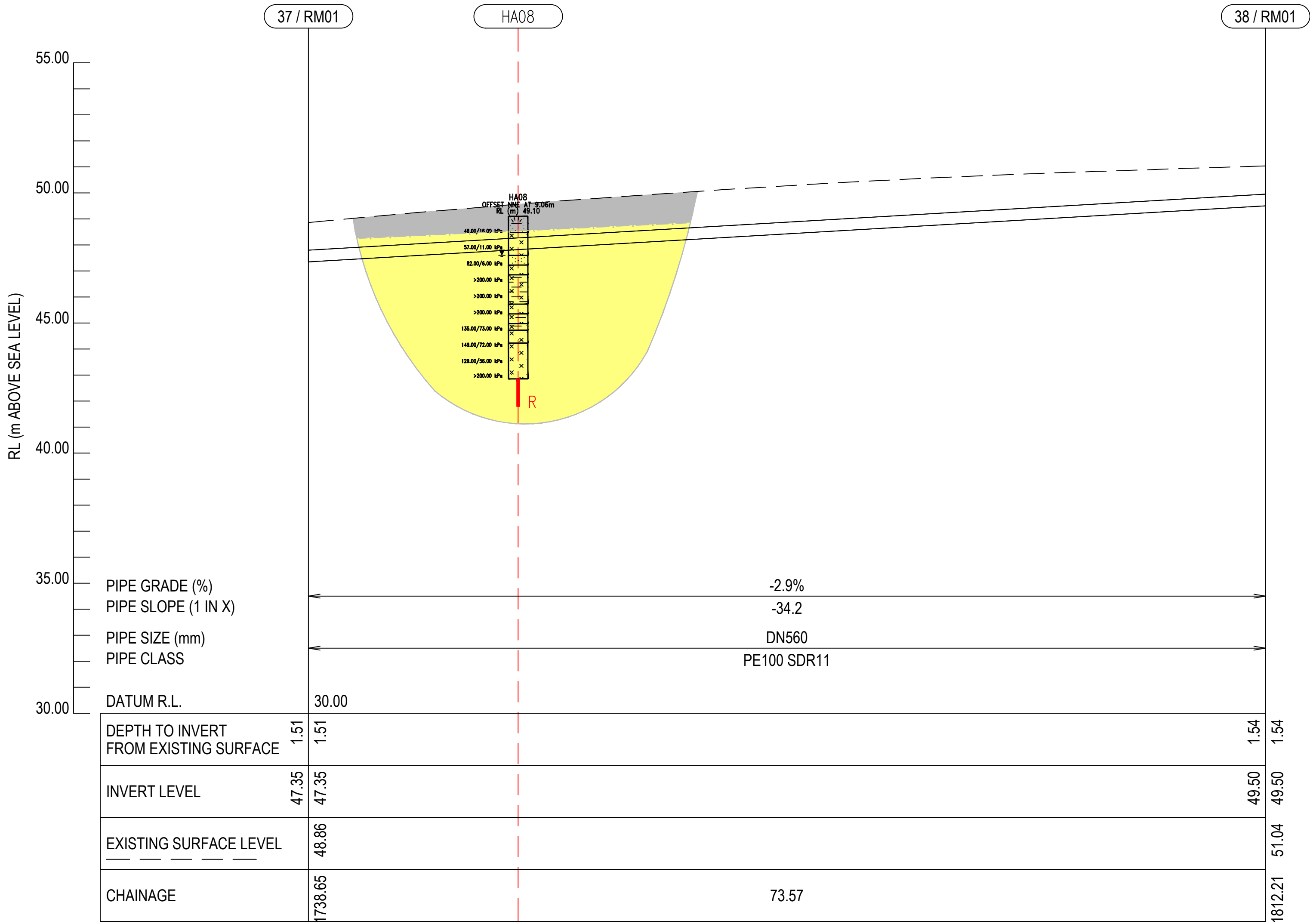
Size
A1
Rev
A

Rev
A



PLAN

SCALE 1:250



LEGEND

TOP SOIL/FILL (NON - ENGINEERED)	FILL	SANDY CLAY	CLAYEY GRAVEL
TGA-P: ORGANIC CLAY/SILT & PEAT	SANDY SILT	CLAY	PEAT
TGA-C/TGA-ST: CLAY & SILT DOMINATED ALLUVIUM	SILTY CLAY	CLAYEY SAND	CORELOSS
TGA-S: SAND DOMINATED ALLUVIUM	SILTY SAND	ORGANIC CLAY	SAND
ECBF-RS: EAST COAST BAYS RESIDUAL SOIL	SILT	SANDY CLAY	
ECBF-HW: EAST COAST BAYS HIGH WEATHERED ROCK			
ECBF-MW: EAST COAST BAYS MODERATELY WEATHERED ROCK			
ECBF-SW-UW: EAST COAST BAYS SLIGHTLY TO UNWEATHERED ROCK			
AL-CO CW: ALBANY CONGLOMERATE COMPLETELY WEATHERED			
AL-CO HW-MW: ALBANY CONGLOMERATE HIGHLY TO MODERATELY WEATHERED			
AL-CO SW-UW: ALBANY CONGLOMERATE SLIGHTLY TO UNWEATHERED			
INFERRED GEOLOGICAL UNIT BOUNDARY			
INFERRED GROUNDWATER			
LIMITS OF GEOLOGICAL INTERPRETATION			

166/37 kPa CORRECTED UNDRAINED/DRAINED SHEAR STRENGTH VALUE

N > 50 UNCORRECTED SPT N VALUE

SCALA PENETROMETER

R / TD SCALA REFUSAL/TARGET DEPTH

Plot Date: 23 March 2021 - 1:48 PM Plotted by: Paige Boyed

File Name: N:\NZ\Auckland\Projects\51\12508391\Tech\Geotech\Package 1 Whenuapai Redhills\02 GIR\Working Folder\Drawings\12508391-C214 pb EDIT.dwg



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Client	WATER CARE
Project	WHENUAPAI REDHILLS
Status	

Drawing Title	GEOTECHNICAL LONG SECTION SHEET 14 OF 14
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A

Appendix H Draft GSMCP



Draft Groundwater and Settlement Monitoring & Contingency Plan

Whenuapai Conveyance - Package 1

Prepared for

Beca Limited

Prepared by

Tonkin & Taylor Ltd

Date

October 2023

Job Number

1013050 v2



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Document control

Title: Draft Groundwater and Settlement Monitoring & Contingency Plan					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
April 2023	0	DRAFT	KIRA	EDMA	TIMC
Aug 2023	1	DRAFT - Update pump station construction methodology and associated groundwater assessments	EDMA	TIMC	TIMC
Oct 2023	2	DRAFT – Update to change in construction method and inclusion of wetland D	EDMA	TIMC	TIMC

Distribution:

Beca Limited

1 electronic copy

Tonkin & Taylor Ltd (FILE)

1 electronic copy

Table of contents

1	Introduction	1
1.1	Background	1
1.2	Project overview and construction method	1
1.2.1	Pump station at 23-27 Brigham Creek Road	2
1.2.2	Gravity main	3
1.2.3	Rising main	4
2	Monitoring	4
2.1	General	4
2.2	Building, culvert and ground settlement monitoring	4
2.2.1	General	4
2.2.2	Settlement monitoring intervals	5
2.2.3	Settlement trigger levels	6
2.3	Groundwater monitoring	6
2.3.1	General	6
2.3.2	Groundwater monitoring intervals	6
2.3.3	Groundwater trigger levels	7
3	Pre and Post construction condition survey	8
4	Summary of monitoring frequency	9
5	Reporting of monitoring records	10
5.1	Baseline readings	10
5.2	Reporting intervals and requirements	10
6	Alert and Alarm trigger level response procedures	10
6.1	Response procedure if the Alert trigger levels are exceeded	10
6.2	Response procedure if the Alarm trigger are exceeded	11
7	Contingency options	11
7.1	General	11
7.2	Building, culvert and ground, and deformation contingency measures	11
7.3	Underground service settlement contingency measures	11
8	Monitoring and contingency plan review	12
9	Applicability	13
Appendix A	Monitoring Plans	

Glossary

This glossary defines the specific meaning of certain words and phrases used in this report. Note that some words and phrases used in this report have different definitions and meanings in other literature.

Council	Auckland Council (AC).
Commencement of dewatering	Excavation/tunnelling below groundwater level and/or commencing taking any groundwater.
Completion of dewatering	When all excavation/tunnelling is completed, and ground openings are backfilled above the groundwater level.
Commencement of excavation	Excavations deeper than 1.5 m and greater than 1 m ³ in volume.
Completion of excavation	When all tunnelling and excavations have been completed, tunnel liner has been installed, and ground openings have been backfilled.
Completion of construction	Means when the Certificate of Completion is issued by AC.
Minor severity	Damage and defects that are typically localised in nature and their effects are typically of low significance and readily repairable (e.g. hairline cracks).
Moderate severity	Damage and defects that are typically spread over a larger area and/or may be of greater significance and impact upon serviceability (e.g. sticking doors and cracked window panes).
Severe	Damage and defects that are typically widespread in nature and/or their effects are typically of high significance (e.g. visible deformation and crack in structural elements).
Damage	Includes aesthetic, serviceability and severe damage.
Aesthetic damage	Superficial damage and defects that do not affect the use, integrity or serviceability of the item. In certain situations, aesthetic damage may develop into serviceability and/or structural damage. Aesthetic damage may include fine cracks easily treated during normal redecoration, cracks in exterior visible upon close inspection, etc.
Serviceability damage	Damage and defects that may impact the use, integrity or serviceability of the item but have not led to (nor are expected to immediately develop in) structural damage. Serviceability damage may include cracked windowpanes, uneven pavements, bowing and/or cupping decking boards, sticking windows and doors etc. Over time, serviceability damage may develop into structural damage.
Structural damage	Damage and defects that affect structural components of an item and have the potential to cause structural failure of the item. This may include bulging concrete block walls, detached structural members, decay in structural timber members, differential settlement in foundations resulting in reduced stability etc.
Alert Level	Monitoring reaches a level close to where damage may occur unless movement continues unchecked and requires review of available monitoring information (plus other information) to assess the future trend.
Alarm Level	Monitoring reaches a level where damage may occur and requires immediate action including the cessation of ground dewatering and other construction activities that may have an effect on ground deformation.
The Council	Auckland Council (Team Leader, Water Allocation, NRSI) or nominated AC staff acting on The Team Leader's behalf.

NRSI	Natural Resources and Specialist Input, Auckland Council.
RL	Reduced Level.
Services	Includes for example fibre optic cables, sanitary drainage, gas and water mains, power and telephone, road infrastructure assets such as footpaths, kerbs, catch-pits, pavements and street furniture.

1 Introduction

1.1 Background

Beca Limited (Beca) has been engaged by Watercare under the Consultancy Services Panel Framework Agreement, to undertake Feasibility, Design and Consenting for Whenuapai-Redhills Wastewater Service Scheme – Package 1. Tonkin & Taylor Ltd (T+T) has been engaged as a subconsultant to Beca to provide geotechnical service for this project.

As part of our service, we have been asked to prepare a Draft Groundwater and Settlement Monitoring and Contingency Plan (GSMCP) to support a Resource Consent application for the proposed Whenuapai-Redhills Wastewater Service Scheme – Package 1 (the project), in Whenuapai, Auckland (the site). Monitoring and settlement contour plans are shown in Appendix A.

The GSMCP is based on the following reports prepared for the project:

- Whenuapai-Redhills Wastewater Service Scheme – Package 1, Geotechnical Effects Report by T+T reference 1013050.v4 dated 25 August 2023.

This GSMCP is an adaptive plan that serves to establish a set of project controls to measure groundwater drawdown and ground settlements, and to address potential geotechnical effects related to the project works. The GSMCP also provides contingency and mitigation measures that may be applied should monitoring results indicate ground settlement and groundwater drawdown to be approaching or likely to exceed established alert and alarm limits.

This report should be reviewed once detailed design has been completed and construction methodologies have been confirmed to confirm that the recommendations of this report are still valid.

This report should be read in conjunction with the Whenuapai Wastewater Servicing Package 1: Wetland Monitoring and Reinstatement Plan prepared by Beca, October 2023.

1.2 Project overview and construction method

The Project aims to provide wastewater servicing capacity for approximately 10,240 dwellings, or 30,720 people, in the Whenuapai catchment. This growth is projected to occur by 2041. The Project includes the following five key components (see Figure 1.1):

- 1 A **Pump Station** at a point where the Whenuapai and Redhills Catchments meet at 23-27 Brigham Creek Road, with an emergency overflow outfall to Sinton Stream.
- 2 A **Gravity Main Pipeline** (approximately 700 m long and 375 – 475 mm in diameter) between Whenuapai Village Pump Station on Tamiro Road and the new pump station.
- 3 A **Rising Main** (approximately 1.4 km long and 500 mm in diameter) between the Pump Station and a proposed new break pressure chamber on Mamari Road (the boundary of Package 2)¹.
- 4 A **Culvert** (approximately 63 m long including wing wall and rip rap) to provide access for the rising main across Sinton Stream.
- 5 A **Break Pressure Chamber** which connects to the Massey Connector rising main (proposed under Package 2).

¹ An extension of the rising main is part of 'Package 2' and will be designed to connect to the planned Northern Interceptor Phase 2 tunnel and deliver flows from the Whenuapai Catchment to the Rosedale Wastewater Treatment Plant for treatment. Package 2 is subject to a separate consent application.

The Project extends from the existing Whenuapai Village pump station site in Tamiro Road in the north, across Brigham Creek Road, to Spedding Road in the south.

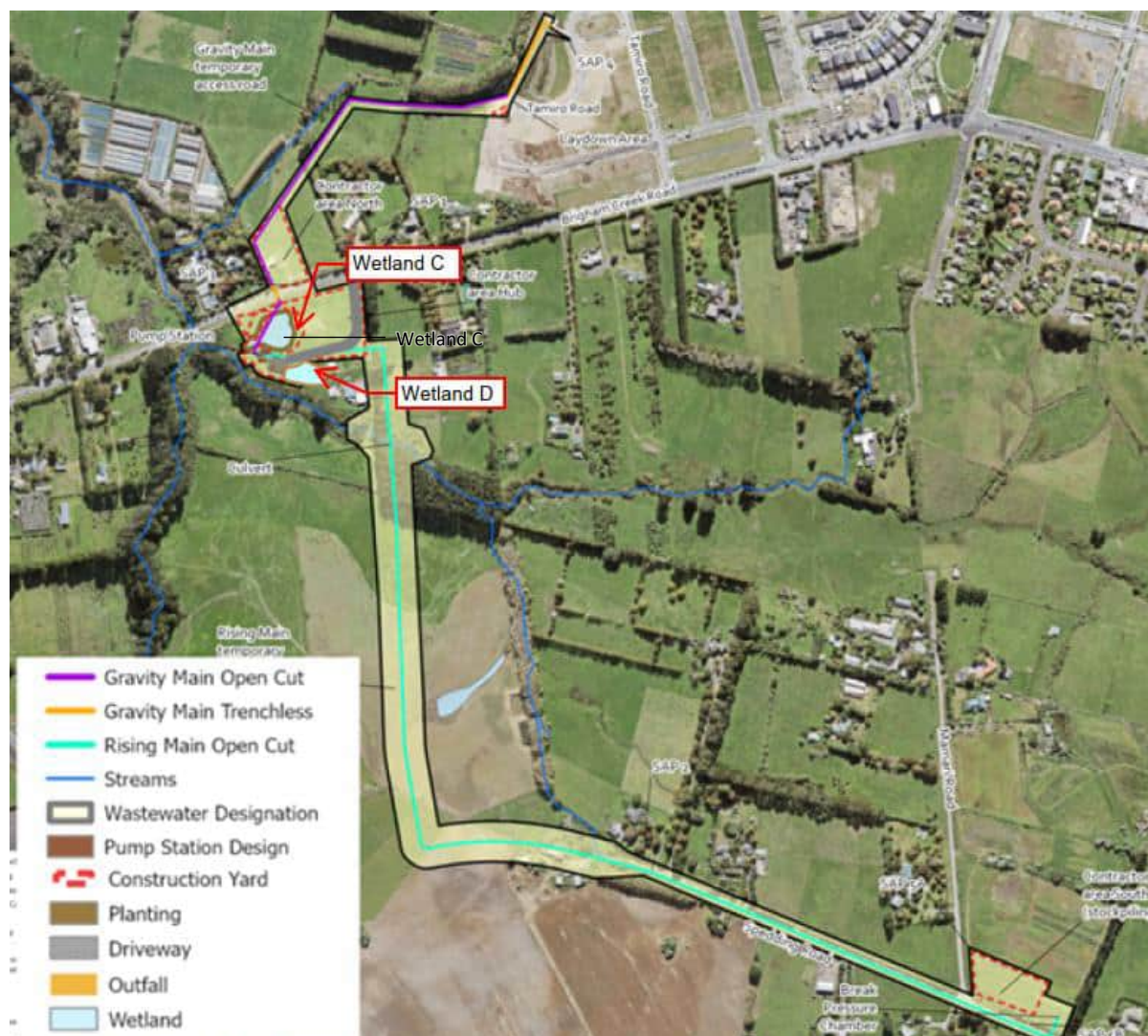


Figure 1.1: Package 1 – ‘the Project’ overview.

Section 1.2.1 through to section 1.2.3 provide further detail of the proposed infrastructure to be constructed.

1.2.1 Pump station at 23-27 Brigham Creek Road

A new wastewater pump station is proposed to be installed at 23-27 Brigham Creek Road. The pump station will comprise:

- 2 No. wet wells – approximately 8.65 m deep to invert which will require an excavated depth of approximately 9.5 m.
- 5 No. storage tanks – approximately 5.3 m depth to invert, which will require an excavated depth of approximately 6.0 m.

The construction methodology presented in the Beca Assessment of Effects on the Environment (October 2023) proposes that the pump station is to be constructed by open bulk excavation. To reduce groundwater seepage flows from the wetland into the excavation, temporary sheet piles acting as a partial seepage cut off wall will be installed around the southern boundary of the wetland

prior to commencement of excavation. The sheet piles are expected to be driven approximately 0.5 m to 1 m into the underlying rock (approximately 6 m below existing ground level) and clutched together.

Construction works will be staged for the inlet manhole, wet wells (pump station), storage tanks, and connecting pipes to limit the extent of excavation open at any given time and limit potential dewatering effects. Excavations for each component are to be carried out in two stages in which a wider, upper excavation is to extend through the soil layers, and a smaller excavation is to be carried out within and to the design depth through into the ECBF bedrock.

For the wet wells, each level of the excavation is to be supported by a double slide rail system to provide safe access, and limit ground deformations associated with mechanical and consolidation settlements. For the storage tanks, the upper excavation area will be battered at approximately 1V:2H, whilst the deeper excavation area will be supported by double slide rails.

Groundwater recharge is expected to be required across both Wetland C and Wetland D during construction to maintain suitable hydrological conditions for the wetland as outlined in the Wetland Monitoring and Reinstatement Plan.

1.2.2 Gravity main

A gravity main is proposed from the existing Whenuapai Village pump station to the pump station comprising:

- Approximately 715 m long 375 mm – 475 mm diameter gravity pipeline with an invert level ranging between approximately 2.4 and 5.5 m below ground level. The pipeline will commence at the existing Whenuapai Village pump station and extend through farmland between 20 and 28 Brigham Creek Road before crossing underneath Brigham Creek Road to terminate at the pump station.
- 11 No 1540 mm diameter manholes (SSMH-1 through SSMH-11).

The construction methodology proposes:

- Pipe hammering underneath Brigham Creek Road between chambers SSMH3 and SSMH4.
- Trenchless construction between SMH11 and SMH12.
- The remainder of the alignment will be installed by open cut method. Trenches shall be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days, and manhole structures no longer than 30 days.

Temporary support for excavations will be required. For the purposes of this assessment, we have considered the following excavation and seepage control methods:

- SMH11 – trench shields with no seepage controls.
- Brigham Creek Road Drive Shaft – sheet piles with lateral restraint.
- Brigham Creek Road Receiving Shaft – trench shields with no seepage control.

Open cut methods may be required where trenchless methods are proposed in case of an obstruction. If this is the case, the settlement results from the driving and receiving shafts can be adopted to predict the settlement that may arise between these two points if the pipeline shall be trenched.

1.2.3 Rising main

A rising main is proposed from the pump station to the break pressure tank at 32 Mamari Road comprising:

- Approximately 1492 m long 500 mm diameter riser pipeline with an invert level ranging between approximately 0.5 and 5.9 m below the existing ground level. The pipeline will commence at the pump station and extend along the future extension of Spedding Road, then Spedding Road, and terminate 32 Mamari Road.

The construction methodology proposes:

- That the full length of the rising main is to be installed by open cut method. The pipeline is intended to run underground for its full length except where it passes through a culvert at Sinton Creek. Trenches for the pipeline will be progressively opened, closed and stabilised, and the part of the trench that is open at any given time will be no longer than 10 days.
- To enable culvert construction at Sinton Creek, sheet piles shall be installed to provide ground support over a length of approximately 60 m for a duration of approximately 12 weeks.
- An air valve chamber and connection chamber are proposed at approximately chainage 155 and 235 respectively, north of Sinton Creek. The chambers will require excavations approximately 3.3 m and 2.4 m deep. The excavations are expected to take up to 4 weeks to construct and backfill.

2 Monitoring

2.1 General

Ground settlement and groundwater drawdown monitoring during the construction works will be undertaken to assess if the response of the surrounding structures is within design tolerances. This process allows for the geotechnical effects to be monitored and can act as an indication for mitigation or remedial measures to be implemented if required.

Monitoring and surveying of the following shall be undertaken during construction:

- Building, Culvert and Ground Settlement Monitoring Points via survey markers.
- Groundwater level monitoring via standpipe piezometers.

The monitoring results will be collected by the contractor prior to and during construction and collated by the Geotechnical Engineer for comparison with the specified Alert and Alarm trigger levels (refer to Section 2.2.3 of this Plan). Should any Alert or Alarm levels be breached, the response detailed in the sections below shall be implemented.

Monitoring records will be included in summary reports prepared by the Geotechnical Engineer and issued to AC every two months during the implementation of this GSMCP.

2.2 Building, culvert and ground settlement monitoring

2.2.1 General

Building, culvert and ground settlement monitoring marks shall be established at the approximate locations presented in the Ground settlement monitoring plan presented in Appendix A.

The philosophy of the monitoring programme is to monitor that actual settlements are less than the values that can be expected to result in the onset of minor severity damage to structures under worst-case assumptions.

The potential for the onset of minor damage under worst-case assumptions equates to the Alarm Trigger Level. This corresponds to the point at which remedial actions to prevent further settlement are enacted. Alarm Trigger Levels are presented in Section 2.2.3. Required actions are presented in Section 6.

Each monitoring point has an Alert Trigger Level which represents a settlement at 70% of the Alarm Trigger Level. These are defined in Section 2.2.3. The purpose of the Alert Trigger Level is to provide sufficient notice for additional monitoring and assessment of construction operations to be undertaken prior to the Alarm Trigger Level being reached. The Alert Trigger Level checks that adjacent structures will not suffer damage from either excavation or groundwater drawdown effects.

Building and Culvert Monitoring Points have been assigned to any structure that lies within the envelope of potential settlement effects adjacent to the pump station or pipe installation via open trench excavation. Buildings and culverts that are outside the calculated settlement envelope will not be directly monitored. Ground Monitoring Points will be utilised to assess ground movements within and immediately outside the calculated settlement envelope, particularly along Brigham Creek Road where multiple services are installed within the roadway corridor.

The Alert and Alarm settlement levels are uniform for all Building, Culvert Monitoring Points and Ground settlement monitoring points, as their purpose is to monitor that settlement of a magnitude sufficient to cause minor damage will not occur. A minimum of three Building monitoring points arranged in a triangular orientation and four Culvert monitoring points arranged in a rectangular orientation are proposed on each structure to monitor differential settlements as shown in Appendix A.

Ground Monitoring Points have been placed at approximately 30 m centres along and parallel to the road alignment. Ground Monitoring Points placed along the roadway are to provide settlement monitoring for underground services.

Vertical survey measurements shall be accurate to ± 2 mm vertically. It is noted that the settlement markers will be subject to landowner approval when placed on private property and may require re-locating.

2.2.2 Settlement monitoring intervals

Surveys shall be carried out by the Contractor or the contractor's approved surveyor at the intervals outlined in Table 2.1. Although no settlement effects can reasonably be expected to occur beyond 100 m from the work site, those points located at this distance or greater are to be surveyed once every 2 months as a means of assessing the magnitude of natural ground surface elevation fluctuations.

Table 2.1: Settlement monitoring interval summary

Phase	Monitoring frequency
Prior to excavation and dewatering	A minimum period of 3 months prior to commencement of dewatering.
During excavation/dewatering	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering.

	Monthly where: All monitoring markers within 100 m of excavations or dewatering.
After completion of excavation and dewatering	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated, and written confirmation is provided from AC to cease monitoring.

Monitoring frequency to be increased as advised by the Geotechnical Engineer at any monitoring point where the measured rate of settlement indicates that the alert or alarm level trigger may be approached prior to the next normally scheduled monitoring round.

2.2.3 Settlement trigger levels

Alert and Alarm Trigger Levels are summarised in Table 2.2. Monitoring data shall be compared with the trigger levels within 24 hours of recording. If an Alert or Alarm Trigger Level is breached, the actions identified in Section 6 of this GSMCP shall be undertaken.

Table 2.2: Building (B), Culvert (C) and Ground (G) settlement trigger levels

Monitoring item	Description	Settlement Alert level (mm)	Settlement Alarm level (mm)	Differential settlement Alert level	Differential settlement Alarm level
BS01-BS03, CS01-CS04	Building or Culvert monitoring point	7	10	1 in 750 between any two building or culvert settlement survey markers	1 in 500 between any two building or culvert settlement survey markers
GS01-GS10	Ground monitoring point	18	25	1 in 750 between any two ground settlement survey markers	1 in 500 between any two ground settlement survey markers

2.3 Groundwater monitoring

2.3.1 General

Groundwater levels shall be monitored at eight groundwater monitoring wells (standpipe piezometers) installed along the pipe alignment. Additional monitoring wells may be required during the course of the project if the proposed works is likely to destroy the groundwater monitoring well or if excavations change from the proposed locations.

Should any of the monitoring bores be damaged and become in-operable during construction works, then AC is to be informed and a new monitoring bore is to be drilled at an appropriate nearby location.

2.3.2 Groundwater monitoring intervals

Groundwater monitoring shall be carried out by the Contractor prior to, during and post construction at the intervals specified in Table 2.3. Groundwater monitoring wells are required to be operational prior to commencement of dewatering to establish the baseline readings summarised in the Table 2.3 below. If groundwater monitoring wells are within the excavation footprint and shall be damaged, the wells shall be re-established outside the excavation footprint.

Table 2.3: Groundwater monitoring interval summary

Phase	Monitoring frequency
Prior to dewatering	Monthly for a minimum period of 3 months prior to commencement of dewatering.
During excavation/dewatering	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: - All monitoring markers within 100 m of excavations or dewatering.
After completion of excavation/dewatering	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated, and written approval is granted from AC to cease monitoring.

Monitoring frequency to be increased as advised by the Geotechnical Engineer at any monitoring point where the measured water level indicates that the alert or alarm trigger level may be approached prior to the next normally scheduled monitoring round.

Monitoring frequency may be reduced if stable measurements are observed, and written confirmation is provided by AC.

2.3.3 Groundwater trigger levels

Monitoring data shall be compared with the design assumptions and baseline readings. The baseline reading shall be taken as the summer low groundwater level (GWL) where possible and recorded before the commencement of construction. Preliminary Alert and Alarm levels prior to establishing baseline readings are summarised in Table 2.4. If the Alert or Alarm levels are reached, the actions outlined in Section 6 shall be carried out.

The trigger levels set for BH-WL1, BH-WL2 and BH117 are proposed to be preliminary thresholds and be adaptive to respond to the adaptive Wetland Management Plan.

Table 2.4: Groundwater drawdown trigger levels

Monitoring item	Description	Alert level for drawdown below summer low GWL (m)	Alarm level for drawdown below summer low GWL (m)
BH05 (A&B)	Groundwater monitoring wells – Standpipe piezometers.	1.0	1.5
BH-WL1, BH-WL2, BH117	Groundwater monitoring wells – Standpipe piezometers.	0.2 (preliminary - to be adapted based on the Wetland Management Plan).	0.3 (preliminary - to be adapted based on the Wetland Management Plan).
BH113, BH116	Groundwater monitoring wells – Standpipe piezometers.	1.0	1.5

Monitoring item	Description	Alert level for drawdown below summer low GWL (m)	Alarm level for drawdown below summer low GWL (m)
BH-WL3	Groundwater monitoring wells – Standpipe piezometers.	0.5	0.8

3 Pre and Post construction condition survey

A pre-construction condition survey of the property listed in Table 3.1 shall be carried out a maximum of 3 months prior to the commencement of construction and/or dewatering (whichever occurs first). An external survey should be undertaken as a minimum.

Table 3.1: Summary of property to be surveyed

Building Address	Legal Title	Building Type
18 Brigham Creek Road	LOT 2 DP 89629	Residential

The survey report shall confirm the existing condition of this property (including dwelling, garage and sheds where applicable). Major features of the buildings and site developments shall be recorded including location, type of construction, age and present conditions including defects.

The survey shall include, but not limited to the following:

- Type of foundations (where observable or otherwise inferred).
- Condition of existing asset including existing level of damage.
- Susceptibility of structure to further movement and damage.
- Review of proposed Alert and Alarm levels to confirm they are appropriately set based on the building type and condition.
- Photographic evidence of (1), (2), and (3) above.

During construction, visual external observations of the structure and surrounding ground of the assets identified in the pre-construction property survey shall be performed on a fortnightly basis where properties are within 25 m of active works.

Within six months of completion of construction, a post-construction survey covering the items detailed above shall be completed for any building that had a pre-construction survey carried out. The survey report shall include a determination of the cause of damage identified (if any) since the pre-construction or previous survey and steps to repair it.

A copy of the pre and post-construction survey reports shall be forwarded to AC within 15 working days of completing the reports. Reports should be reviewed and signed by a Chartered Professional Engineer who has certified that the survey has been completed in a professional manner and is an accurate assessment of the condition of the buildings concerned.

4 Summary of monitoring frequency

The monitoring frequency requirements detailed in the previous sections are summarised in Table 4-1 below.

Table 4-1: Summary of monitoring frequency requirements

Monitoring system	Monitoring Locations	Prior to commencement of excavation and dewatering	During excavation and dewatering	After completion of excavation and dewatering	After completion of construction
Settlement monitoring points	BS01-BS03, CS01-CS04, GS01-GS10	A minimum of 3 months prior to excavation and dewatering to establish baseline levels.	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: - All monitoring markers within 100 m of excavations or dewatering.	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated and written confirmation is provided from AC to cease monitoring.	Post-construction condition survey of 18 Brigham Creek Road
Standpipe piezometers	BH05A, BH05B, BH-WL1, BH-WL2, BH-WL3, BH113, BH116, BH117	Monthly for a minimum period of 3 months prior to commencement of dewatering.	Weekly for: - All monitoring markers within 25 m of excavations or dewatering. Fortnightly where: - All monitoring markers within 50 m of excavations or dewatering. Monthly where: All monitoring markers within 100 m of excavations or dewatering.	Monthly for three months or until such time following the completion of excavation and dewatering that stable measurements are demonstrated and written confirmation is provided from AC to cease monitoring.	N/A

5 Reporting of monitoring records

5.1 Baseline readings

Baseline readings for building, culvert and ground deformation shall be established before the commencement of dewatering and excavation.

These baseline readings shall be compiled and submitted to AC's representative prior to commencement of dewatering.

Groundwater monitoring shall be undertaken monthly throughout the summer period when possible for a minimum period of 3 months prior to dewatering. The lowest recorded groundwater level during monitoring season will be taken as the baseline level.

All monitoring results shall be submitted to AC and written confirmation provided that all pre-construction monitoring has been completed prior to beginning works.

5.2 Reporting intervals and requirements

All monitoring records as detailed in this report shall be compiled and submitted to AC's representative at 2 month intervals from the commencement of construction until three months after the completion of excavation and dewatering (or at such time following the completion of excavation that stable measurements are demonstrated and written confirmation is provided from AC).

Each report shall include the following:

- Monitoring records presented in a tabulated format as well as on a timeline plot with rainfall data.
- Comparison of monitoring data with trigger levels.
- Previous results set out with an explanation of any trends.
- A construction progress summary.
- Results of fortnightly visual observations of the structure and surrounding ground of the assets identified in the relevant pre-construction property survey.
- Any other information relevant to the reporting period (i.e. exceedance of trigger levels and contingency measures being undertaken).

6 Alert and Alarm trigger level response procedures

6.1 Response procedure if the Alert trigger levels are exceeded

If any of the monitoring Alert trigger levels are reached, then one or more of the contingency options described in Section 7 of this plan shall be carried out together with the following:

- Notify the Project Manager.
- Notify AC, in writing within one working day of the trigger level being exceeded, with details of any actions being undertaken.
- Survey all survey monitoring marks within 25 m of the affected monitoring marks to confirm the extent of deformation and exceedance of the Alert trigger.
- Review the monitoring data, as-built details and geology, and compare against the assumptions made in the design analyses.

- Submit a written report by a Suitably Qualified Engineering Professional to AC for approval, within one week of trigger level exceedance, which provides analyses of all monitoring data relating to the exceedance of any of the trigger levels and any recommendations for remedial actions and time frames for implementing these actions.
- If considered necessary:
 - Increase monitoring frequency.
 - Develop a detailed contingency plan and submit to AC.

6.2 Response procedure if the Alarm trigger are exceeded

If the monitoring Alarm trigger levels are reached for any building, culvert or ground then the following shall be carried out for the different works in addition to the actions outlined in Section 7:

- Cease further excavation or any other activity such as dewatering which has the potential to cause further deformations. Dewatering will not cease where this may result in the potential loss of ground instability in an excavation.
- Submit a written report by a Chartered Professional Engineer to AC for approval, within one week of Alarm trigger level exceedance, which provides analyses of all monitoring data and any recommendations for remedial action.
- Once approved by AC the recommendations shall be implemented.

Dewatering and/or construction may be resumed once AC's representative provides written notice to the Contractor that AC's representative is satisfied that damage to buildings, structures and services is unlikely with or without any approved additional mitigation measures to be undertaken and that AC is satisfied that owners of potentially affected buildings, structures and services have given written approval for construction to continue.

7 Contingency options

7.1 General

If any of the monitoring trigger levels are exceeded the general response will be as detailed in Section 6. Specific actions will be selected depending on the exact nature of the problem. Possible contingency actions are detailed in the following sections.

7.2 Building, culvert and ground, and deformation contingency measures

In the event of building, culvert or ground deformation exceeding the monitoring trigger levels, one or more of the following actions shall be taken:

- Review pre-construction condition surveys of the affected buildings or culverts, followed up by discussions on the situation with the property/service owner that may be affected.
- If deformations are due to groundwater drawdown, groundwater injection may commence.
- Monitor the rate of settlement (assuming that other steps have been undertaken to address the cause).
- Check public safety is maintained.

7.3 Underground service settlement contingency measures

Contingency measures for the settlement of underground services shall be established with the asset owner.

8 Monitoring and contingency plan review

The GSCMP shall be reviewed as required during construction to reflect on any changes that relate to implementation of the GSCMP. Reviews shall take into consideration the following:

- Changes in ground conditions and or site conditions.
- Changes in existing structures.
- Changes in analysis, design or construction methods.
- Changes in legal requirements, consent conditions, guidance notes, industry best practices standards, etc.
- Unresolved comments and/or complaints and responses to the complaints and remedial action (if taken) to the address.

9 **Applicability**

This report has been prepared for the exclusive use of our client Beca Limited , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

Report prepared by:

Report Reviewed by:

.....

Kishan Ranchhod
Geotechnical Engineer

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Geotechnical Engineer

Authorised for Tonkin & Taylor Ltd by:

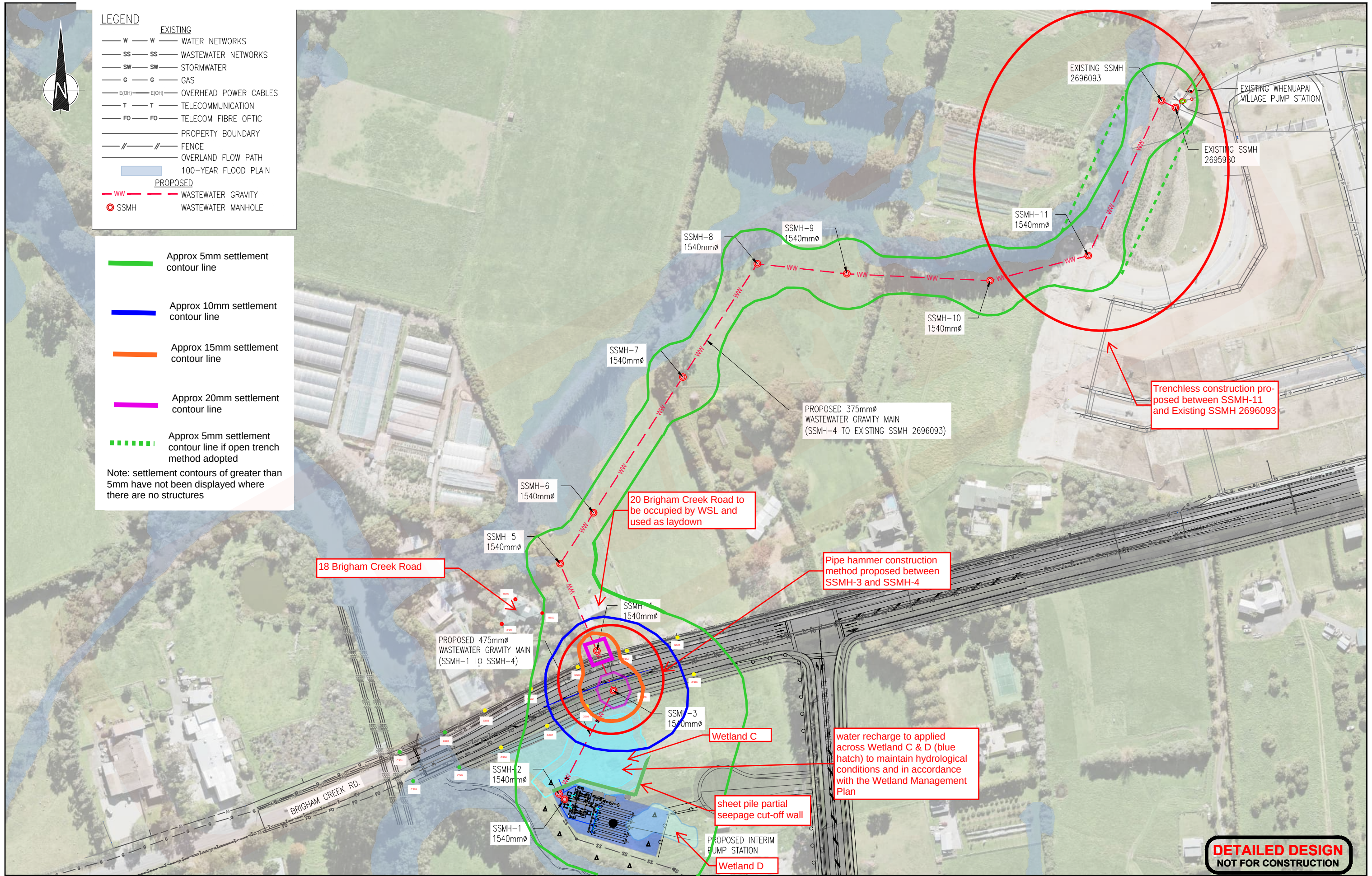
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Tim Coote
Project Director

20-Oct-23
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Appendix A Monitoring Plans

T+T SURVEY MONITORING PLAN MARK-UP WITH SURFACE GROUND SETTLEMENT CONTOURS OCTOBER 2023



				DESIGNED	PH	12-21	 Watercare COPYRIGHT - This drawing, the design concept, remain the exclusive property of Watercare Services Limited and may not be used without approval. Copyright reserved.	WHENUAPAI-REDHILLS WASTEWATER SERVICING BRIGHAM CREEK ROAD, WHENUAPAI INTERIM SLAUGHTERHOUSE PS - WASTEWATER GRAVITY MAIN - GENERAL LAYOUT	 	CAD FILE	R0017910.002	DATE	10-12-21
			DES. APPROVED	SW	12-21	ORIGINAL SCALE				A3 1:2000	CONTRACT No.	6484-6934	
			DRAWN	JC	12-21								
			DWG. APPROVED	DJ	12-21								
3	12-21	ISSUED FOR DETAILED DESIGN	J.C.	WSL DESIGN MGMT.						REF No.	12508391 3-AWD32		
2	8-21	RE-ISSUED FOR PRELIMINARY DESIGN	J.C.	WSL PROJ. LEAD						DWG No.	R0017910.004	ISSUE	3
1	5-21	ISSUED FOR PRELIMINARY DESIGN	J.C.										
ISSUE	DATE	AMENDMENT	BY	APPD.		BY	DATE						



NOTE:

1. AERIAL PHOTO SOURCED FROM LINZ DATA SERVICE <<https://data.linz.govt.nz/layer/95497-auckland-0075m-urban-aerial-photos-2017/>> , LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 17/12/2020.
2. PROPERTY BOUNDARY SOURCED FROM LINZ DATA SERVICE <<https://data.linz.govt.nz/layer/51571-nz-parcels/>> , LICENSED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 NEW ZEALAND LICENCE (CC BY 4.0). ACCESSED 17/12/2020.

PR C No. 1014985

D	N	D	CBM	Dec.20
DRA	N	JC		Dec.20
C	C	D	CBM	Dec.20

APPR D DA

C N **WATERCARE SERVICES LIMITED**
PR C **WHENUAPAI AND REDHILLS WASTEWATER SCHEME**

GEOTECHNICAL INVESTIGATION
SITE INVESTIGATION PLAN

CA A 1:7500 No. FIGURE 1 R 1

