Memorandum

To:	Caleb Pearson (Unity Developments Limited)
From:	Tim Hawke (Maven Waikato Limited)
Subject:	Ashbourne - Infrastructure Technical Memorandum for Referral
Date:	January 2025

Introduction

Unity Developments Ltd have engaged Maven to provide Concept Infrastructure design services for the master planning, consenting and design of Ashbourne. Ashbourne is located approximately 1.8 kilometres south-west of the centre of Matamata in the Waikato region and comprises a total area of 125 hectares. Ashbourne is a multi-use development that includes four key precincts:

1. A new **residential community**, comprising of circa 525 new homes, a green space and a commercial node;
2. A multi-functional **greenway** that weaves from the neighbourhood centre and commercial node to the Waitoa River on the site's western boundary;
3. A **retirement living centre**, comprising of circa 220 units, with additional supporting facilities; and
4. Two **solar farms** which will provide a sustainable energy resource onsite, with the potential to integrate into the wider electricity network to generate energy outside of the immediate development.

Residential Precinct

The 42-hectare residential community is underpinned by a series of design principles, which focus on creating a well-connected, legible and diverse community on the edge of Matamata. The nine-stage development is framed around a central spine road which runs from Station Road to the north of the site, down to the eastern boundary.

Intersecting this is a secondary spine road connection to link the wider residential precinct to the commercial node, green space and greenway, as well as provide access and connectivity to the future retirement living centre located in the western portion of the site.

This transport network, supported by local roads, pedestrian and cycle connections, enables a legible grid structure in the residential area. A range of housing typologies and densities are proposed to meet the growing and changing needs of the housing market to ensure there are options for future residents.

The commercial node located in the heart of the development, includes a number of amenities and services to support the Ashbourne Residential Development, wider community and local economy, including local shops, a childcare facility and a café. The commercial node comprises an area of 0.8 hectares in the centre of the Ashbourne development.

Staging

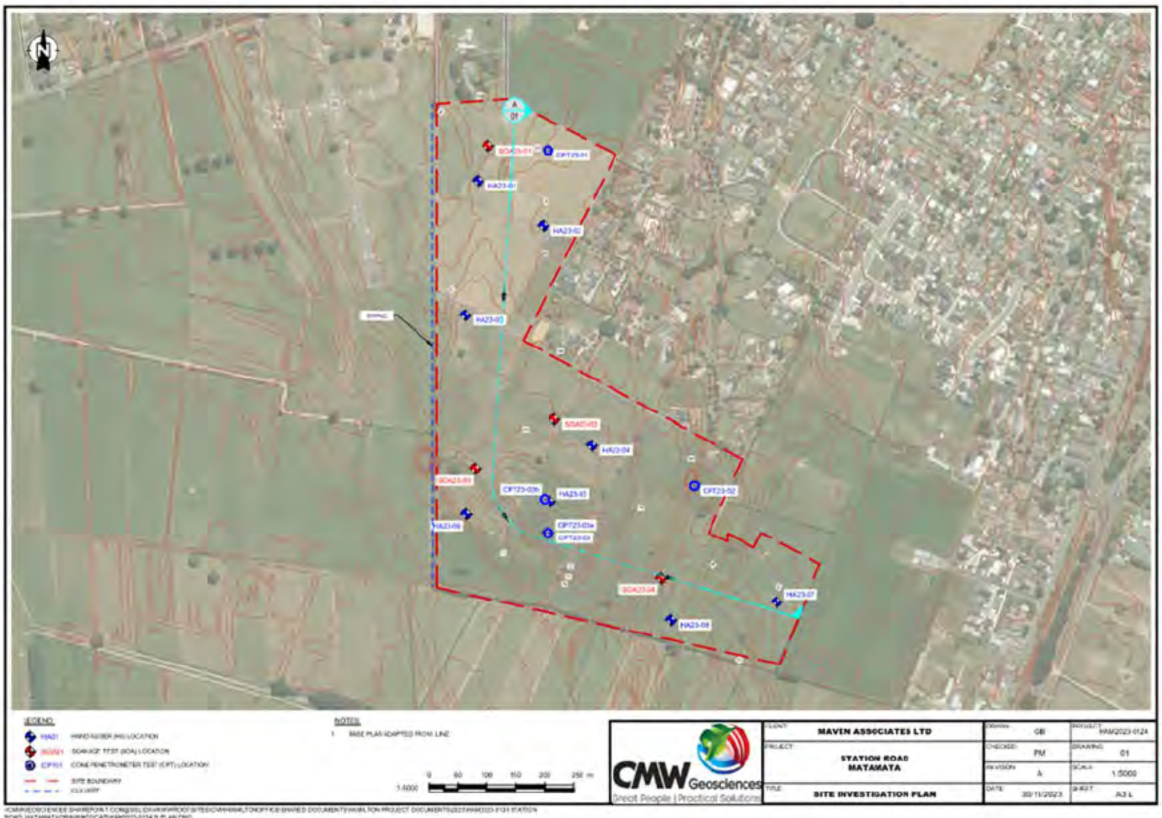
The Ashbourne Residential Development staging will include nine separate stages, eight residential stages and one commercial development stage. The staging yields are summarised in the table below:

Stage	Lots	Area (Ha)
Residential Stage 1	66	5.9
Residential Stage 2	76	5.2
Residential Stage 3	71	4.6
Residential Stage 4	51	4.35
Residential Stage 5	75	5.6
Residential Stage 6	79	5.7
Residential Stage 7	71	5.7
Residential Stage 8	39	4.2
Commercial Stage 1	1	0.8

Earthworks

Earthworks are required to create building platforms, roading networks, accessways, stormwater devices, and drainage construction. The extent of earthworks will vary considerably depending on demand and yield driving design considerations such as developable lots, transport corridors, and protection and mitigation from flooding and overland flow.

CMW were engaged by Maven in December 2023 to prepare a geotechnical investigation report for the central residential and southern residential blocks, refer to (Appendix B) for the CMW report.



CMW Site Investigation Plan 1

Site Geology

Site geology identified in the report the approximate distribution of prevailing landforms and geologies for the local area. The published geological maps for the area generally align with the geology encountered onsite as comprised of interbedded sand, silt and gravel from the Hinuera Formation. Further geotechnical site investigations will be required to determine the overall ground conditions.

The site will present some geotechnical challenges for establishing the site proposed landforms. These geotechnical challenges will be addressed through adopting appropriate geotechnical mitigation measures, specified by the Geotechnical Engineer. From the ground investigations undertaken by CMW, they have summarised the site geology results in the CMW Table 1 below.

Table 1: Summary of Strata Encountered				
Unit	Depth to base (m)		Thickness (m)**	
	Min	Max	Min	Max
Topsoil	0.1	0.4	0.1	0.4
Firm to Stiff Silt/Sandy Silt (Hinuera Formation)	0.8	1.2	0.5	0.9
Loose to Medium Dense Sand/Silty Sand (Hinuera Formation)	1.4	2.5	0.6	1.7
Very Stiff to Hard Silt (Hinuera Formation)	1.7	4.0	0.2	1.6
Dense to Very Dense Sand (Hinuera Formation)	>5		>2.0	
Very Stiff to hard Clayey Silt (Walton Subgroup) *	>5		>4.7	
Notes: *Strata only encountered in HA23-05 and CPT23-03b **Thickness only recorded where base of strata has been confirmed.				

A preliminary earthworks assessment has been undertaken for the proposed development. The design terrain was developed based on the latest design layout for the roading and stormwater. An earthworks balance was achieved, and it is summarised in Table 2 below.

Earthworks Volumes	
Total Cut =	243,274m³
Total Fill =	236,449m³
Balance (Cut) =	6,825m³

Stormwater

MPDC hold a discharge consent that was issued by WRC. This consent outlines how stormwater runoff from the urbanised area of the Matamata town centre should be managed. The consent provides guidance on managing stormwater and flooding to support future urban development within the catchment area. Refer to drawing SW proposed stormwater overview plan in Appendix A for the proposed drainage details.

The existing stormwater infrastructure within the site is limited to farm/roadside drains and streams. Stormwater for the proposed residential lots and the commercial area, will be managed through ground soakage devices and rainwater harvesting for storm events up to the 10-year ARI storm. Flows exceeding the 10-year ARI storm will drain towards to road as surface flows from bubble up pits.

The development will be supported by new public road soakage trenches within the berm frontage, that will manage the stormwater flows within the road area for up to the 10-year ARI storm events and will provide groundwater recharge. The road corridors will form the overland flowpaths, which will manage the overland flows for up to the 100-year ARI storm. The overland flows will be directed to designated proposed stormwater dry basins and the proposed green way for water quality treatment and soakage.

The proposed stormwater infrastructure will need to comply with the conditions for resource consent and engineering approval before being vested with MPDC. Where possible, the stormwater network will be designed and constructed within the roads.

Even though the development area is unlikely to be directly connected to the existing public stormwater network, the rules and requirements required by MPDC remain applicable to the development of this site. Consequently, it is expected that a stormwater discharge consent will be necessary to facilitate the development within this site.

Key stormwater management principles that are applicable for this site can be derived from the WRC Technical Report 2020/07, as follows:

- Provision of stormwater quality treatment
- Limit peak flow from post development to 80% of pre-development level (MPDC requirement)
- In the event secondary flow path is not possible, ground soakage shall be design to disposal of stormwater runoff up to 100 years rainfall events
- Active management of stormwater devices to maintain flood carrying capacity.
- Secondary overland flow path needs to be considered during the design of the developments.

These principles will guide stormwater management for this site and align with regional regulations and requirements.

A new greenway will be constructed to manage the stormwater from Catchment B area for up to the 100-year storm events, less 10-year flows which will be managed through onsite soakage within the site.

Stormwater Management

Catchment A is the south-eastern portion of the site. Soakage will be provided within the lots and the road to manage the stormwater flows within the road corridor for up to 10-year ARI storm events. Storm events in excess of the 10-year ARI storm events, will be conveyed as overland flows to a new designated stormwater dry basin located south of Eldonwood Drive.

Catchment B is the south-central portion of the site. The stormwater from this catchment will drain to a newly formed greenway, that will start from the western boundary, and it will continue west to connect into the Waitoa River. The greenway will be sized to accommodate for up to the 100-year ARI storm events for Catchment B.

Catchment C is the north-western portion of the site. Soakage will be provided within the lots and the road to manage the stormwater flows within the road corridor for up to 10-year ARI storm events. Storm events in excess of the 10-year ARI storm events, will be conveyed as overland flows to a new designated stormwater dry basin in the northern portion of the catchment area.

Catchment D is the northern portion of the site. Soakage will be provided within the lots and the road to manage the stormwater flows for up to 10-year ARI storm events. Storm events in excess of the 10-year ARI storm events, will be conveyed as overland flows within the road corridor to a new designated stormwater dry basin in the northern portion of the catchment area.

Wastewater

Maven have undertaken a desktop study to identify the most suitable option for wastewater disposal for the Ashbourne Residential Development area. Reticulated, decentralised, and at source solutions have been considered. MPDC advised that the existing wastewater downstream reticulation is currently at capacity, however planned wastewater network upgrades are planned, and they will allow for the future growth of Matamata.

A staged approach in developing the proposed infrastructure will likely be adopted, with a preference to connect into the existing wastewater infrastructure where possible. Refer to the wastewater overview plans drawings in Appendix A for the proposed wastewater drainage details.

Wastewater Reticulation

The site topography is generally flat, and Ashbourne Development would be predominantly serviced by gravity mains that would drain to intermediary pump stations located in the low points throughout the development. The intermediary pump stations will transfer wastewater through the site for discharge to the existing MPDC wastewater network.

We have not undertaken an in-depth review of the existing network capacity, MPDC have identified they currently do not have additional network capacity to support this development from the initial consultation with MPDC. To address these issues MPDC are upgrading the existing wastewater treatment plant to provide some additional capacity and to allow for the future growth of the town.

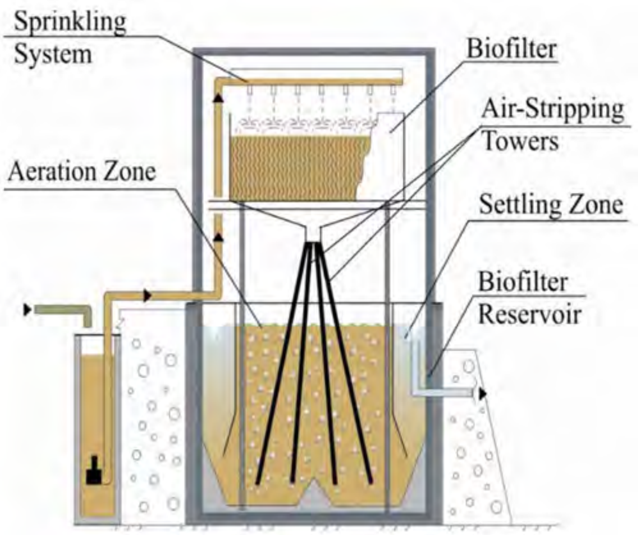
Given the volume of additional flows forecasted by the 42ha development, discharge of additional wastewater to the MPDC network will compound these existing issues, so strategic capacity upgrades (covered below) are likely before significant development can progress. Connection to the existing network may need to be split into separate sub catchments and the development will be limited to the capacity of the existing downstream network, where connections are made into the existing network.

Wastewater servicing options being considered connection into the existing MPDC infrastructure where feasible. Recognising the issues and constraints around traditional centralised solutions identified above, Maven have considered “at source” and “decentralised” wastewater treatment solutions.

At source wastewater treatment solutions are being considered, but discounted, as treatment devices will significantly reduce the available yield that can be achieved due to the need for large lot sizes to provide for sufficient secondary treatment area, rendering development in the area unfeasible.

Decentralised treatment would provide a long-term solution for the Ashbourne Residential Development.
Recent advances in onsite wastewater treatment plant technology have enabled package plants to be implemented to land development projects elsewhere in New Zealand (A case study is presented in Appendix C). The benefits of doing so would avoid capacity constraints on existing infrastructure and enable early release of developable areas. Whilst treated liquid waste is “clean” and can be discharged to a stream environment, consideration would need to be given to the effects of such discharge into the environment for water quality.

The treated greywater would discharge to the ground prior to entering an artificial wetland. The treated sludge would then be carted offsite using a honey sucker truck and then sent to a nearby approved landfill or worm farm for offsite disposal.



Wastewater Treatment Plant Treatment Process

Wastewater Catchments

Catchment A is the south-eastern portion of the site. A new wastewater pump station will be installed near the proposed Peakedale Drive road connection point, and it will be fitted with underground wastewater storage tanks that will be sized to provide a minimum of 9 hours of emergency storage.

The proposed wastewater gravity reticulation network will drain to the new wastewater pump station. A new rising main will be installed from the pump station and it will be extended to connect to the existing public WWMH 20230419101435, located within Peakedale Drive. The wastewater would then be pumped to the existing public network during the off-peak times. If there is insufficient capacity in the existing network then the rising main would instead be constructed from the wastewater pumpstation and extended into Catchment B, to connect in with the upstream receiving wastewater manhole within the spine road.

Catchment B is the central portion of the site. The proposed gravity reticulation through this catchment area, will drain to the new wastewater treatment plant located within the proposed Southern Solar Farm site.

Catchment C is the northern portion of the site. A new wastewater pump station will be installed off the primary spine road in the northern portion of the catchment area, and it will be fitted with underground wastewater storage tanks that will be sized to provide a minimum of 9 hours of emergency storage.

The proposed wastewater gravity reticulation network will drain to the new wastewater pump station. A new rising main will be installed from the pump station and it will be extended to connect to the existing public WWMH 300560, located within Station Road. The wastewater would then be pumped to the existing public network during the off-peak times. If there is insufficient capacity in the existing network then the rising main would instead be constructed from the wastewater pumpstation and extended into Catchment B, to connect in with the upstream receiving wastewater manhole within the spine road.

Wastewater Management Options

Proposed Option – Connecting into the existing wastewater public network

The Catchment A wastewater drainage network would drain to the new wastewater pumpstation. The wastewater would then be pumped via a new wastewater rising main from the pumpstation, to the existing gravity wastewater public network, located within the Peakedale Drive. The Catchment C wastewater drainage network would drain to the new wastewater pumpstation. The wastewater would then be pumped via a new wastewater rising main from the pumpstation, to the existing gravity wastewater public network, located within the Station Road.

The Catchment B wastewater drainage network would drain to the new wastewater pumpstation located within the Southern Solar Farm site. The wastewater would then be pumped via a new wastewater rising main to a receiving manhole located within Catchment A, to be gravity feed to the Catchment A wastewater pumpstation.

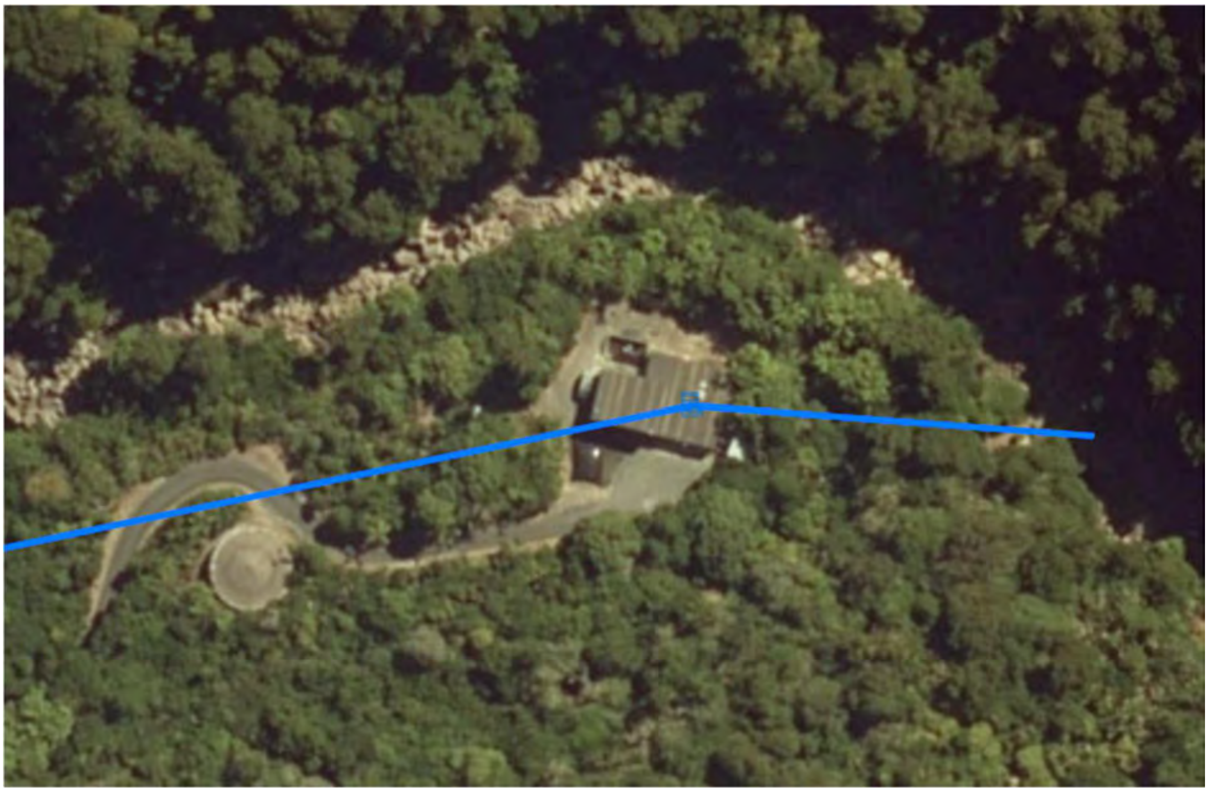
Alternative Option – Decentralised Wastewater Treatment

If the existing public wastewater network cannot support the overall wastewater demands from this development, then a new wastewater plant would need to be constructed. It would be located within the Southern Solar Farm site. Like option 1 if the public wastewater network can support the wastewater demands for Catchments A or C or both, the preference would be to connect to the public network where feasible. If there is no capacity to support the development at all, then the wastewater from Catchments A and C, would then be pumped to an upstream gravity manhole located within Catchment B along the spine road. The wastewater would all then be gravity feed to the onsite wastewater treatment plant for onsite treatment.

Water

Maven have undertaken a desktop study to identify the most suitable option for potable water for the Ashbourne Residential Development area. Reticulated and decentralised solutions have been considered. Refer to the proposed water supply overview plan drawing in Appendix A for the water supply details.

Matamata township has one existing centralised water treatment plant, located at the end of Tills Road in Okauia. The raw water is sourced from the stream flows off the Kaimai ranges. An average of 4.7 million litres of water is collected on average per day. The only known public upgrades for the water supply network are upgrading the water supply measurement instruments and no network upgrades.



Matamata Water Treatment Plant

Reticulation will be designed to provide Ashbourne Residential Development with a suitable means of potable water and firefighting supply. There are existing 200mmØ trunk watermains, that pass through Peakedale Drive, Smith Street and Eldonwood Drive. There is also an existing 100mmØ watermain located within Station Road to the east of this development site.

Alternative Water Supply Source

Bore water supply would be an alternative water supply option, if the existing network cannot support this development. Onsite testing would be required to confirm the feasibility.

Whilst decentralised approaches offer long term viability for development of the Ashbourne Residential Development, it will also require installing onsite water treatment devices to treat the raw bore water for potable water. This option would provide further resilience for the public water supply to the Matamata township, if it was later connected into the public network.

Water Supply Options

Proposed Option - To provide water supply for the development, the existing 200mmØ trunk watermain at the end of Peakedale Drive (Asset ID 20230418142829) could be extended into the development or alternatively extend the existing 200mmØ trunk watermain at the end of Eldonwood Drive (Asset ID 20080528142808) into the development. A new 250OD PE watermain would constructed form the development site following Station Road, to connect into the existing 200mmØ watermain at the intersection of Station Road and Smith Street (Asset ID 20060525121402).

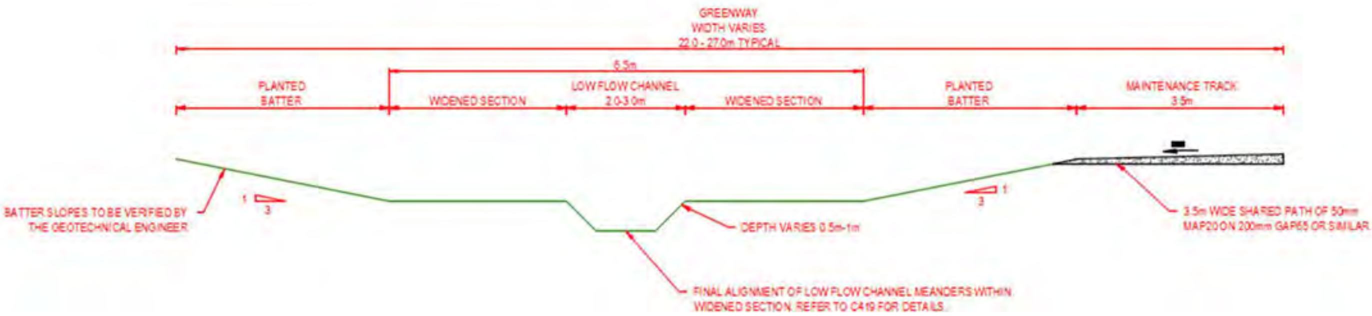
Alternative Option - If the existing water infrastructure cannot provide for whole development, then groundwater supply would be considered as an alternative water source. Water bore testing would be required to determine if there are underground aquifers and suitable water source locations within the development for establishing water bores. Containerised water treatment plants would be required onsite to treat the raw water supplied from each bore, before the treated bore water could be used as a portable water supply for the development.

Greenway Precinct

The multi-functional greenway links the commercial node and open spaces of the Ashbourne development area. This corridor interconnects infrastructure, ecological wellbeing, connectivity and amenity to support a place-based identity. A number of uses are proposed along this corridor to encourage future residents to interact with the greenway, such as sheltered rest areas for relaxation and socialisation, active mode pathways, and play areas.

The proposed greenway is sized to accommodate the 100-year ARI stormwater event flows less the 10-year ARI event flows from the residential Catchment B and the Retirement Village Catchment B. The greenway will provide the stormwater treatment prior to discharging into the Waitoa River.

To provide for future maintenance of the greenway a 3.5m wide maintenance track will be constructed along the northern side of the greenway. The maintenance track will also provide a shared access track for pedestrians and cyclists. The greenway will have widened sections to provide some additional flood storage and to enhance the aesthetics of the greenway. The typical greenway sections are shown below.



Greenway Corridor

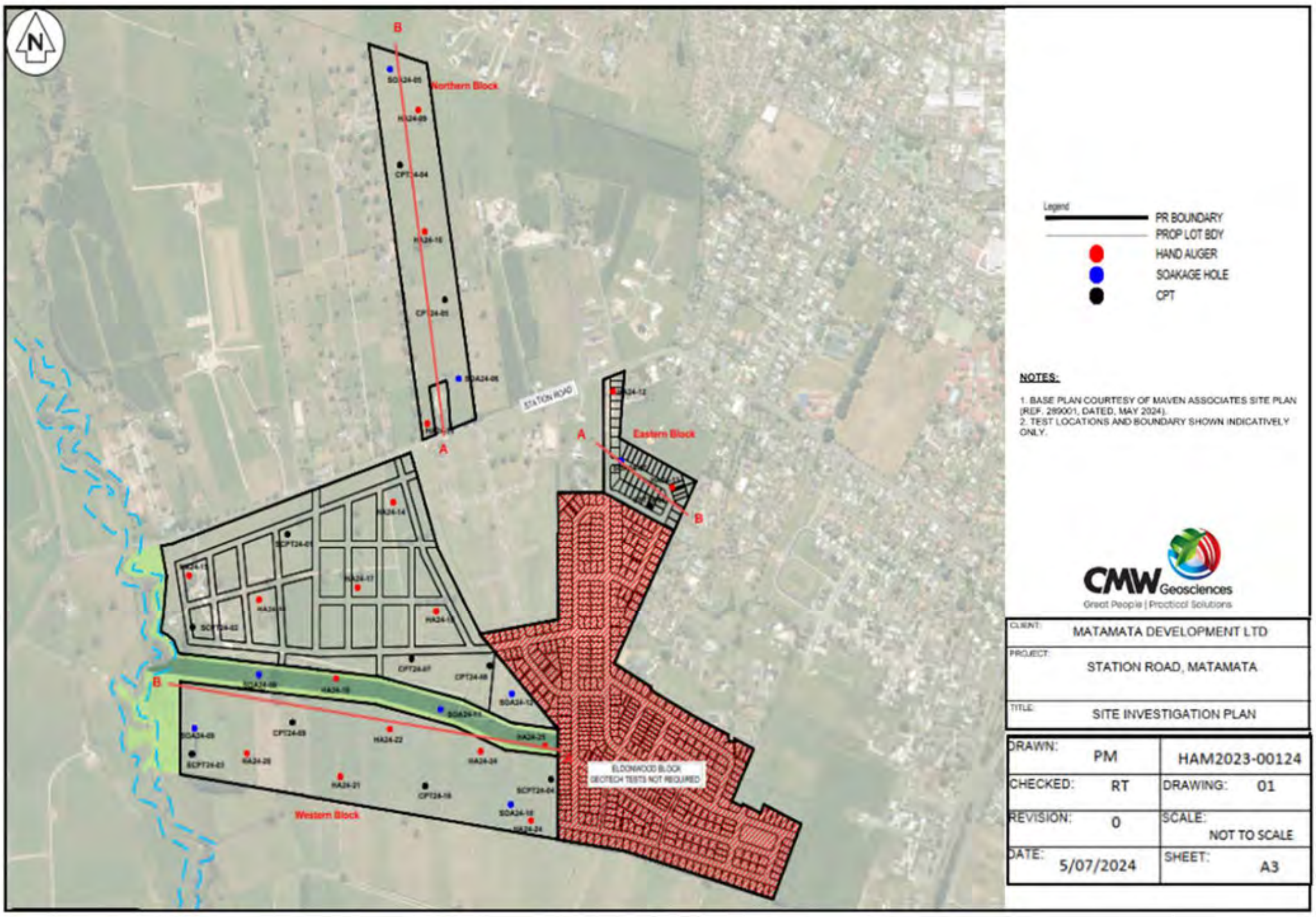
Retirement Living Centre Precinct

To support the growing demand for retirement living in Matamata, Ashbourne is anticipated to deliver 218 retirement living units, as well as an aged care hospital and other supported community facilities across an area of 19 hectares. A staged approach is proposed, from east to west, to establish a high-quality development overlooking the greenway. Refer to Retirement Village drawings in Appendix A.

Earthworks

Earthworks are required to create building platforms, accessways, stormwater devices, and drainage construction. The extent of earthworks will be minimal to create minor accessways, some building structures, drainage and protection and mitigation from flooding and overland flow.

CMW were engaged by Maven in July 2024 to prepare a preliminary geotechnical investigation report for the Ashbourne solar farm sites, the retirement village site and 127 Station Road Residential northern block site. Refer to (Appendix D) for the CMW report.



CMW Site Investigation Plan 2

Site Geology

Site geology identified in the report the approximate distribution of prevailing landforms and geologies for the local area. The published geological maps for the area are generally align with the geology encountered onsite as comprised of cross-bedded pumice sand, silt and gravel of the Hinuera Formation. Further geotechnical site investigations will be required to determine the overall ground conditions.

The site will present some geotechnical challenges for establishing the site proposed landforms. These geotechnical challenges will be addressed through adopting appropriate geotechnical mitigation measures, specified by the Geotechnical Engineer. From the ground investigations undertaken by CMW, they have summarised the site geology results in the CMW Table 1 below.

Table 1: Summary of Strata Encountered

Unit	Depth to base (m)		Thickness (m)**	
	Min	Max	Min	Max
Topsoil/Fill	0.1	0.5	0.1	0.5
Stiff to Very Stiff Silt (Hinuera Formation)	1.0	1.1	0.5	1
Dense to Very Dense Sand with interbedded Silt (Hinuera Formation)	5.9	17.3	4.9	16.3
Very Stiff to Hard Silt/Clay (Walton Subgroup)	0.1	18.1	9*	18*
Very Dense Silty Sand (Walton Subgroup)	-	-	**	**

Notes: * Strata not encountered within all test locations.
**Thickness only recorded were base of strata has been confirmed.

Stormwater

MPDC hold a discharge consent that was issued by WRC. This consent outlines how stormwater runoff from the urbanised area of the Matamata town centre should be managed. The consent provides guidance on managing stormwater and flooding to support future urban development within the catchment area. Refer to retirement village drawing C400 proposed stormwater drainage overview plan in Appendix A for the proposed drainage details.

The existing stormwater infrastructure within the site is limited to farm/roadside drains and streams. The development will be supported by new public stormwater networks, that will discharge into groundwater recharge pits and into the existing wetlands and proposed stormwater ponds and a greenway for water quality treatment. The stormwater infrastructure will need to comply with the conditions for resource consent and engineering approval before being vested with MPDC. Where possible, the stormwater network will be designed and constructed within the roads.

Even though the development area is unlikely to be directly connected to the existing public stormwater network, the rules and requirements required by MPDC remain applicable to the development of this site. Consequently, it is expected that a stormwater discharge consent will be necessary to facilitate the development within this site.
Key stormwater management principles that are applicable for this site can be derived from the WRC Technical Report 2020/07, as follows:

- Provision of stormwater quality treatment
- Limit peak flow from post development to 80% of pre-development level (MPDC requirement)
- In the event secondary flow path is not possible, ground soakage shall be design to disposal of stormwater runoff up to 100 years rainfall events
- Active management of stormwater devices to maintain flood carrying capacity.
- Secondary overland flow path needs to be considered during the design of the developments.

These principles will guide stormwater management for this site and align with regional regulations and requirements.

Stormwater Management

The buildings and units will provide onsite soakage to manage the stormwater for up to the 10-year storm events.

Catchment A is the eastern portion of the site. The stormwater from this catchment will drain to a new stormwater basin in the north-eastern corner of the site. The stormwater basin will provide the stormwater quality treatment, and it will manage the stormwater discharge into the road table drain.

Catchment B is the southern portion of the site. The stormwater from this catchment will drain to a new stormwater basin to the west of the development area. The stormwater basin will provide the stormwater quality treatment and will manage up to the 10-year ARI storm events. For storm events exceeding the 10-year and up to the 100-year ARI storm, will be conveyed from the stormwater basin to either the new green way or into the existing farm drain, that discharges into the Waitoa River.

Wastewater

Maven have undertaken a desktop study to identify the most suitable option for wastewater disposal for the Ashbourne Retirement Village Development area. Reticulated, decentralised, and at source solutions have been considered. MPDC advised that the existing wastewater downstream reticulation is currently at capacity, however planned wastewater network upgrades are planned, and they will allow for the future growth of Matamata.

There is no existing wastewater network near the development for connection, and the existing public network does not have enough capacity to support the development. Refer to retirement village C500 series proposed wastewater overview plans in Appendix A for the proposed drainage details.

Wastewater Reticulation

The site topography is generally flat, and Ashbourne Retirement Village Development will be serviced by gravity reticulation network, that will drain to a new wastewater pump station (WWPS) located to the south of the northern stormwater basin. A proposed wastewater onsite treatment plant (WWTP) is proposed to be constructed near Station Road and to the west of the development. The wastewater generated from the development would be pumped to the proposed WWTP to provide the wastewater treatment. The treated greywater would then be separated, and it would discharge to ground via onsite dripper fields.

Given the volume of additional flows forecasted by the 34ha development, discharge of additional wastewater to the MPDC network would compound these existing issues, so strategic capacity upgrades (covered below) are likely before significant development can progress.

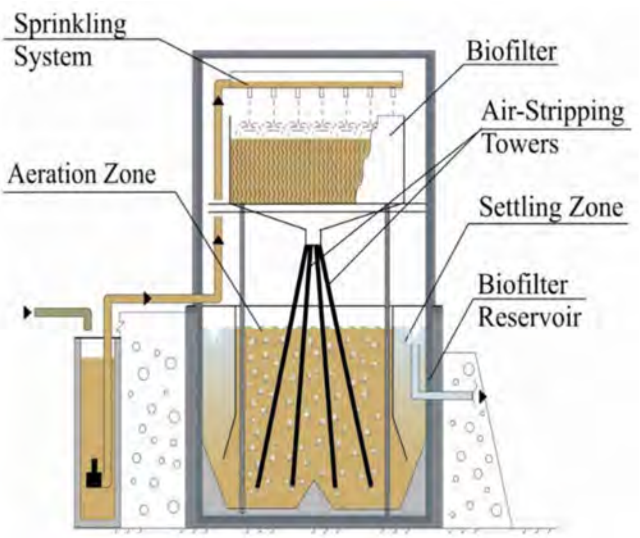
Wastewater servicing options being considered connection into the existing MPDC infrastructure where feasible. Recognising the issues and constraints identified above, Maven have considered “at source” and “decentralised” wastewater treatment solutions.

At source wastewater treatment solutions are being considered, but discounted, as treatment devices will significantly reduce the available yield that can be achieved due to the need for large lot sizes to provide for sufficient secondary treatment area, rendering development in the area unfeasible.

Decentralised treatment approaches will offer long term viability of the Ashbourne Retirement Village Development, however, prohibitive costs and programme to implement capital infrastructure for surrounding areas and downstream capacity upgrades could unnecessarily delay or prolong initial development of the Ashbourne Development.

Recent advances in onsite wastewater treatment plant technology have enabled package plants to be implemented to land development projects elsewhere in New Zealand (A case study is presented in Appendix C). The benefits of doing so would avoid capacity constraints on existing infrastructure and enable early release of developable areas. Whilst treated liquid waste is “clean” and can be discharged to a stream environment, consideration would need to be given to the effects of such discharge into the environment for water quality.

The treated greywater would discharge to the ground prior to entering an artificial wetland. The treated sludge would then be carted offsite using a honey sucker truck and then sent to a nearby approved landfill or worm farm for offsite disposal.



Wastewater Treatment Plant Treatment Process

Wastewater Catchments

Catchment A is the entire site that will all drain back to the centralised WWPS by gravity and the wastewater would then be pumped to the proposed WWTP.

Wastewater Management Options

Option 1 – Decentralised Wastewater Treatment Plant with onsite soakage

Pumping the site wastewater to the new wastewater treatment plant and the treatment greywater being directed to the Soakage Area A dripper field site for ground soakage, refer to the retirement village drawing C500 in Appendix A for the Option 1 drainage option.

Option 2 – Decentralised Wastewater Treatment Plant with onsite soakage

Pumping the site wastewater to the new wastewater treatment plant and the treatment greywater being directed to the Soakage Area B dripper field site located within the Southern Solar Farm site for ground soakage, refer to the retirement village drawing C501 in Appendix A for the Option 2 drainage option.

Recommendations

Option 1 would be our recommended option, it would be the shortest distance to discharge the wastewater from the WWTP to the dripper fields and it would not require crossing the proposed public green way and into private property

Water

Maven have undertaken a desktop study to identify the most suitable option for potable water for the Ashbourne Retirement Village Development area. Reticulated and decentralised solutions have been considered. Refer to drawing C600 in Appendix A for the proposed water layout drawing.

The proposed water reticulation network will be designed to provide the Ashbourne retirement village with a suitable means of potable water and firefighting supply. There are existing 200mmØ trunk watermains that passes through the Station Road and Smith Street intersection.

Alternative Water Supply Source

Bore water supply would be an alternative water supply option, if the existing network cannot support this development. Onsite testing would be required to confirm the feasibility.

Whilst decentralised approaches offer long term viability for development of the Ashbourne Retirement Village Development, it will also require installing onsite water treatment devices to treat the raw bore water. This option would provide further resilience for public water supply to the Matamata township, if it was later connected into the public network.

Water Supply Options

Option 1 – A new 200mmØ trunk main could be constructed from the entrance of the development heading northeast following Station Road to connect into the existing 200mmØ water trunk main (Asset 20080218110817) at the intersection of Station Road and Smith Street.

Option 2 - If the existing water infrastructure cannot provide for whole development, then groundwater supply would be considered as an alternative water source. Water bore testing would be required to determine if there are underground aquifers and suitable water source locations within the development for establishing water bore(s).

Containerised water treatment plants would be required onsite, to treat the raw water supplied from each bore, before the treated bore water could be used as a portable water supply source for the development.

Recommendations

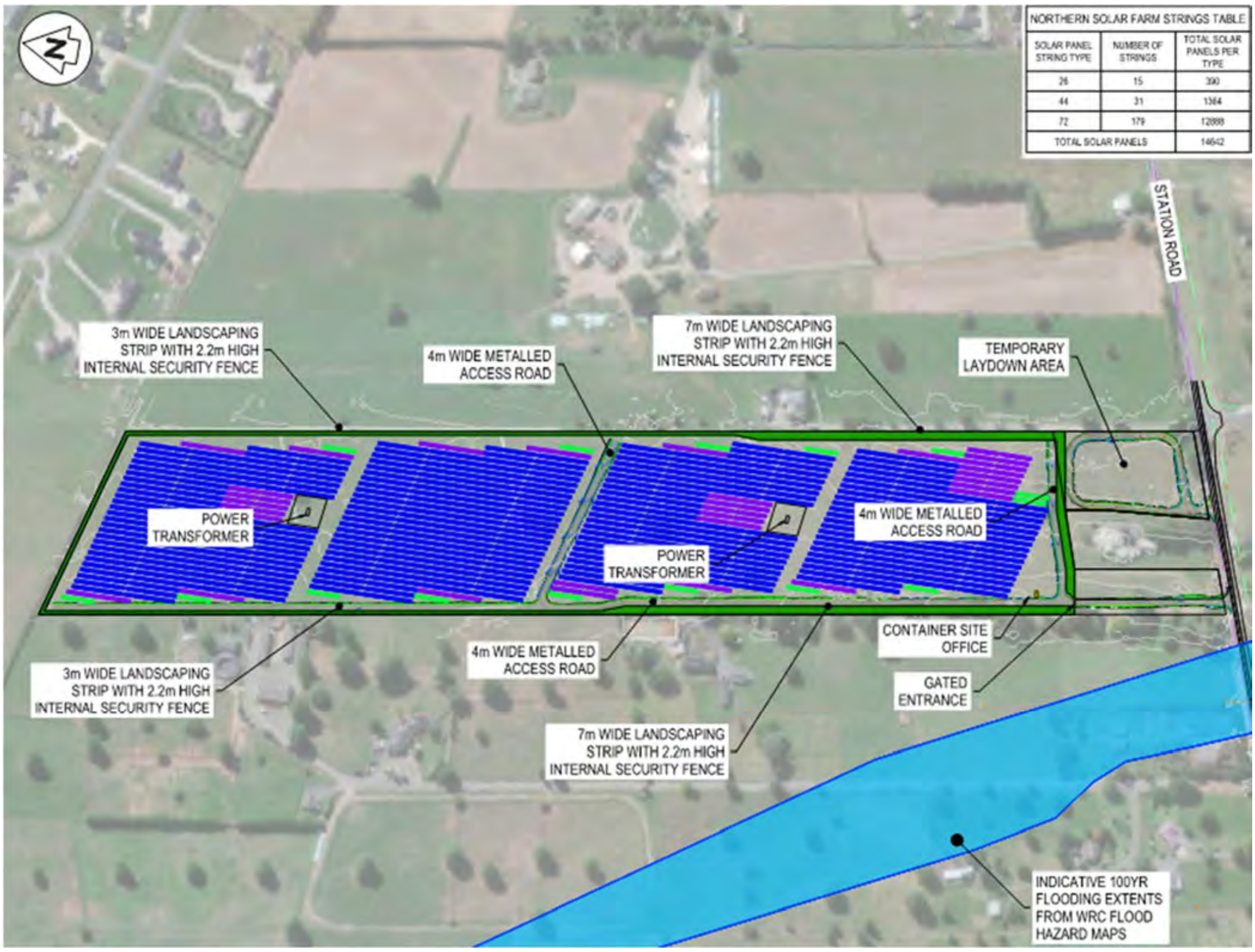
Option 1 would be our recommended option. This option would provide a long-term solution, and MPDC would manage the ongoing maintenance of the water reticulation network feeding the private development.

Solar Farms Precinct

There are two proposed solar farm sites, the southern Solar Farm and the northern Solar Farm.
The two solar farm sites will produce enough energy for over 7,000 homes per year, with the ability of powering not only Ashbourne but the wider community. The northern solar farm has an approximate site area of 12.28 hectares, while the southern solar farm will be approximately twice the size with an area of 24.82 hectares. An underpinning design principle of the solar farms is the dual-use, with agrivoltaics farming proposed to be undertaken underneath the solar panels to promote sustainability and preserve the identified highly productive land. Typical landscaping, planting and security will complement the solar farms to ensure their integration with the wider Ashbourne development. Refer to Appendix A for the Solar Farm drawings.

Northern Solar Farm

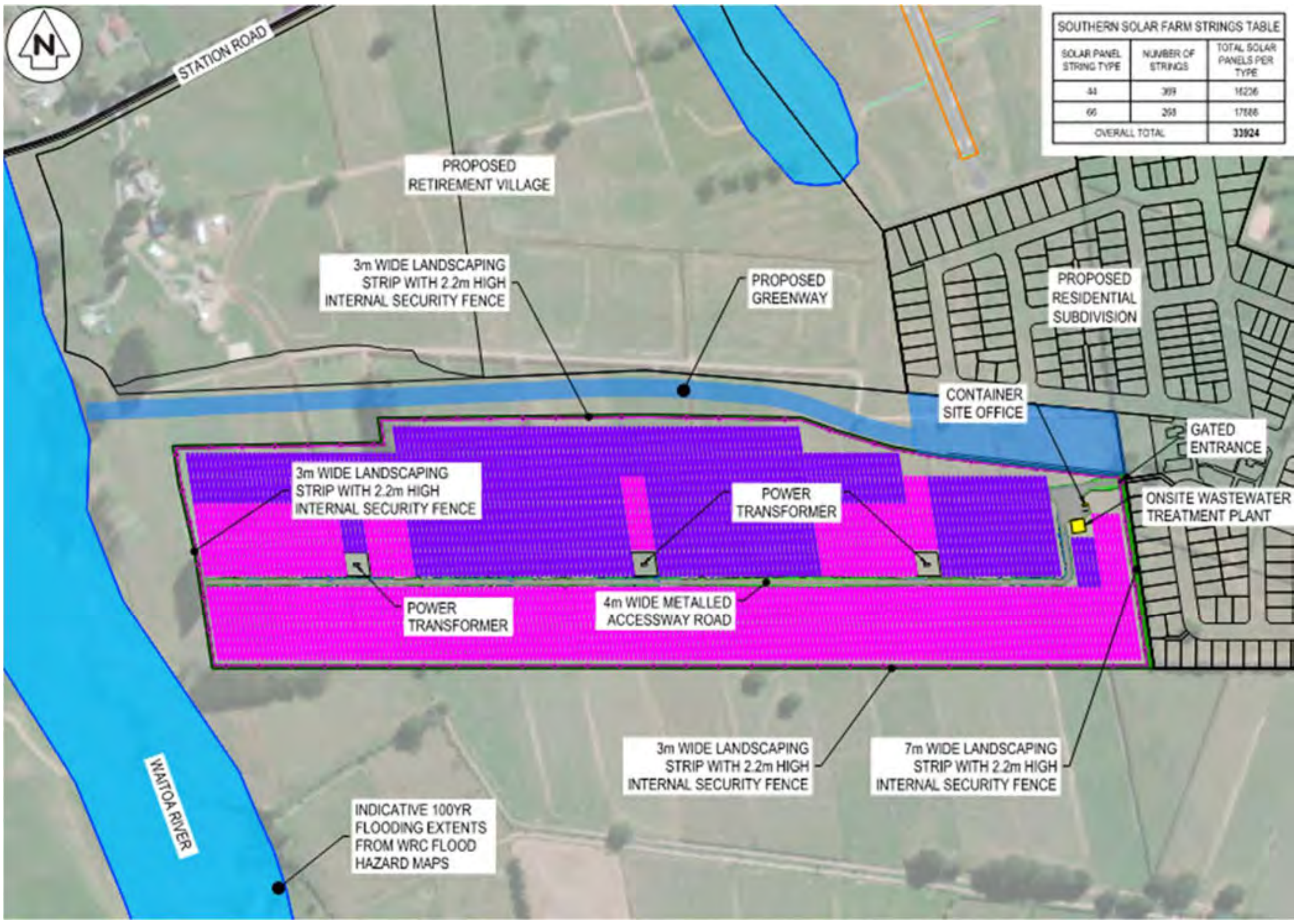
The northern Solar farm site is located at 172 Station Road. This solar farm site will include 14,642 solar panels, power transformers, 4m wide access tracks. The site will have a 2.2m high internal perimeter security fence and a 3m wide landscape perimeter strip between the boundary and the security fence and it will be extended to 7m wide strip where the boundary adjoins with the rural properties, where there are houses and main accessways. The Solar Farm will generate 9.04MW of power per day.



Northern Solar Farm Site

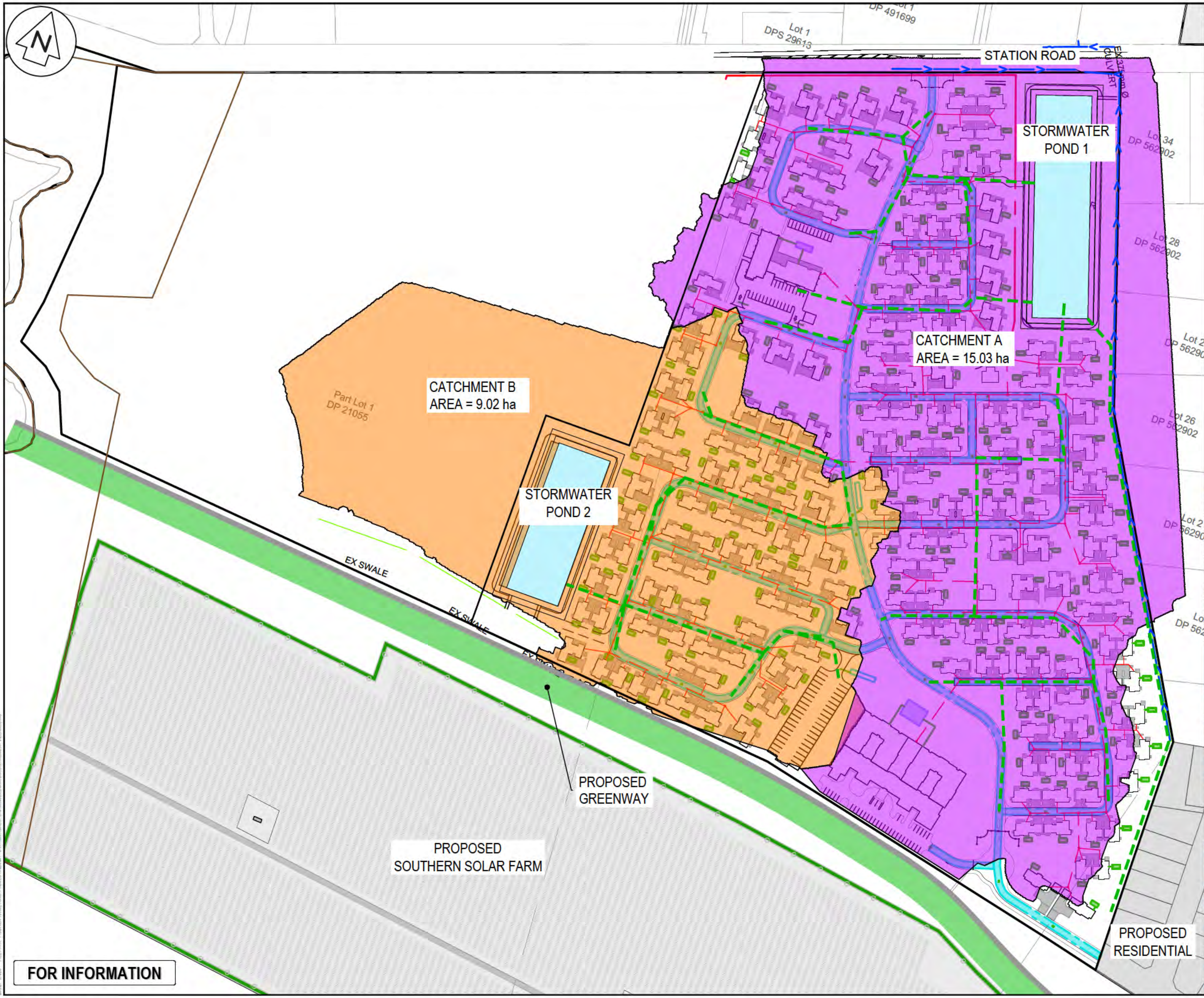
Southern Solar Farm

The Southern Solar Farm site is south of the proposed greenway and to the west of the proposed Ashbourne residential subdivision. This solar farm site will include 33,924 solar panels, power transformers, a 4m wide central access track, an onsite wastewater treatment plant. The onsite wastewater treatment plant will service Ashbourne residential development. The site will have a 2.2m high internal perimeter security fence and a 3m wide landscape perimeter strip between the boundary and the security fence and it will be extended to 7m wide strip where the boundary adjoins with the residential properties. The Solar Farm will generate 21.03MW of power per day.



Southern Solar Farm Site

APPENDIX A – Drawings



Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
2. Co-ordinates in terms of NZ Geodetic Datum NZTM 2000. Levels in terms of the New Zealand Vertical Datum 2016.
3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. The 100 year indicative flooding extents shown is based on the Waikato Regional Council Hazards portal data. We will undertake a flood modelling assessment at the resource consent stage.

Legend

- STORMWATER CATCHMENT A
- STORMWATER CATCHMENT B
- PR GRAVITY NETWORK
- EXISTING WATERCOURSE

Rev	Description	By	Date
D	FOR INFORMATION	TCH	02/2025
C	FOR INFORMATION	AJP	12/2024
B	FOR INFORMATION	TCH	10/2024
A	DRAFT	TCH	09/2024

	By	Date
Survey	LINZ	02/2024
Design	TCH	09/2024
Drawn	TCH	09/2024
Checked	DJM	12/2024

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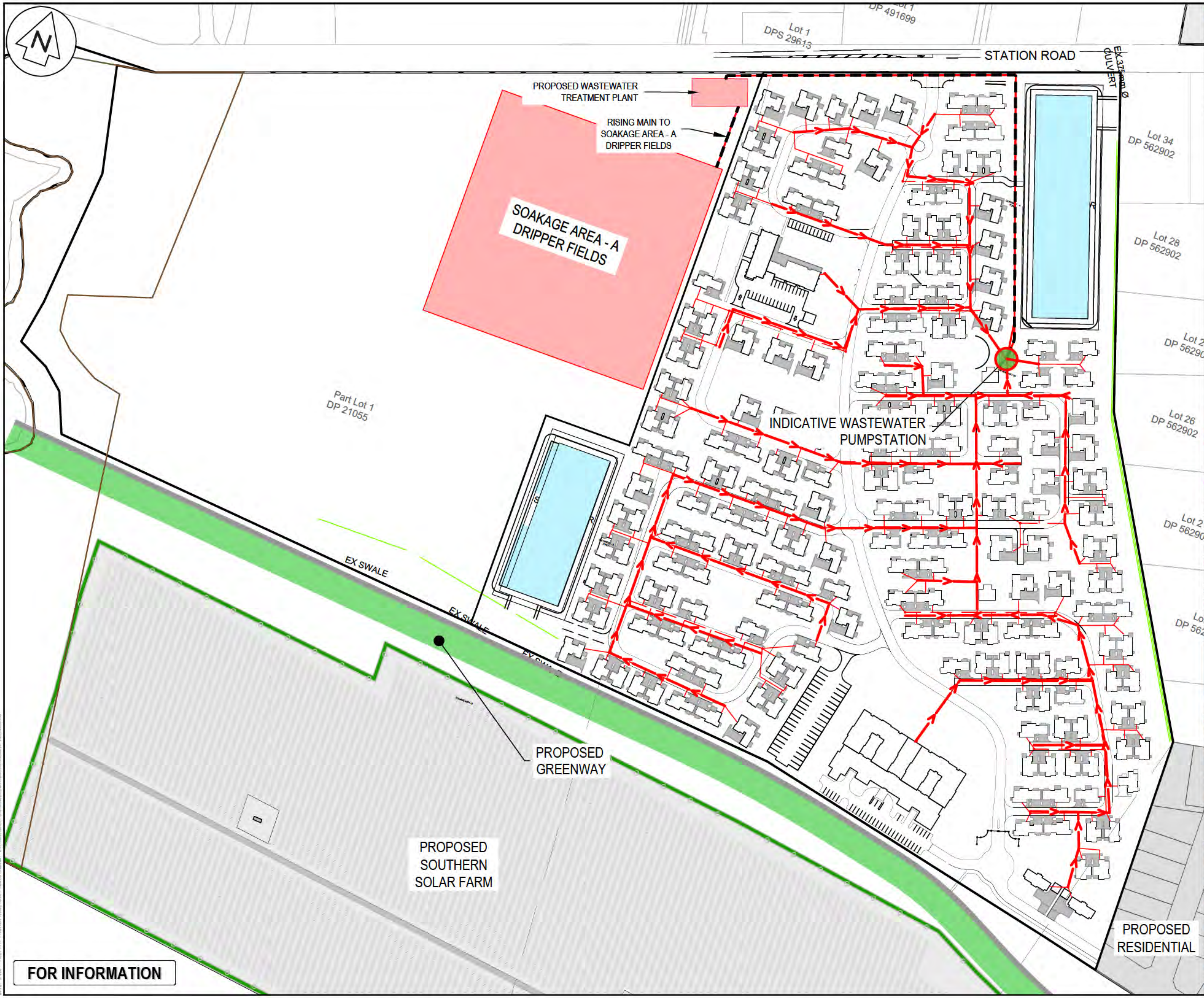
Project

RETIREMENT VILLAGE MATAMATA 247 STATION ROAD FOR MATAMATA DEVELOPMENTS

Title

PROPOSED STORMWATER DRAINAGE OVERVIEW PLAN

Project no.	289001
Scale	1:2500 @ A3
Cad file	RETIREMENT VILLAGE.DWG
Drawing no.	C400
Rev	D



Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
2. Co-ordinates in terms of NZ Geodetic Datum NZTM 2000. Levels in terms of the New Zealand Vertical Datum 2016.
3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. The 100 year indicative flooding extents shown is based on the Waikato Regional Council Hazards portal data. We will undertake a flood modelling assessment at the resource consent stage.

Legend

- INDICATIVE WASTEWATER PUMP STATION
- WW RISINGMAIN
- WW GRAVITY NETWORK

Rev	Description	By	Date
D	FOR INFORMATION	TCH	02/2025
C	FOR INFORMATION	TCH	12/2024
B	FOR INFORMATION	TCH	10/2024
A	DRAFT	TCH	09/2024

	By	Date
Survey	LINZ	02/2024
Design	TCH	09/2024
Drawn	TCH	09/2024
Checked	DJM	12/2024

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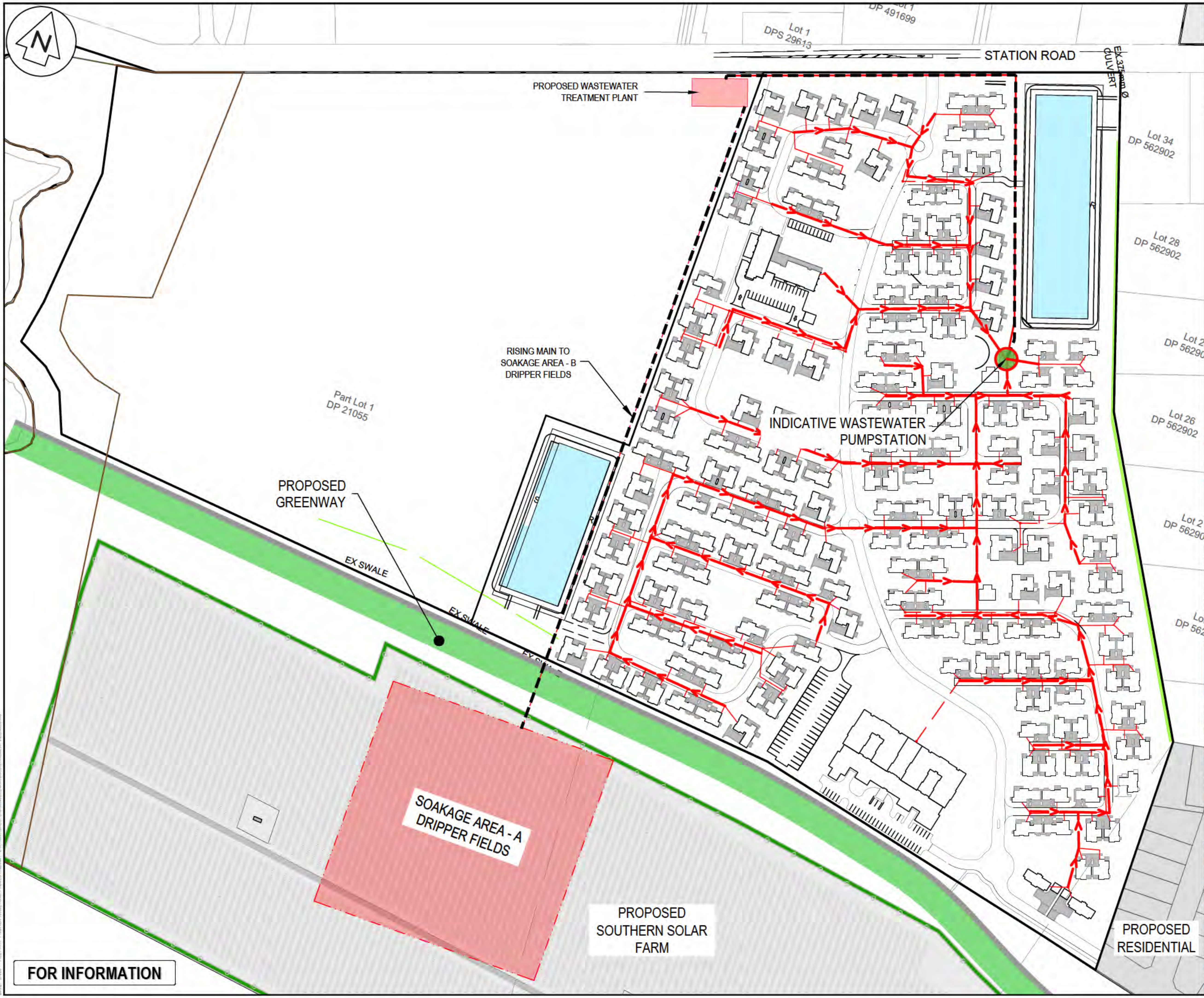
RETIREMENT VILLAGE MATAMATA 247 STATION ROAD FOR MATAMATA DEVELOPMENTS

Title
PROPOSED WASTEWATER OVERVIEW PLAN OPTION 1

Project no.	289001
Scale	1:2500 @ A3
Cad file	RETIREMENT VILLAGE.DWG
Drawing no.	C500
Rev	D



Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
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3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. The 100 year indicative flooding extents shown is based on the Waikato Regional Council Hazards portal data. We will undertake a flood modelling assessment at the resource consent stage.

Legend

- INDICATIVE WASTEWATER PUMP STATION
- WW RISINGMAIN
- WW GRAVITY NETWORK

Rev	Description	By	Date
D	FOR INFORMATION	TCH	02/2025
C	FOR INFORMATION	AJP	12/2024
B	FOR INFORMATION	TCH	10/2024
A	DRAFT	TCH	09/2024

	By	Date
Survey	LINZ	02/2024
Design	TCH	09/2024
Drawn	TCH	09/2024
Checked	DJM	12/2024

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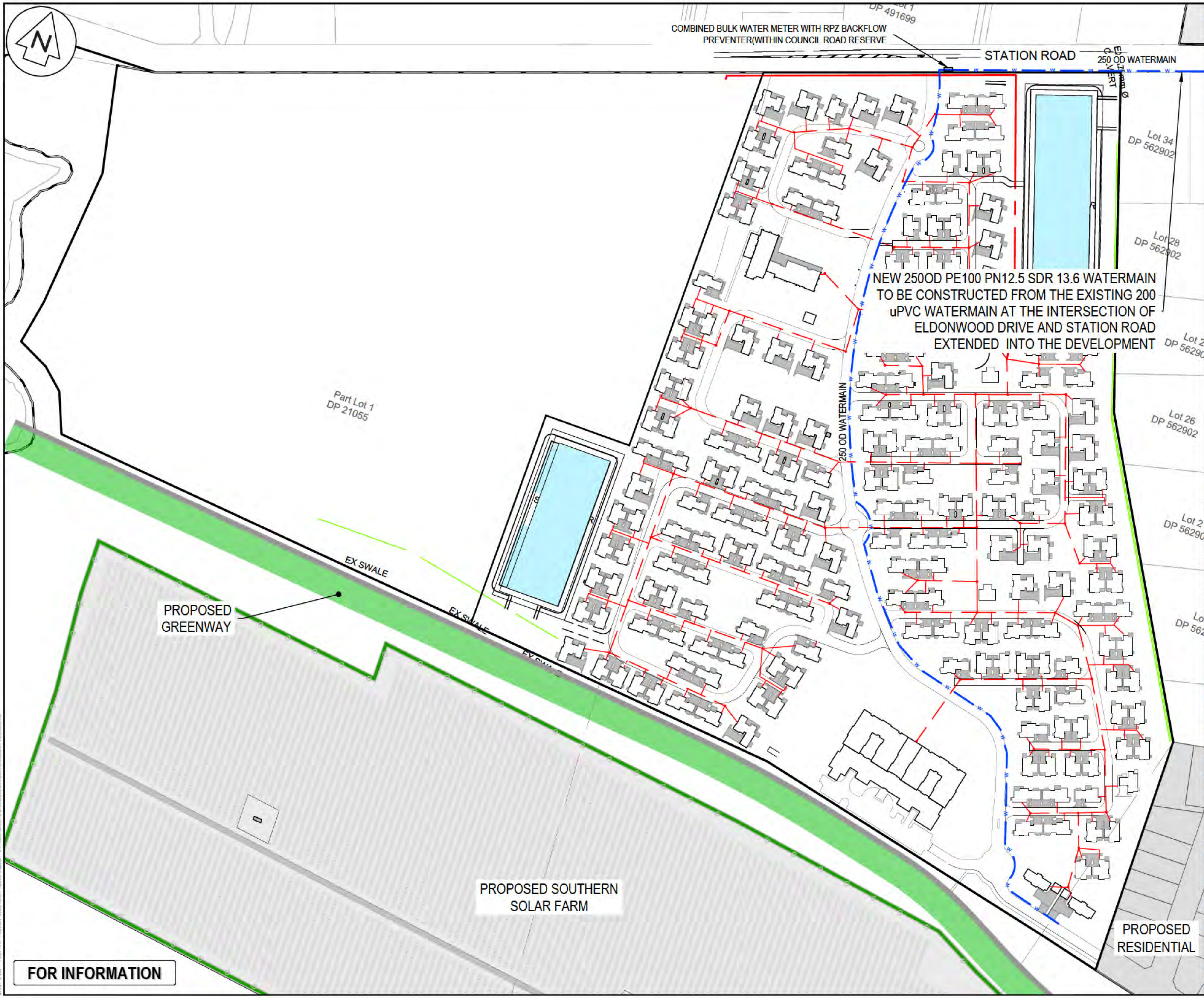
RETIREMENT VILLAGE MATAMATA 247 STATION ROAD FOR MATAMATA DEVELOPMENTS

Title

PROPOSED WASTEWATER OVERVIEW PLAN OPTION 2

Project no.	289001
Scale	1:2500 @ A3
Cad file	RETIREMENT VILLAGE.DWG
Drawing no.	C501
Rev	D



Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
2. Co-ordinates in terms of NZ Geodetic Datum NZTM 2000. Levels in terms of the New Zealand Vertical Datum 2016.
3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. The 100 year indicative flooding extents shown is based on the Waikato Regional Council Hazards portal data. We will undertake a flood modelling assessment at the resource consent stage.

Legend

— w — PROPOSED WATERMAIN

Rev	Description	By	Date
D	FOR INFORMATION	TCH	02/2025
C	FOR INFORMATION	TCH	12/2024
B	FOR INFORMATION	TCH	10/2024
A	DRAFT	TCH	09/2024

	By	Date
Survey	LINZ	02/2024
Design	TCH	09/2024
Drawn	TCH	09/2024
Checked	DJM	12/2024

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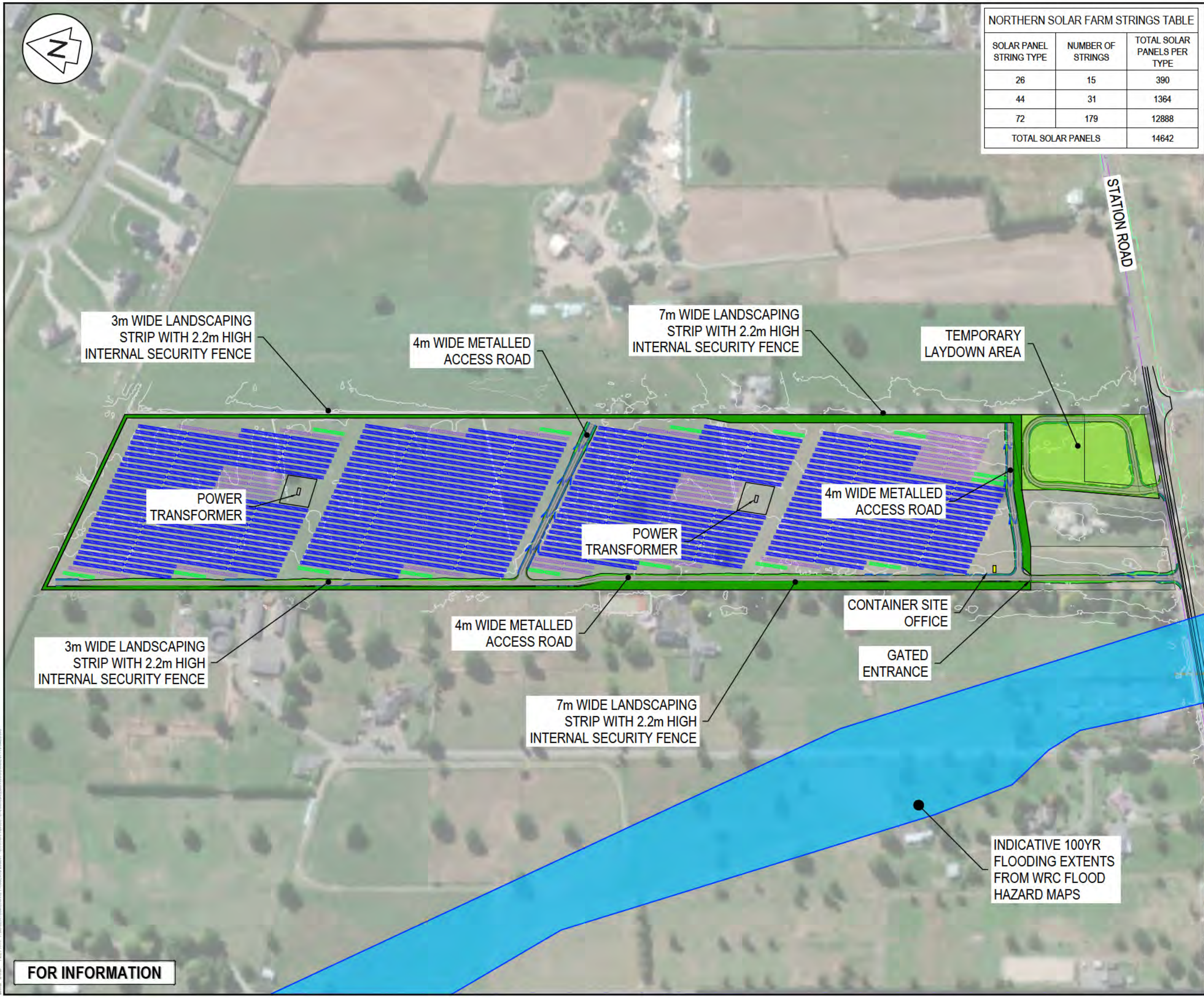
RETIREMENT VILLAGE MATAMATA 247 STATION ROAD FOR MATAMATA DEVELOPMENTS

Title

PROPOSED WATER SUPPLY OVERVIEW PLAN

Project no.	289001
Scale	1:2500 @ A3
Cad file	RETIREMENT VILLAGE.DWG
Drawing no.	C600 — Rev D



NORTHERN SOLAR FARM STRINGS TABLE

SOLAR PANEL STRING TYPE	NUMBER OF STRINGS	TOTAL SOLAR PANELS PER TYPE
26	15	390
44	31	1364
72	179	12888
TOTAL SOLAR PANELS		14642

Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
2. Co-ordinates in terms of NZ Geodetic Datum NZTM 2000. Levels in terms of the New Zealand Vertical Datum 2016.
3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. 2.2m high security perimeter fence to be installed along the site boundary.
5. Minimum clearance distance of 5m between the solar panels and the landscape strips or any buildings.

LEGEND

- FUTURE RURAL RESIDENTIAL
- 100YR INDICATIVE FLOODING EXTENTS
- 72 x SOLAR PANEL STRING
- 44 x SOLAR PANEL STRING
- 26 x SOLAR PANEL STRING

Rev	Description	By	Date
F	FOR INFORMATION	TCH	02/2025
E	FOR INFORMATION	TCH	12/2024
D	FOR INFORMATION	TCH	10/2024
C	FOR INFORMATION	TCH	10/2024

	By	Date
Survey	MAVEN BOP	05/2024
Design	TCH	08/2024
Drawn	TCH	09/2024
Checked	DJM	09/2024

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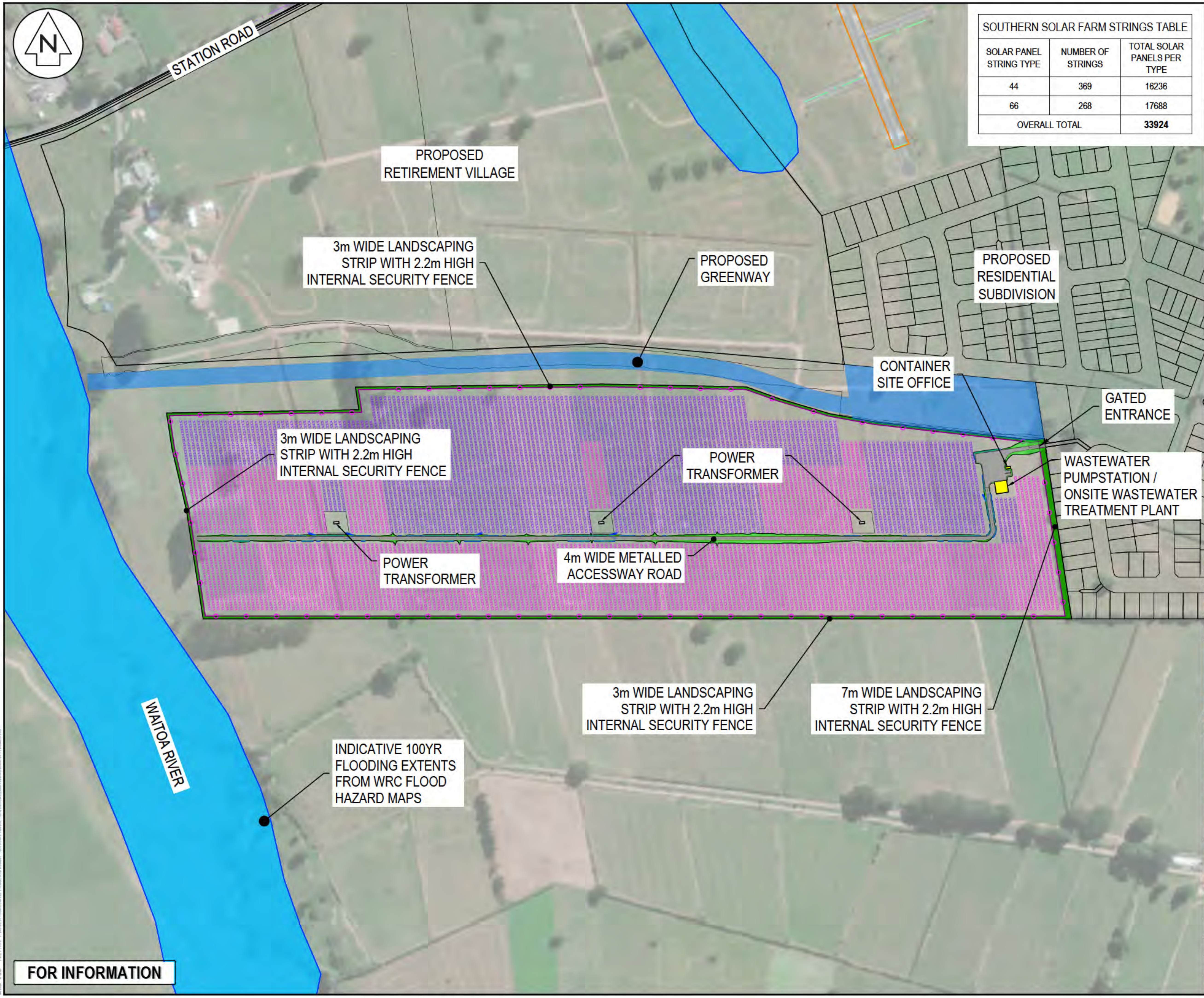
STATION ROAD MATAMATA FOR MATAMATA DEVELOPMENTS

Title

PROPOSED NORTHERN SOLAR FARM OVERVIEW PLAN

Project no.	289001
Scale	1:3000 @ A3
Cad file	SOLAR FARMS.DWG
Drawing no.	C300 — Rev F



SOUTHERN SOLAR FARM STRINGS TABLE		
SOLAR PANEL STRING TYPE	NUMBER OF STRINGS	TOTAL SOLAR PANELS PER TYPE
44	369	16236
66	268	17688
OVERALL TOTAL		**33924**

Notes

1. All works to be in accordance with Waikato Regional Infrastructure Technical Specifications.
2. Co-ordinates in terms of NZ Geodetic Datum NZTM 2000. Levels in terms of the New Zealand Vertical Datum 2016.
3. Existing services are from B4UDIG and they are indicative only, contractor to locate the existing services prior to construction.
4. 2.2m high security perimeter fence to be installed along the site boundary.
5. Minimum clearance distance of 5m between the solar panels and the landscape strips or any buildings.

LEGEND

- 100YR INDICATIVE FLOODING EXTENTS
- 66 x SOLAR PANEL STRING
- 44 x SOLAR PANEL STRING

Rev	Description	By	Date
F	FOR INFORMATION	TCH	02/2025
E	FOR INFORMATION	TCH	12/2024
D	FOR INFORMATION	TCH	10/2024
C	FOR INFORMATION	TCH	10/2024

	By	Date
Survey	MAVEN BOP	05/2024
Design	TCH	09/2024
Drawn	TCH	09/2024
Checked	DJM	09/2024

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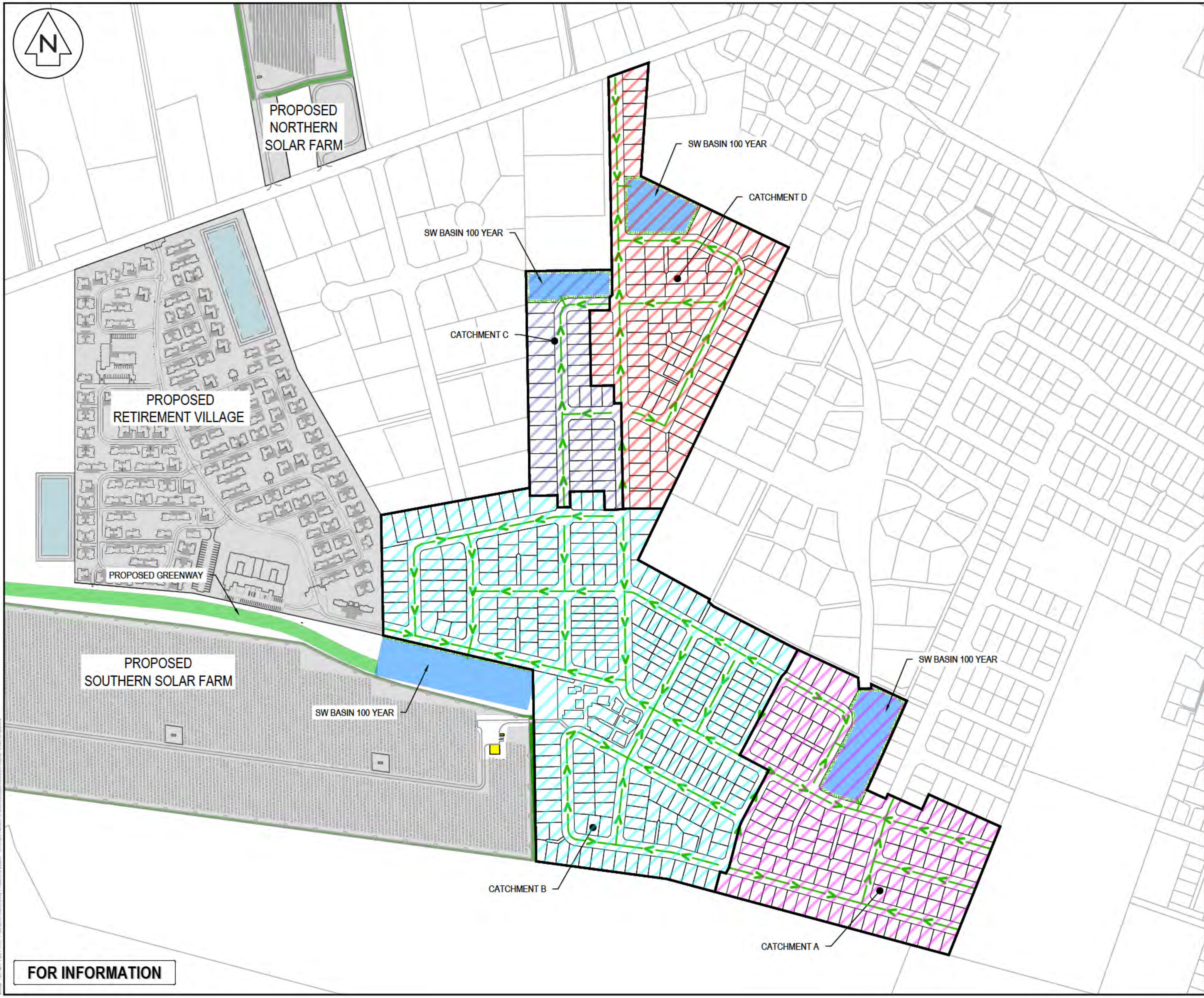
STATION ROAD MATAMATA FOR MATAMATA DEVELOPMENTS

Title

PROPOSED SOUTHERN SOLAR FARM OVERVIEW PLAN

Project no.	289001		
Scale	1:4000 @ A3		
Cad file	SOLAR FARMS.DWG		
Drawing no.	C310	Rev	F



Legend

CATCHMENT BDY
SW SOAKAGE TRENCH

Rev	Description	By	Date
D	FOR INFORMATION	AJP	12/2024
C	FOR INFORMATION	MKS	10/2024
B	FOR INFORMATION	MKS	09/2024
A	FOR INFORMATION	MKS	07/2024

	By	Date
Survey	LINZ	02/2024
Design	MKS	07/2024
Drawn	MKS	07/2024
Checked	DJM	10/2024

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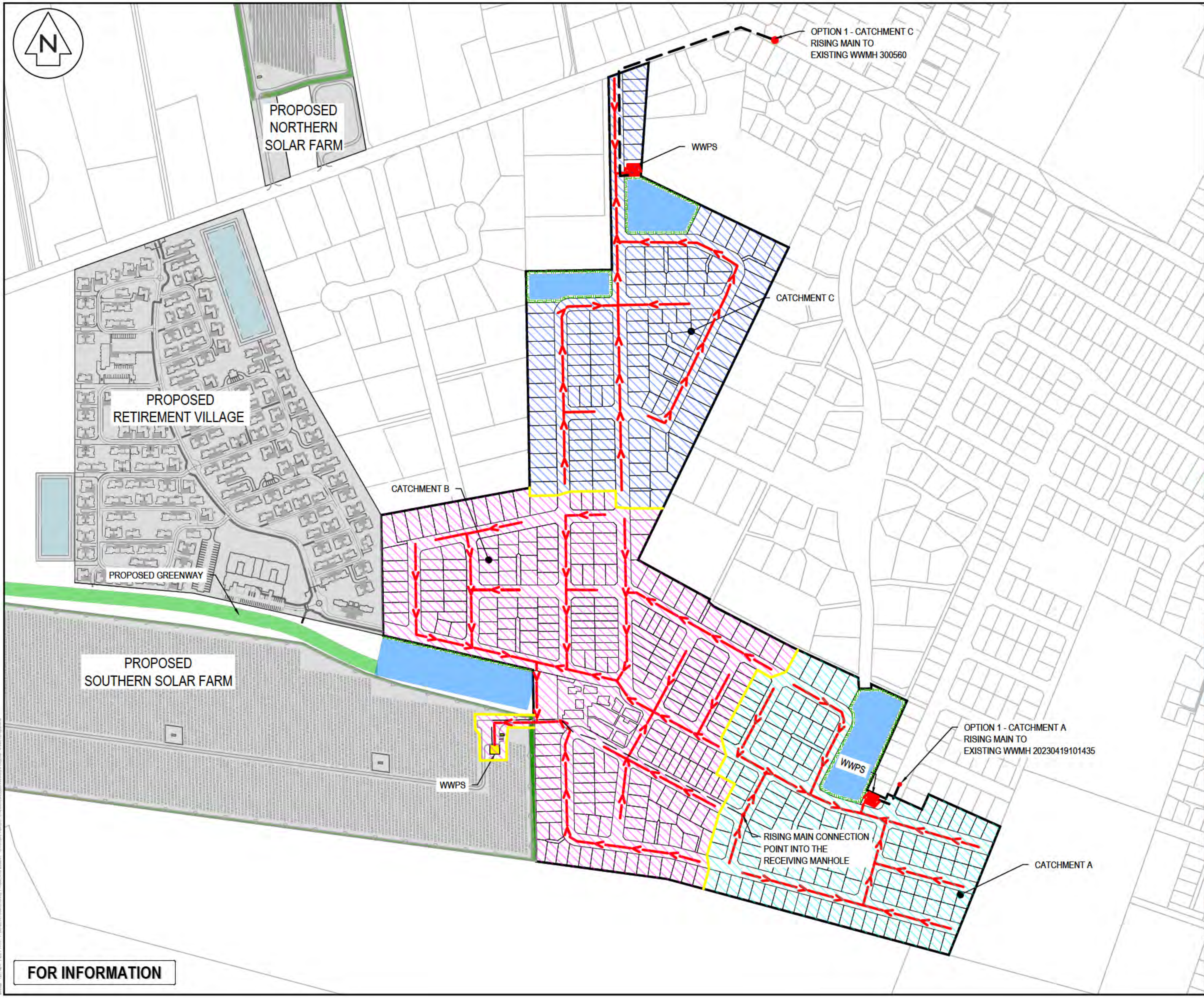
Title

PROPOSED STORMWATER DRAINAGE OVERVIEW PLAN

Project no.	289001
Scale	1:5000 @ A3
Cad file	PRELIM - 3 WATERS.DWG
Drawing no.	SW
Rev	D



Legend

WWPS	WW PUMP STATION
	CATCHMENT BDY
	WW GRAVITY MAIN
	WW RISING MAIN

Rev	Description	By	Date
E	FOR INFORMATION	TCH	12/2024
D	FOR INFORMATION	AJP	12/2024
C	FOR INFORMATION	MKS	09/2024
B	FOR INFORMATION	MKS	07/2024

	By	Date
Survey	LINZ	02/2024
Design	MKS	07/2024
Drawn	MKS	07/2024
Checked	DJM	09/2024

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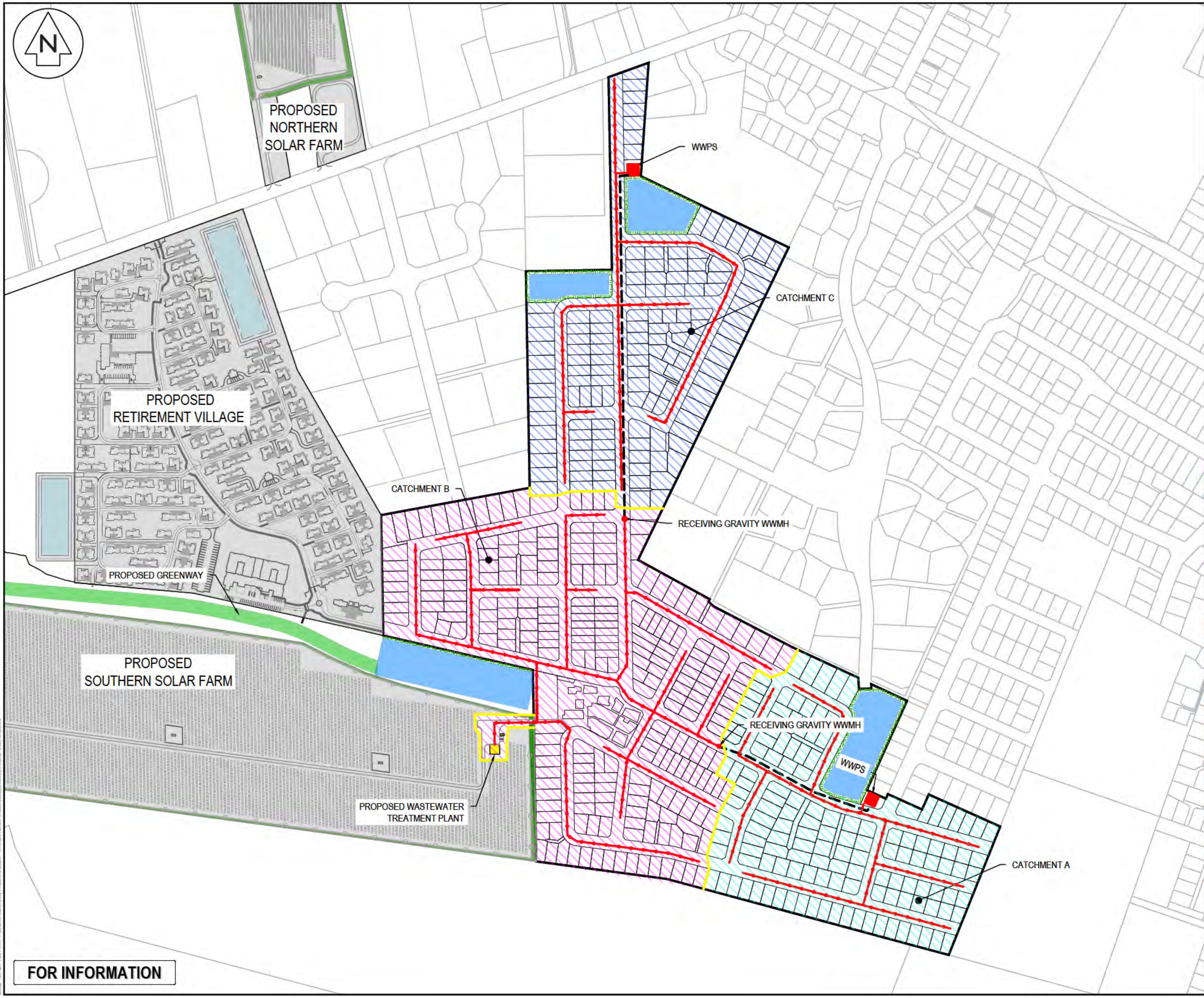
STATION ROAD MATAMATA FOR MATAMATA DEVELOPMENTS

Title

PROPOSED WASTEWATER OVERVIEW PLAN OPTION 1

Project no.	289001
Scale	1:5000 @ A3
Cad file	PRELIM - 3 WATERS.DWG
Drawing no.	WW - OPTION 1
Rev	E



Legend

WWPS	WW PUMP STATION
	CATCHMENT BDY
	WW GRAVITY MAIN
	WW RISING MAIN

Rev	Description	By	Date
E	FOR INFORMATION	TCH	12/2024
D	FOR INFORMATION	AJP	12/2024
C	FOR INFORMATION	MKS	09/2024
B	FOR INFORMATION	MKS	07/2024

	By	Date
Survey	LINZ	02/2024
Design	MKS	07/2024
Drawn	MKS	07/2024
Checked	DJM	09/2024

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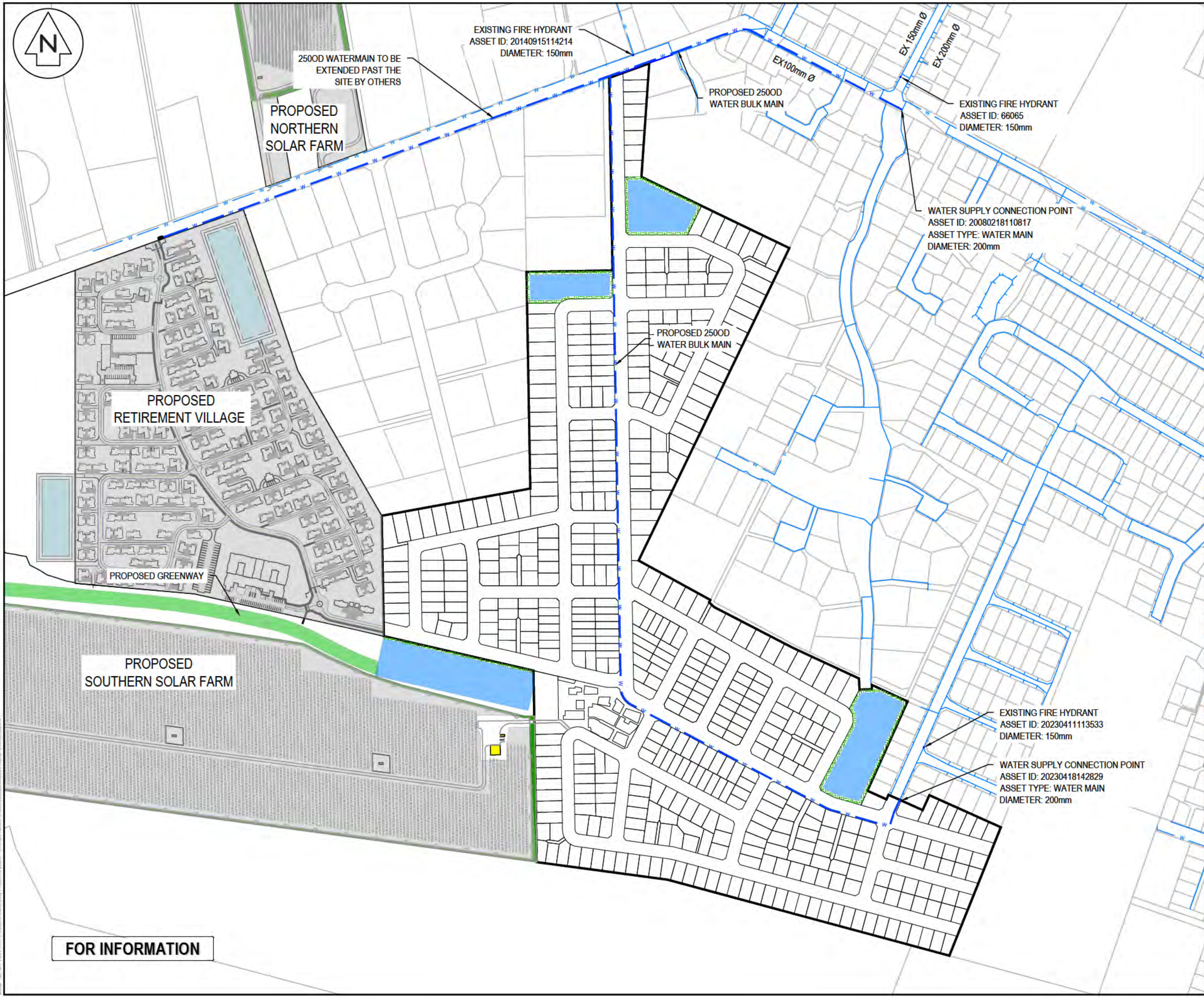
Project
STATION ROAD MATAMATA FOR MATAMATA DEVELOPMENTS

Title
PROPOSED WASTEWATER OVERVIEW PLAN OPTION 2

Project no.	289001
Scale	1:5000 @ A3
Cad file	PRELIM - 3 WATERS.DWG
Drawing no.	WW - OPTION 2
Rev	E



Legend

CATCHMENT BDY
WS BULK MAIN

Rev	Description	By	Date
D	FOR INFORMATION	AJP	12/2024
C	FOR INFORMATION	MKS	09/2024
B	FOR INFORMATION	MKS	09/2024
A	FOR INFORMATION	MKS	07/2024

	By	Date
Survey	LINZ	02/2024
Design	MKS	07/2024
Drawn	MKS	07/2024
Checked	DJM	09/2024

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Project
STATION ROAD MATAMATA FOR MATAMATA DEVELOPMENTS

Title
PROPOSED WATER SUPPLY OVERVIEW PLAN

Project no.	289001
Scale	1:5000 @ A3
Cad file	PRELIM - 3 WATERS.DWG
Drawing no.	WS	Rev D

APPENDIX B – CMW Residential GIR Report

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12 December 2023

STATION ROAD, MATAMATA

35-39 PEAKEDALE DRIVE

GEOTECHNICAL INVESTIGATION REPORT

Maven Associates Ltd

HAM2023-0124AB Rev 1

HAM2023-0124AB		
Date	**Revision**	**Comments**
6 December 2023	A	Initial draft for internal review
8 December 2023	0	Final Issue
12 December 2023	1	Updated drawings

	Name	Signature	Position
Prepared by	Peta McGiven		Engineering Geologist
Reviewed by	Bryn Jones		Principal Geotechnical Engineer Post nominals Choose an item.
Authorised by	Dave Morton		Principal Geotechnical Engineer CMEngNZ, CPEng

TABLE OF CONTENTS

APPENDICES

Appendix D: In-situ Permeability Testing Results

Appendix E: Liquefaction Results

Appendix F: Geohazard Assessment Table

1 INTRODUCTION

1.1 Project Brief

CMW Geosciences (CMW) have been engaged by Maven Associates Ltd to carry out a geotechnical investigation for a site located at 35-39 Peakedale Drive, which is being considered for the construction of a residential subdivision.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2023-0124AA, Rev1 dated 21 November 2023.

This report has been prepared to support as a due diligence for the property located at 35-39 Peakedale Drive. At the time of writing this report the project was in the early stages of planning and it was anticipated that the geotechnical investigation will inform site suitability and development options for the site. Further investigations and analyses are expected as the project progresses.

1.2 Scope of Work

The purpose of this report is to describe the investigation completed, the ground conditions encountered and to provide a preliminary geological hazard assessment the proposed subdivision development, as detailed in our proposal letter.

2 SITE DESCRIPTION

2.1 Site Location

The site comprises an area of approximately 33.12Ha and is located at Peakedale Drive, Matamata as shown on Figure 1 below.

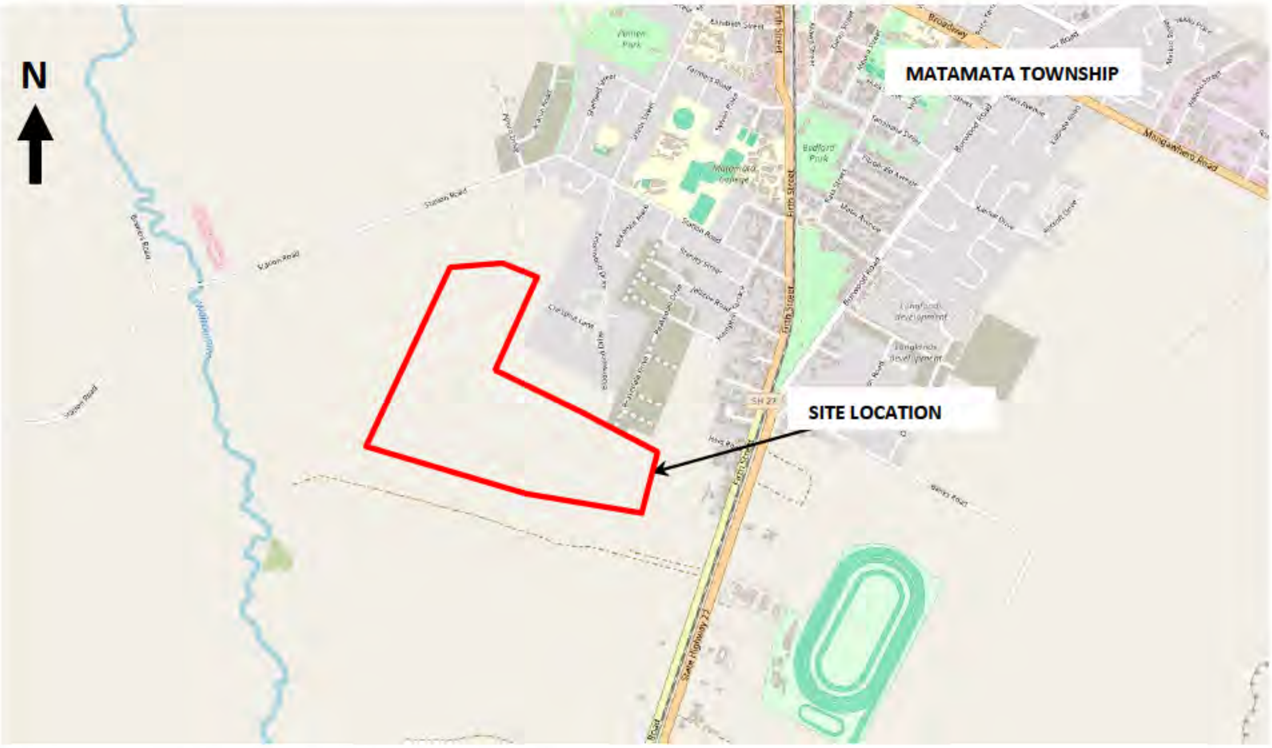


Figure 1: Site Location Plan (Ref. Openstreetmap.org)

2.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on the attached Site Plan as ***Drawing 01.***

The site is essentially near level with existing ground levels ranging from RL 67m (DATUM) in the northern corner with a gentle grading to RL 71m along the southern boundary. There are two landform areas on the site, a gradually sloping hill in the southwestern corner of the site which reaches approximately RL71m at its highest point and low-lying flood plains across the remainder of the site.

A stormwater swale is located along the western boundary. From the western boundary the Waitoa River runs south to north approximately 1km to the west.

The site is bound to the north by a residential subdivision and to the south, east and west by pastural farmland. Access to the site is through Peakedale Drive.

Review of historical aerial photographs[1] show the site has historically been used as pastoral farmland.

3 PROPOSED DEVELOPMENT

At the time of undertaking this investigation and the writing of this report, the project was in the early stages of planning and it was anticipated that the geotechnical investigation would provide details of preliminary feasibility options for the site.

4 INVESTIGATION SCOPE

4.1 Field Investigation

Following a dial before you dig search, and onsite service location, the field investigation was carried out between 23 November 2023 and 24 November 2023. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS specifications[2] and logged in accordance with NZGS guidance[3]. The scope of fieldwork completed was as follows:

- On-site services search undertaken by a specialist contractor to identify the presence of any underground obstructions or hazards prior to the field investigation program commencing;
- The drilling of eight hand auger boreholes, denoted HA23-01 to HA23-08, drilled using a 50mm diameter auger to target depths of up to 5.0m below existing ground levels to visually observe the near surface soil profile and to facilitate in-situ permeability / vane shear strength testing. In summary, HA23-01, HA23-02, HA23-03, HA23-06 and HA23-08 were terminated due to refusal. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths are presented in ***Appendix B***;
- Dynamic cone (Scala) penetrometer (DCP) tests were carried out adjacent to each hand auger borehole to depths of up to 5m to provide soil density profiles, for use as a comparison with the CPT data. Graphical results of the DCP testing are presented on the borehole logs in ***Appendix B***;
- Five Cone Penetrometer Tests (CPTu), denoted CPT23-01 to CPT23-03b, were completed to depths of up to 30m or refusal to define the ground model at depth. In summary, CPT23-03 refused at 4.06m and CPT23-

[1] Retrolens website, Sourced from http://retrolens.nz and licensed by LINZ CC-BY 3.0

[2] NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification

[3] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

03a refused at 7.26m due to excessive tip resistance. Results of the CPT's, presented as traces of tip resistance (qc), friction resistance (fs) and friction ratio are presented in ***Appendix C***; and

- In-situ falling head permeability tests were completed in the open standpipe piezometers denoted SOA23-01 to SOA23-04 at depths of 1m to 2.5m. There is an error present in the data of SOA23-04. Results of the permeability tests are presented in ***Appendix D***;

The approximate locations of the respective investigation sites referred to above are shown on the Site Investigation Plan as ***Drawing 01***. Test locations were measured using handheld GPS.

5 GROUND MODEL

5.1 Published Geology

Published geological maps[4] for the area depict the regional geology as comprising interbedded sand, silt and gravel from the Hinuera Formation.

The ground conditions encountered and inferred from the investigation were generally consistent with the published geology for the area and can be generalised according to the following subsurface sequences. The distribution of the various units encountered is presented in the appended Geological Section A on ***Drawing 02***.

5.1.1 Summary

The distribution of these units is illustrated on the appended Geological Section A (***Drawing 02***) and presented below in **Table1.**

Table 1: Summary of Strata Encountered				
Unit	Depth to base (m)		Thickness (m)**	
	Min	Max	Min	Max
Topsoil	0.1	0.4	0.1	0.4
Firm to Stiff Silt/Sandy Silt (Hinuera Formation)	0.8	1.2	0.5	0.9
Loose to Medium Dense Sand/Silty Sand (Hinuera Formation)	1.4	2.5	0.6	1.7
Very Stiff to Hard Silt (Hinuera Formation)	1.7	4.0	0.2	1.6
Dense to Very Dense Sand (Hinuera Formation)	>5		>2.0	
Very Stiff to hard Clayey Silt (Walton Subgroup) *	>5		>4.7	
Notes: *Strata only encountered in HA23-05 and CPT23-03b **Thickness only recorded where base of strata has been confirmed.				

5.2 Groundwater

During the investigation, which was completed in late spring conditions (November 2023), groundwater was encountered within the CPTs and boreholes at the depths provided in **Table 2** below:

Table 2: Groundwater Data			
Location	Depth (mbgl)	Elevation (m RL)	End of HA/CPT (mbgl)
CPT23-01	0.78	65.22	30.01
CPT23-02	4.54	63.46	30.02

Table 2: Groundwater Data			
Location	Depth (mbgl)	Elevation (m RL)	End of HA/CPT (mbgl)
CPT23-03	GWNE		4.06
CPT23-03a	GWNE		7.26
CPT23-03b	8.8	62.2	21.04
HA23-01	2.0	64.5	2.1
HA23-02	2.2	64.8	2.3
HA23-03	2.5	65.5	2.7
HA23-04	GWNE		5.0
HA23-05	GWNE		5.0
HA23-06	4.5	65.5	4.8
HA23-07	GWNE		5.0
HA23-08	3.5	64.5	4.2
SOA23-01	1.0	65	1.0
SOA23-02	GWNE		2.3
SOA23-03	GWNE		2.3
SOA23-04	GWNE		2.5
Note: mbgl = metres below ground level, GWNE = groundwater not encountered.			

Given the presence of a variable and silty soil profile, it is possible that perched groundwater may occur during and following periods of rainfall.

Due to an early refusal, CPT23-03 and CPT23-03a did not reach groundwater.

6 GEOHAZARDS ASSESSMENT

6.1 Seismicity

A preliminary seismic assessment has been carried out in general accordance with NZGS guidance[7]. The ultimate limit state (ULS) and serviceability state (SLS) peak ground accelerations (PGAs) have been assessed based on a 50-year design life and Importance Level (IL) 2 development, in accordance with current MBIE guidance[8]. These values are presented in **Table 3**, below.

Table 3: Design Peak Ground Acceleration (PGA) for Various Limit States			
Limit State	AEP	PGA(g)	$Magnitude_{eff}$
SLS	1/25	0.07	5.9
ULS	1/500	0.28	5.9
Note: ULS = ultimate limit state; AEP = annual exceedance probability			

6.2 Fault Rupture

The nearest active fault to the site is the Kerepehi Fault is approximately 5km east from the site. The Kerepehi Fault has a recurrence interval which is considered to be between 2,000 to 3,500 years. We consider the site to be at 'low' risk with respect to fault rupture.

6.3 Liquefaction

6.3.1 Methodology

Liquefaction occurs in loose saturated cohesionless soils that are subject to cyclic shear loading during an earthquake. This process leads to pore pressure build-up, soil grains moving into suspension and temporary loss of strength causing vertical and lateral ground deformation.

In accordance with MBIE/NZGS guidance[5] the liquefaction susceptibility of the soils at this site was assessed with respect to geological age and compositional (soil fabric and density) criteria, based on the following assumptions:

- Only saturated soils below an assessed seasonal average groundwater level, which is anticipated to be at a level of RL65.0m within the investigation area, were modelled as being susceptible to liquefaction;
- In accordance with MBIE/NZGS guidance[1] and in the absence of site-specific shear wave velocity measurements, no aging / strength gain factor has been applied to the Pleistocene aged Hinuera soils;
- Soils are also classified with respect to their grain size and plasticity to assess liquefaction susceptibility. For this project, a cut-off threshold soil behaviour type index value (Ic) of 2.6 was used to distinguish between liquefiable (Ic<2.6) and non-liquefiable (Ic>2.6) soils.
- Specific liquefaction analyses were undertaken for an IL2 structure, using the software package CLiq using the Boulanger and Idriss (2014) method. The cyclic stress ratio (CSR), being a function of the earthquake

[5] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (November 2021)

magnitude for the design return period event, was compared to the cyclic resistance ratio (CRR), being a function of the CPT cone resistance (qc) and friction ratio (Fr); and

- Free-field liquefaction induced settlements were determined in accordance with Zhang et al. (2002). With respect to liquefaction response, consideration was given to a 10m cut-off depth to estimate index settlements as per MBIE[6] guidance (foundation technical categories). These were compared to liquefaction settlement estimates over the full depth range of the CPT's with a depth weighting factor (e_v) applied ranging from 1 at the ground surface to 0 at 20m depth.

6.3.2 Results

Results are presented in ***Appendix E*** and can be summarised as in Table 4 below. The result show that

Table 4: Liquefaction Analyses Results

CPT No.	Total Settlement (mm)	Index ULS Settlement	Depth to Liquefied Layer (m)
CPT23-01	90	80	1.0
CPT23-02	90	55	4.0
CPT23-03b	30	10	6.0

Note:
All settlements and depths have been based on the existing ground profile.
Index settlements have been calculated based on the upper 10m of the soil profile using no depth weighting factor.
Total ULS settlements are based on the full depth of the CPT trace with a depth weighting factor applied.
Index settlements are for assessment of the site against the MBIE site Technical Category guidelines and are not comparable to the total ULS settlements.

The calculations indicate that liquefaction may occur in some soil layers during a ULS earthquake event. Based on the above, the suite has been divided into the following two liquefaction hazard categories.

Low Liquefaction Risk

The elevated part of the site (low-lying hill in southwestern corner) is expected to experience total liquefaction-induced free field settlements of less than 25mm. Affected soil layers are relatively deep below the finished ground surface (>5m). These areas would be analogous to the Technical Category 1 (TC1) zones of the Canterbury rebuild[11].

Moderate Liquefaction Risk

This zone includes the majority of site and includes the low-lying plains where relatively shallow groundwater is recorded to be present and with more significant liquefaction predicted in the CPTs during a ULS event. Total liquefaction-induced settlements within this zone range from 70mm to 80mm in a ULS earthquake.

Index settlements (i.e. within the upper 10m and without applying a depth reduction factor) range from 50mm to 80mm and would classify this zone as Technical Category 2 (TC2) per the guidelines developed for the Canterbury earthquake rebuild.

The post development liquefaction risk at this site will be affected by future earthworks. These effects will need to be considered once a development plan is in place for the scheme.

---

6 Repairing and Rebuilding House affected by the Canterbury Easrthquakes", (December 2012)

6.4 Lateral Spread

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where proposed cut and fill batters are proposed over or within liquefied soils.

Based on the current landforms there is a possibility lateral spread may occur into the open swale on the western boundary and additionally any permanent excavations (i.e. stormwater ponds) will need to consider lateral spread. More detailed CPT investigation is required to confirm presence of continuous lateral layers of liquefiable soils which would lead to lateral spread. Further stability analysis of this area will need to be undertaken to assess this hazard further.

6.5 General Slope Stability

The general landform across site is flat to gently grading, therefore we do not consider slope stability will be problematic on this site.

6.6 Load Induced Settlement

The predominantly stiff nature of the subsoils dictates that the soils encountered across the majority of the site are generally not prone to excessive load-induced or 'static' settlements under typical residential development proposed fill and building loads.

The majority of the site is recorded to be underlain by predominantly sandier soils which will see any settlement built out during construction.

6.7 Sensitive Soils

The Hinuera Formation silt unit present across site and encountered between 0.3 – 2.6m depth is typically considered moderately sensitive to sensitive.

These characteristics may make the silt unit challenging to earthwork and will require specific consideration to plant movements during the construction period, where exposed.

7 PRELIMINARY GEOHAZARDS ASSESSMENT

In general, the overall landform does not indicate major geotechnical problems that cannot be controlled with common geotechnical remediations.

A summary of the geotechnical hazards and general remediations is presented in ***Appendix F.***

8 FURTHER WORK

The following items may require further geotechnical input as the project progresses:

- Additional investigation and analyses to better define risks such as liquefaction, lateral spreading and static settlements below housing areas and infrastructure, particularly within the low-lying parts of the site.
- Geotechnical analysis and reporting suitable to support future project stages including resource consent, detailed design and building consent applications.
- Design of ground improvement if necessary to mitigate load or liquefaction induced settlement or lateral spread.

- **Preparation of Geotechnical Design Reports and an earthworks specification for future earthworks, followed by observations, testing and certification and preparation of a Geotechnical Completion Report for the development.**

9 CLOSURE

Additional important information regarding the use of your CMW report is provided in the '*Using your CMW Report*' document attached to this report.

This report has been prepared for use by Maven Associates Ltd in relation to the Station Road, Matamata 35-39 Peakedale Drive project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Maven Associates Ltd seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

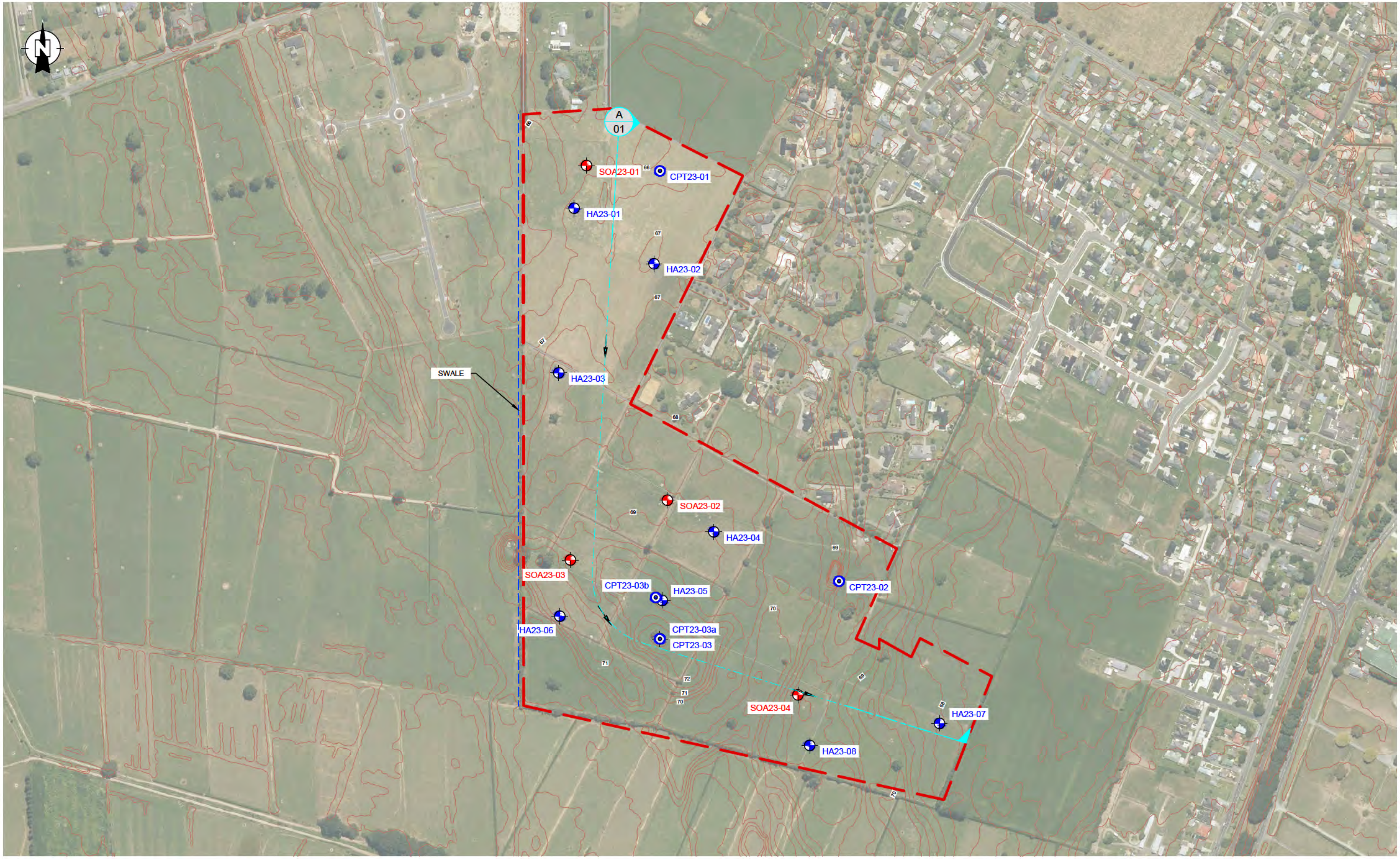
Environmental Matters Are Not Covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

APPENDIX A: DRAWINGS

Title	Reference No.	Date	Revision
Site Investigation Plan	*Drawing 01*	30/11/2023	0
Geotechnical Section A	*Drawing 02*	4/12/2023	0



LEGEND:

- HA01 — HAND AUGER (HA) LOCATION
- SOA01 — SOAKAGE TEST (SOA) LOCATION
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- SITE BOUNDARY
- CULVERT

NOTES:

1. BASE PLAN ADAPTED FROM: LINZ

1:5000 — 0, 50, 100, 150, 200, 250 m

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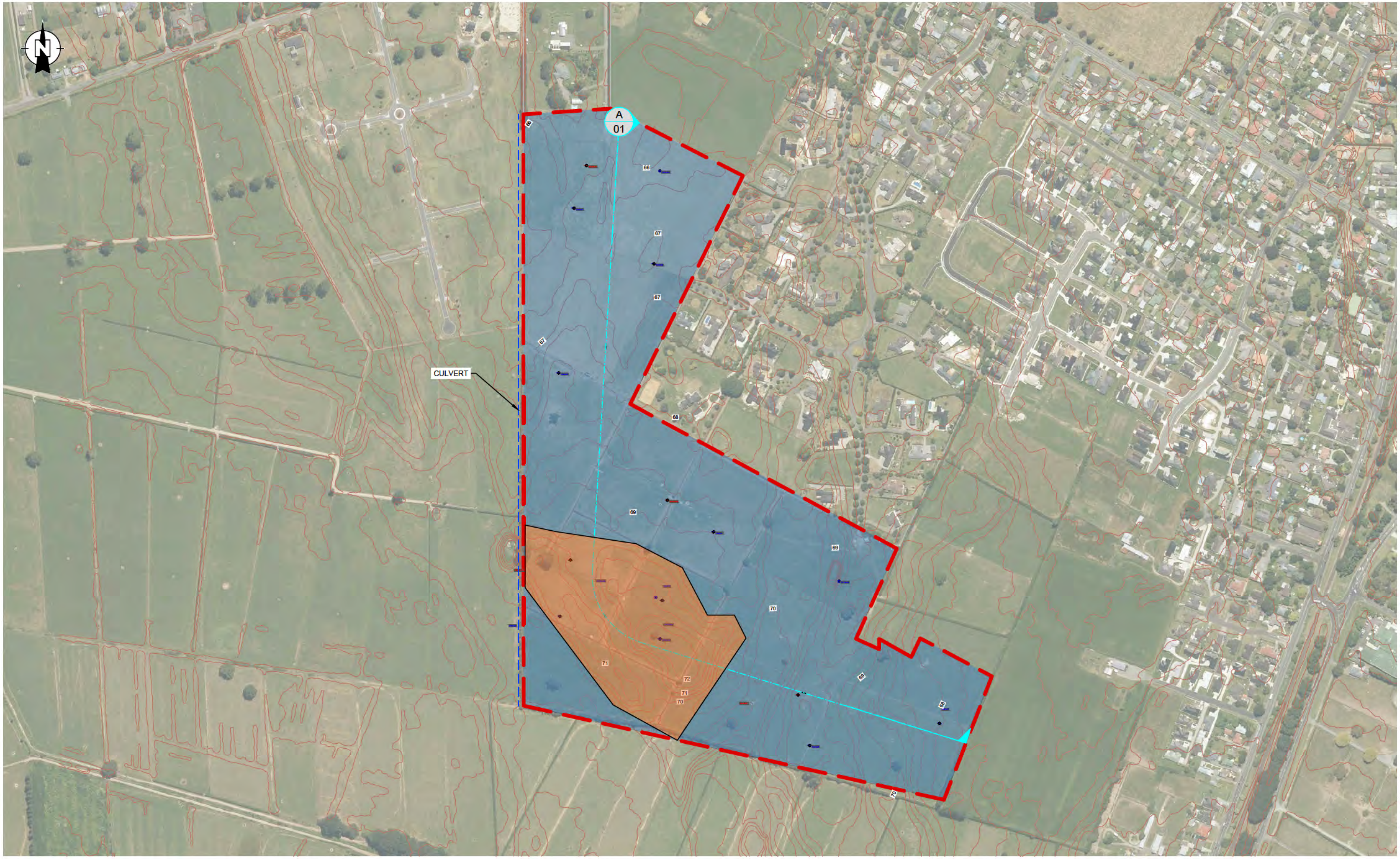
CLIENT: MAVEN ASSOCIATES LTD		DRAWN: GB	PROJECT: HAM2023-0124
PROJECT: STATION ROAD MATAMATA		CHECKED: PM	DRAWING: 01
		REVISION: A	SCALE: 1:5000
TITLE: SITE INVESTIGATION PLAN		DATE: 30/11/2023	SHEET: A3 L

\\CMWGEOSCIENCES.SHAREPOINT.COM@SSL\DAVWWWROOT\SITES\CMWHAMILTONOFFICE\SHARED DOCUMENTS\HAMILTON PROJECT DOCUMENTS\2023\HAM2023-0124 STATION ROAD, MATAMATA\DRAWINGS\CAD\HAM2023-0124 SI PLAN.DWG



LEGEND:

- HA01 — HAND AUGER (HA) LOCATION
- SOA01 — SOAKAGE TEST (SOA) LOCATION
- CPT01 — CONE PENETROMETER TEST (CPT) LOCATION
- SITE BOUNDARY
- CULVERT
- ROLLING HILL TOPOGRAPHY (TC1)
- LOW LYING PLAINS (TC2)

NOTES:

1. BASE PLAN ADAPTED FROM: LINZ

1:5000 — 0, 50, 100, 150, 200, 250 m

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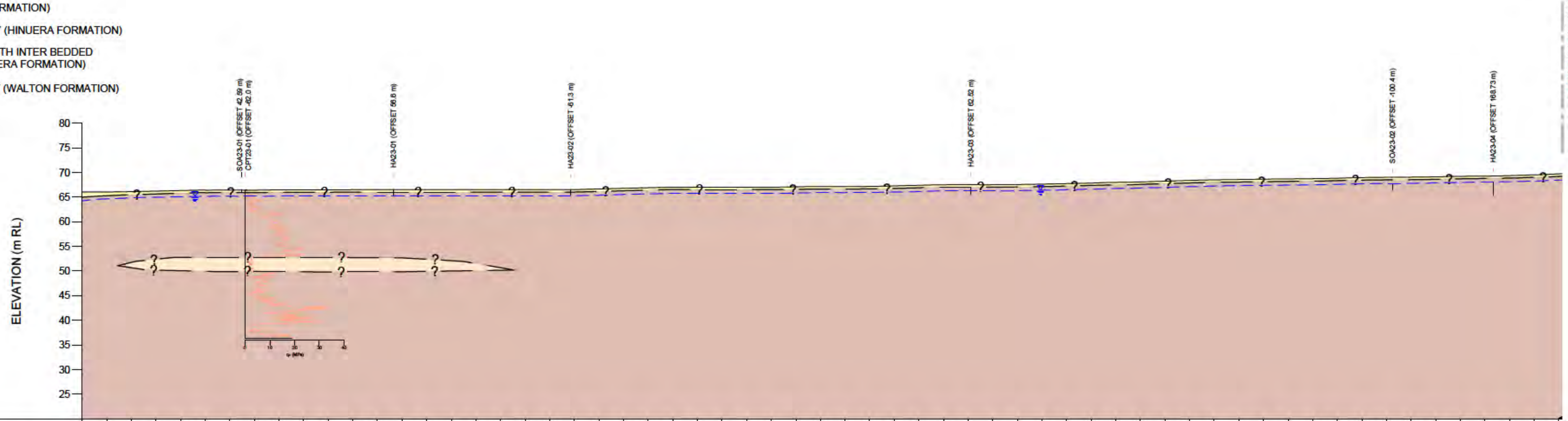
CLIENT: MAVEN ASSOCIATES LTD		DRAWN: GB	PROJECT: HAM2023-0124
PROJECT: STATION ROAD MATAMATA		CHECKED: PM	DRAWING: 01
		REVISION: A	SCALE: 1:5000
TITLE: SITE INVESTIGATION PLAN		DATE: 30/11/2023	SHEET: A3 L

C:\USERS\WILLEMDIKMANS\CMW GEOSCIENCES PTY LTD\HAMILTON OFFICE - HAM2023-0124 STATION ROAD, MATAMATA\DRAWINGS\CAD\HAM2023-0124 SI PLAN.DWG

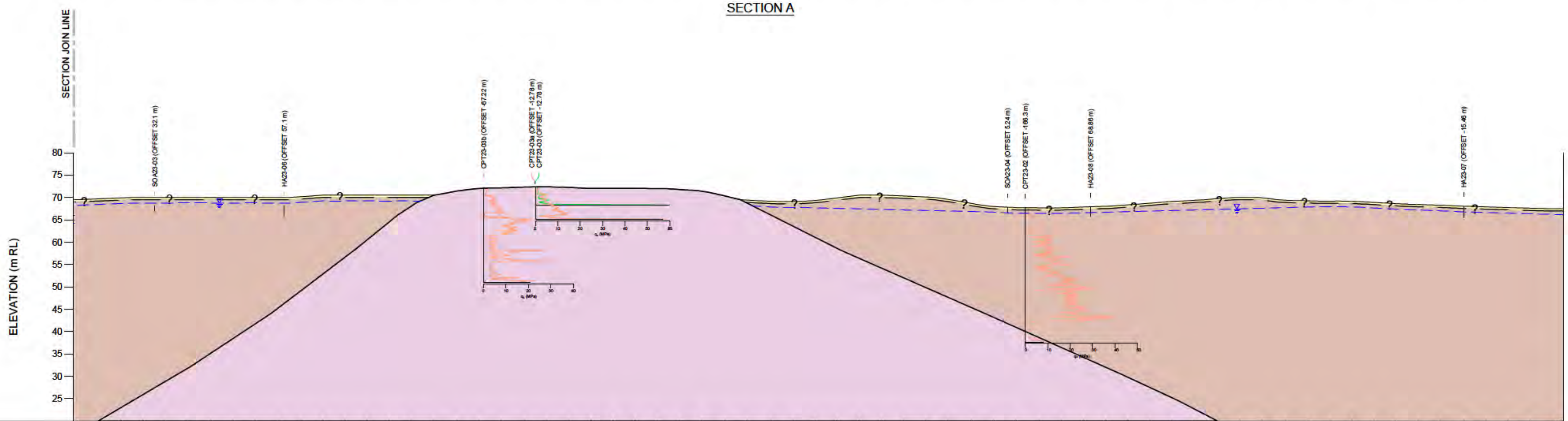
LEGEND:

- FIRM TO STIFF SILT (HINUERA FORMATION)
- FIRM TO STIFF CLAY / SILTY CLAY (HINUERA FORMATION)
- DENSE TO VERY DENSE SAND WITH INTER BEDDED VERY STIFF TO HARD SILT (HINUERA FORMATION)
- VERY STIFF TO HARD SILT / CLAY (WALTON FORMATION)
- EXISTING SURFACE LEVEL
- GROUND WATER



DISTANCE (m)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550	560	570	580	590	600
EXISTING GROUND (m RL)	66.03	66.11	66.22	66.31	66.40	66.44	66.41	66.48	66.48	66.48	66.49	66.50	66.50	66.50	66.50	66.50	66.50	66.50	66.50	66.51	66.64	66.77	66.90	67.00	67.00	67.00	67.00	67.00	67.07	67.14	67.15	67.17	67.26	67.38	67.51	67.52	67.51	67.54	67.63	67.74	67.85	67.99	68.08	68.22	68.37	68.50	68.57	68.62	68.68	68.73	68.83	68.93	69.00	69.03	69.11	69.21	69.28	69.36	69.50	69.69

SECTION A



DISTANCE (m)	600	610	620	630	640	650	660	670	680	690	700	710	720	730	740	750	760	770	780	790	800	810	820	830	840	850	860	870	880	890	900	910	920	930	940	950	960	970	980	990	1000	1010	1020	1030	1040	1050	1060	1070	1080	1090	1100	1110	1120	1130	1140	1150	1160	1170	1180	1190	1200	1210	1220	1230	1240	1250	1254
EXISTING GROUND (m RL)	69.69	69.89	70.00	70.00	70.00	70.00	70.00	70.00	70.00	70.14	70.50	70.50	70.50	70.50	70.50	70.50	71.41	72.01	72.14	72.32	72.36	72.24	72.02	72.02	72.02	72.00	71.77	71.36	70.31	69.40	69.14	69.07	69.31	69.89	70.49	70.50	70.30	70.08	69.54	68.66	67.96	67.73	67.68	67.69	67.84	68.00	68.33	68.72	69.09	69.37	69.71	70.00	69.91	69.39	69.25	69.17	69.12	68.89	68.61	68.42	68.25	68.02	67.89	67.74	67.59	67.50	67.50

SECTION A

REV	DATE	DESCRIPTION	BY
A	04/12/2023	FOR REVIEW	PM

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CLIENT: MAVEN ASSOCIATES LTD	DRAWN: GB	PROJECT: HAM2023-0124	
PROJECT: STATION ROAD MATAMATA	CHECKED: PM	FIGURE: 02	
	REVISION: A	SCALE: 1:2000 (H) 1:1000 (V)	
TITLE: SECTION A	DATE: 04/12/2023	SHEET: A3 L	

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APPENDIX B: HAND AUGER BOREHOLES LOGS

HAND AUGER BOREHOLE LOG - HA23-01

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 24/11/2023
Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
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Position: 487470.3mE; 695089.2mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/ geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
				0.0–0.3	OL: Organic SILT: dark brown. No plasticity. (Topsoil)		
	0.4	Peak = 150kPa Residual = 31kPa		0.3–1.1	ML: SILT: light brown. Low plasticity, moderately sensitive to sensitive. (Hinuera Formation)	M	St to VSt
	0.7	Peak = 162kPa Residual = 38kPa			... from 0.80m to 1.10m, Becoming brownish grey.		
	1.0	Peak = 98kPa Residual = 25kPa		1			
				1.1–1.9	SW: Fine to coarse SAND: grey. Well graded, sub rounded. (Hinuera Formation)	M to W	L to MD
24-11-2023 (2.0 m)				1.9–2.1	SW: Fine to coarse SAND: brown. Well graded, sub rounded. (Hinuera Formation)	W / S	
				2.1	Borehole terminated at 2.1 m		

Depth scale (m): 1, 2, 3, 4, 5

Dynamic Cone Penetrometer (Blows/100mm), scale 5, 10, 15:

1, 1, 2, 1, 1, 1, 2, 2, 2, 2, 4, 5, 3, 3, 2, 3, 3, 2, 2, 3, 4, 5, 4, 3, 4, 2, 3, 5, 5, 7, 9, 9, 8, 10, 12, 9, 12, 10, 9, 9, 15, 20

Termination Reason: No retrieval
Shear Vane No: 3434 | DCP No: 26
Remarks: Groundwater encountered at 2.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-02

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 24/11/2023

CMW Geosciences
Great People | Practical Solutions

Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

Position: 487585.2mE; 695012.4mN | Projection: Mt Eden 2000 | Datum: Moturiki | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/Relative Density
				0.0	OL: Organic SILT: dark brown. No plasticity. (Topsoil)		
	0.5	Peak = 119kPa, Residual = 30kPa			ML: SILT: light brown. Low plasticity, moderately sensitive. (Hinuera Formation)	D to M	St
	0.7	Peak = 104kPa, Residual = 30kPa					
	1.0	Peak = 104kPa, Residual = 30kPa		1			
					SW: Fine to Coarse SAND: brown. Well graded, sub rounded. (Hinuera Formation)	M	MD
					... from 1.60m to 1.80m, becoming dark brown.	W	
					... from 1.80m to 2.00m, becoming grey.	W to S	
				2	SM: Silty Fine to Coarse SAND: brown. Well graded, sub rounded. (Hinuera Formation)		
24-11-2023					*... at 2.20m, becoming fine, uniformly graded SAND. Becoming grey.*	S	
					Borehole terminated at 2.3 m		

Dynamic Cone Penetrometer (Blows/100mm)

3	2	2	2	1	2	1	1	1	2	3	6	6	5	4	2	3	5	6	6	5	6	6	6	5	6	5	5	4	5	9	7	8	8	9	11	10	10	10	15	10	11	9	10	10	9	10	12	10

Termination Reason: No retrieval
Shear Vane No: 2560 DCP No: 26
Remarks: Groundwater encountered at 2.2m.

HAND AUGER BOREHOLE LOG - HA23-03

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023

CMW Geosciences
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Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 |

Position: 487452.9mE; 694855.0mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Material Description	Moisture Condition	Consistency/ Relative Density
OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
ML: SILT: light brown. Low plasticity, moderately sensitive. (Hinuera Formation)	M	St
SP: Silty fine to medium SAND: brownish grey. Well graded, sub rounded. (Hinuera Formation)	M	L to MD
SW: Fine to coarse SAND: greyish brown. Well Graded, sub rounded. (Hinuera Formation)	M to W	MD to D
... *at 1.80m, Becoming grey.*	W	MD to D
ML: SILT: grey. Low plasticity. (Hinuera Formation)	S	H
SM: Sandy SILT: grey. Low plasticity. (Hinuera Formation)	S	H

Borehole terminated at 2.7 m

Groundwater: 23-11-2023

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 60kPa Residual = 12kPa
2.6	Peak = UTP

Dynamic Cone Penetrometer (Blows/100mm)

1, 2, 1, 2, 1, 2, 1, 3, 3, 3, 5, 2, 2, 2, 3, 4, 4, 4, 4, 3, 4, 5, 8, 4, 5, 9, 9, 10, 6, 7, 9, 10, 8, 8, 7, 9, 8, 8, 8, 8, 9, 9, 9, 8, 7, 10, 9, 8, 8

Termination Reason: No retrieval
Shear Vane No: 3434 DCP No: 26
Remarks: Groundwater encountered at 2.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-04

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023

CMW Geosciences
Great People | Practical Solutions

Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

Position: 487677.3mE; 694633.7mN | Projection: Mt Eden 2000 | Datum: Moturiki | Survey Source: Site Plan

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0–0.25	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	VSt
0.25–1.2	ML: SILT: light brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	M	VSt
1.2–1.5	SM: Silty Fine SAND: light brown. Uniformly graded. (Hinuera Formation)	M	L to MD
1.5–2.2	SW: Fine to coarse SAND: brown. Well graded, sub rounded. (Hinuera Formation) ... at 1.80m, Becoming grey mottled orange.	M	L to MD
2.2–2.4	SM: Silty fine to medium SAND: light brown. Poorly graded, sub rounded. (Hinuera Formation)	W	L to MD
2.4–4.0	ML: SILT: grey mottled orange. Low plasticity. Sensitive. (Hinuera Formation) ... from 3.00m to 3.80m, Becoming brownish grey. ... from 3.80m to 4.00m, Becoming brownish orange.	M	VSt to H
4.0–5.0	SM: Sandy SILT: brown. Low plasticity. (Hinuera Formation)	M	VSt to H

Borehole terminated at 5.0 m

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 138kPa Residual = 25kPa
0.7	Peak = 50kPa Residual = 19kPa
1.0	Peak = 119kPa Residual = 25kPa
2.5	Peak = 81kPa Residual = 12kPa
3.1	Peak = UTP
3.5	Peak = UTP
4.0	Peak = 175kPa
4.5	Peak = UTP
5.0	Peak = UTP

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	Blows per 100mm
0–1	1, 3, 3, 2, 1, 2, 1, 2, 1, 2
1–2	2, 3, 3, 4, 3, 2, 2, 3, 2, 2
2–3	2, 3, 3, 4, 3, 4, 4, 4, 4, 3
3–4	6, 6, 5, 5, 7, 10, 15, 11, 11, 11
4–5	13, 15, 12, 14, 18, 15, 12, 13, 13, 13

Termination Reason: Target Depth Reached
Shear Vane No: 3434 DCP No: 26
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-05

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
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Position: 487596.8mE; 694539.0mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Groundwater	Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
					OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	St to VSt
	0.4	Peak = 112kPa Residual = 25kPa			MH: Clayey SILT: brown. Moderate plasticity. Sensitive. (Hinuera Formation)	M	St to VSt
	0.7	Peak = 138kPa Residual = 31kPa					
	1.0	Peak = 150kPa Residual = 25kPa		1			
	1.5	Peak = 138kPa Residual = 25kPa					
	2.1	Peak = 88kPa Residual = 12kPa		2	*... from 2.00m to 2.50m, with trace coarse sand.*		
	2.6	Peak = UTP				D to M	
	3.0	Peak = UTP		3	SM: Gravelly SILT: with minor sand; brown. Low plasticity. (Hinuera Formation)	M	VSt to H
	3.5	Peak = UTP					
	4.0	Peak = UTP		4			
	4.5	Peak = UTP					
	5.0	Peak = UTP		5	Borehole terminated at 5.0 m		

Material Description — Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/ geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

2, 2, 2, 2, 2, 1, 2, 2, 2, 2, 2, 3, 3, 2, 3, 2, 3, 5, 4, 8, 8, 8, 8, 8, 8, 7, 7, 8, 8, 11, 9, 11, 12, 10, 9, 8, 10, 10, 10, 15, 16

Termination Reason: Target Depth Reached
Shear Vane No: | DCP No: 26
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-06

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: WD | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences — Great People | Practical Solutions

Position: 487461.0mE; 694509.9mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Depth (m)	Samples Depth	Type & Results	Material Description	Moisture Condition	Consistency/ Relative Density
0.0–0.2			OL: Organic SILT: dark brown. No plasticity. (Topsoil)	D to M	
0.2–0.9	0.3	Peak = 110kPa Residual = 24kPa	ML: SILT: dark orange brown. Low plasticity. Sensitive. (Hinuera Formation)	M	VSt to H
			... *at 0.40m, becoming orange brown with some clay.*		
	0.6	Peak = 122kPa Residual = 27kPa			
	0.9	Peak = UTP			
0.9–1.1			ML: Fine to coarse Sandy SILT: with minor fine to medium gravel; dark orange brown. Low plasticity. Gravel; pumiceous and rhyolitic. (Hinuera Formation)	M	St
1.1–1.4			SW: Fine to coarse SAND: with some fine to medium gravel; dark grey with orange brown. Well graded. Subangular. Gravel; pumiceous and rhyolitic. (Hinuera Formation)	M	L to MD
1.4–4.3			SP: Fine to medium SAND: with minor fine gravel; dark grey. Poorly graded. Subangular. Gravel; pumiceous and rhyolitic. (Hinuera Formation)	M (to 2.0), M to W (2.0–4.1), W (4.1–4.5)	L to MD (to 2.9), MD to D (2.9–4.8)
			... *at 1.40m, becoming fine to medium sand with minor fine gravel, dark grey.*		
			... *at 1.75m, small light orange band.*		
			... *at 1.80m, becoming brownish grey.*		
			... *at 2.90m, becoming light brownish grey with trace fine gravel.*		
4.3–4.8			SW: Fine to coarse SAND: with trace fine gravel and trace silt; light brownish grey. Well graded. Subangular. Gravel; pumiceous and rhyolitic. (Hinuera Formation)	W / S (4.5–4.8)	MD to D
			... *at 4.30m, becoming fine to coarse sand with trace silt.*		
4.8			Borehole terminated at 4.8 m		

Groundwater: 23-11-2023 (at 4.5m)

Dynamic Cone Penetrometer (Blows/100mm):

Depth (m)	Blows	Depth (m)	Blows	Depth (m)	Blows
0.0–0.1	1	1.6–1.7	1	3.2–3.3	7
0.1–0.2	2	1.7–1.8	1	3.3–3.4	8
0.2–0.3	2	1.8–1.9	3	3.4–3.5	8
0.3–0.4	1	1.9–2.0	6	3.5–3.6	8
0.4–0.5	2	2.0–2.1	5	3.6–3.7	7
0.5–0.6	2	2.1–2.2	4	3.7–3.8	7
0.6–0.7	1	2.2–2.3	4	3.8–3.9	7
0.7–0.8	2	2.3–2.4	4	3.9–4.0	8
0.8–0.9	3	2.4–2.5	4	4.0–4.1	8
0.9–1.0	4	2.5–2.6	4	4.1–4.2	9
1.0–1.1	5	2.6–2.7	4	4.2–4.3	9
1.1–1.2	5	2.7–2.8	4	4.3–4.4	6
1.2–1.3	5	2.8–2.9	9	4.4–4.5	9
1.3–1.4	4	2.9–3.0	6	4.5–4.6	5
1.4–1.5	4	3.0–3.1	7	4.6–4.7	7
1.5–1.6	4	3.1–3.2	6	4.7–4.8	5

Termination Reason: Hole collapse
Shear Vane No: 2560 | DCP No: 17
Remarks: Groundwater encountered at 4.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-07

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences — Great People | Practical Solutions

Position: 488002.9mE; 694367.9mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0 – 0.3	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
0.3 – 1.2	ML: SILT: brownish orange. Low plasticity. Insensitive. (Hinuera Formation)	M	F to St
1.2 – 1.5	SP: Fine to medium SAND: with some silt; brown. Poorly graded, sub rounded. (Hinuera Formation)	M	MD
1.5 – 2.3	SP: Fine SAND: brown. Uniformly, sub rounded. (Hinuera Formation) *... at 2.20m, Becoming grey.*	M	L to MD
2.3 – 3.0	SM: Silty fine to medium SAND: brown. Poorly graded. (Hinuera Formation) *... from 2.60m to 3.00m, Becoming grey mottled orange.*	M	L to MD
3.0 – 5.0	SW: Fine to coarse SAND: brown. Well graded. (Hinuera Formation) *... at 4.50m, Becoming orange.*	M (to 4.5 m); M to W (4.5 – 5.0 m)	D to VD

Borehole terminated at 5.0 m

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 62kPa Residual = 19kPa
0.7	Peak = 50kPa Residual = 12kPa

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	Blows per 100 mm
0.0 – 1.0	2, 1, 3, 2, 1, 1, 1, 2, 2, 5
1.0 – 2.0	4, 4, 4, 4, 4, 3, 4, 3, 3, 4
2.0 – 3.0	4, 4, 4, 3, 3, 2, 6, 6, 6, 6
3.0 – 4.0	8, 10, 13, 8, 10, 9, 13, 8, 14, 9
4.0 – 5.0	8, 10, 18, 16, 16, 15, 12, 12, 12, 10

Termination Reason: Target Depth Reached
Shear Vane No: 3434 | DCP No: 26
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA23-08

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: PM | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

Position: 487819.4mE; 694333.1mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

CMW Geosciences — Great People | Practical Solutions

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0 – 0.3	OL: Organic SILT: dark brown. No plasticity. (Topsoil)		
0.3 – 0.8	ML: SILT: brownish orange. Low plasticity. Moderately sensitive. (Hinuera Formation)	M	F to St
0.8 – 1.7	SM: Silty fine SAND: light brown. Uniformly graded, sub rounded. (Hinuera Formation)	M to W	L to MD
1.7 – 2.2	ML: SILT: grey mottled orange. Low plasticity. Sensitive to highly sensitive. (Hinuera Formation)	M to W	VSt
2.2 – 3.9	SM: Silty fine to medium SAND: grey. Poorly graded, sub rounded (Hinuera Formation)	W (to 3.5), S	MD to D
3.9 – 4.2	SW: Fine to coarse SAND: grey. Well graded, sub rounded. (Hinuera Formation)	S	D to VD
4.2	Borehole terminated at 4.2 m		

Groundwater: ▼ at 3.5 m

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 88kPa Residual = 38kPa
0.6	Peak = 50kPa Residual = 19kPa
1.9	Peak = 138kPa Residual = 22kPa
2.2	Peak = 162kPa Residual = 12kPa

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	Blows
0.0–0.1	1
0.1–0.2	2
0.2–0.3	2
0.3–0.4	1
0.4–0.5	2
0.5–0.6	2
0.6–0.7	4
0.7–0.8	2
0.8–0.9	2
0.9–1.0	2
1.0–1.1	2
1.1–1.2	4
1.2–1.3	3
1.3–1.4	4
1.4–1.5	2
1.5–1.6	3
1.6–1.7	3
1.7–1.8	4
1.8–1.9	4
1.9–2.0	4
2.0–2.1	6
2.1–2.2	6
2.2–2.3	8
2.3–2.4	7
2.4–2.5	7
2.5–2.6	8
2.6–2.7	8
2.7–2.8	11
2.8–2.9	8
2.9–3.0	8
3.0–3.1	9
3.1–3.2	10
3.2–3.3	9
3.3–3.4	8
3.4–3.5	8
3.5–3.6	8
3.6–3.7	7
3.7–3.8	8
3.8–3.9	9
3.9–4.0	12
4.0–4.1	13
4.1–4.2	13
4.2–4.3	17
4.3–4.4	16
4.4–4.5	16
4.5–4.6	10
4.6–4.7	9
4.7–4.8	17
4.8–4.9	17
4.9–5.0	18

Termination Reason: No retrieval
Shear Vane No: 3434 | DCP No: 26
Remarks: Groundwater encountered at 3.5m.

HAND AUGER BOREHOLE LOG - SOA23-01

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 24/11/2023
Borehole Location: Refer to site plan | Logged by: NK | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 487486.9mE; 695150.0mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit); Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/Relative Density
				0.0–0.3		OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
				0.3–0.8		ML: Sandy SILT: light brown. Low plasticity. (Hinuera Formation)	M	F
24-11-2023 (at 1.0 m)				0.8–1.0		SM: Silty fine to coarse SAND: light grey. Well graded, sub rounded. (Hinuera Formation)	W	L
				1.0		Borehole terminated at 1.0 m		

Dynamic Cone Penetrometer (Blows/100mm):

Depth interval (m)	Blows
0.0–0.1	2
0.1–0.2	1
0.2–0.3	2
0.3–0.4	2
0.4–0.5	2
0.5–0.6	2
0.6–0.7	2
0.7–0.8	3
0.8–0.9	1
0.9–1.0	2
1.0–1.1	3
1.1–1.2	5
1.2–1.3	6
1.3–1.4	5
1.4–1.5	3
1.5–1.6	1
1.6–1.7	2
1.7–1.8	2
1.8–1.9	2
1.9–2.0	6
2.0–2.1	4
2.1–2.2	6
2.2–2.3	8
2.3–2.4	5
2.4–2.5	3
2.5–2.6	5
2.6–2.7	6
2.7–2.8	6
2.8–2.9	4

Termination Reason: Target Depth Reached
Shear Vane No: | DCP No: 26
Remarks: Groundwater encountered at 1.0m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA23-02

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: WD | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 487610.7mE; 694677.3mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density
					OL: Organic SILT: dark brown. No plasticity. (Topsoil)	D to M	
	0.3	Peak = 92kPa Residual = 21kPa			ML: SILT: dark orange brown. Low plasticity. Sensitive. (Hinuera Formation)	M	St to VSt
					... at 0.40m, becoming orange brown with minor clay.		
	0.6	Peak = 155kPa Residual = 30kPa			*... at 0.50m, becoming light orange brown.*		
					... at 0.70m, with trace fine sand.		
				1	SP: Fine to medium SAND: with trace silt; orange brown. Poorly graded. Subangular. (Hinuera Formation)	M	L to MD
					SM: Silty Fine SAND: light brownish grey. Poorly graded. Subangular. (Hinuera Formation)	W	F
					ML: Fine Sandy SILT: light grey. Low plasticity. (Hinuera Formation)	W	F
	1.6	Peak = 74kPa Residual = 22kPa			ML: SILT: with minor clay; light grey streaked light orange. Low plasticity. Moderately sensitive. (Hinuera Formation)	M to W	St
					SM: Silty Fine SAND: grey. Poorly graded. Subangular. (Hinuera Formation)	M to W	MD
				2	SP: Fine SAND: light brownish grey. Poorly graded. Subangular. (Hinuera Formation)	M to W	MD
					... at 2.20m, thin orange brown band.		
					Borehole terminated at 2.3 m		
				3			
				4			
				5			

Dynamic Cone Penetrometer (Blows/100mm) [scale 5, 10, 15]: 1, 3, 1, 2, 1, 2, 2, 1, 2, 5, 6, 7, 4, 3, 2, 3, 3, 4, 4, 6, 6, 8, 7, 6, 5, 5, 4, 3, 3

Termination Reason: Target Depth Reached
Shear Vane No: 2560 | DCP No: 26
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA23-03

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 23/11/2023
Borehole Location: Refer to site plan | Logged by: WD | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
Great People | Practical Solutions

Position: 487474.6mE; 694589.9mN | Projection: Mt Eden 2000
Datum: Moturiki | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit); Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	D to M	
	0.3	Peak = 104kPa Residual = 18kPa		0.2–0.8	ML: SILT: dark orange brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	D to M	St to VSt
					... at 0.40m, becoming light orange brown with some clay and minor rootlets.	M	
	0.6	Peak = 80kPa Residual = 30kPa			... at 0.60m, becoming light brownish grey.	M to W	
				0.8–1.4	SM: Silty Fine SAND: light brownish grey. Poorly graded. Subangular. (Hinuera Formation)	M to W	L
				1.0	... at 1.00m, becoming light grey streaked light orange brown.	W	
	1.5	Peak = 98kPa Residual = 39kPa		1.4–1.9	ML: SILT: with some clay; light grey streaked light orange. Low plasticity. Moderately sensitive. (Hinuera Formation)	M	St to VSt
					... at 1.70m, small band of fine sand.		
	1.8	Peak = 134kPa Residual = 36kPa			... from 1.80m to 1.85m, with some medium pumiceous gravel.		
				1.9–2.1	ML: Fine Sandy SILT: light grey. Low plasticity. (Hinuera Formation)	M to W	
				2.1–2.3	SP: Fine to medium SAND: grey. Poorly graded. Subangular. (Hinuera Formation) ... at 2.15m, becoming orange brown.	W to S	MD

Borehole terminated at 2.3 m

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	1
0.3–0.4	1
0.4–0.5	1
0.5–0.6	1
0.6–0.7	0
0.7–0.8	1
0.8–0.9	1
0.9–1.0	2
1.0–1.1	3
1.1–1.2	3
1.2–1.3	3
1.3–1.4	3
1.4–1.5	2
1.5–1.6	3
1.6–1.7	3
1.7–1.8	4
1.8–1.9	6
1.9–2.0	5
2.0–2.1	8
2.1–2.2	6
2.2–2.3	5
2.3–2.4	6
2.4–2.5	4
2.5–2.6	5
2.6–2.7	5
2.7–2.8	5
2.8–2.9	4

Termination Reason: Target Depth Reached
Shear Vane No: 2560 | DCP No: 17
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA23-04

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 35-39 Peakedale Drive, Matamata, 3400
Project No.: HAM2023-0124
Date: 24/11/2023

CMW Geosciences
Great People | Practical Solutions

Borehole Location: Refer to site plan | Logged by: NK | Checked by: AS | Scale: 1:25 | Sheet 1 of 1

Position: 487801.3mE; 694404.5mN | Projection: Mt Eden 2000 | Datum: Moturiki | Survey Source: Site Plan

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 77kPa Residual = 24kPa
0.8	Peak = 179kPa Residual = 33kPa
1.2	Peak = 208kPa Residual = 42kPa
1.6	Peak = UTP

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Material Description	Moisture Condition	Consistency/ Relative Density
OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
ML: Sandy SILT: light brown. Low plasticity, moderately sensitive. (Hinuera Formation)	M	St
ML: SILT: light brown. Low plasticity, sensitive. (Hinuera Formation)	M	VSt
ML: SILT: white. Low plasticity, sensitive. (Hinuera Formation) *... from 1.60m to 1.80m, No plasticity.*	M	H
SM: Silty fine SAND: light grey. Poorly graded, sub rounded. (Hinuera Formation)	M	D to VD
SP: Fine to coarse SAND: brownish orange. Poorly graded, sub rounded. Iron staining. (Hinuera Formation)	M	D to VD

Borehole terminated at 2.5 m

Dynamic Cone Penetrometer (Blows/100mm)

Blows/100mm	2, 2, 2, 1, 2, 2, 3, 2, 2, 3, 3, 4, 4, 4, 6, 6, 7, 10, 11, 12, 11, 12, 12, 14, 18, 12, 14, 14, 11

Termination Reason: Target Depth Reached
Shear Vane No: 2560 | DCP No: 26
Remarks: Groundwater not encountered..

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

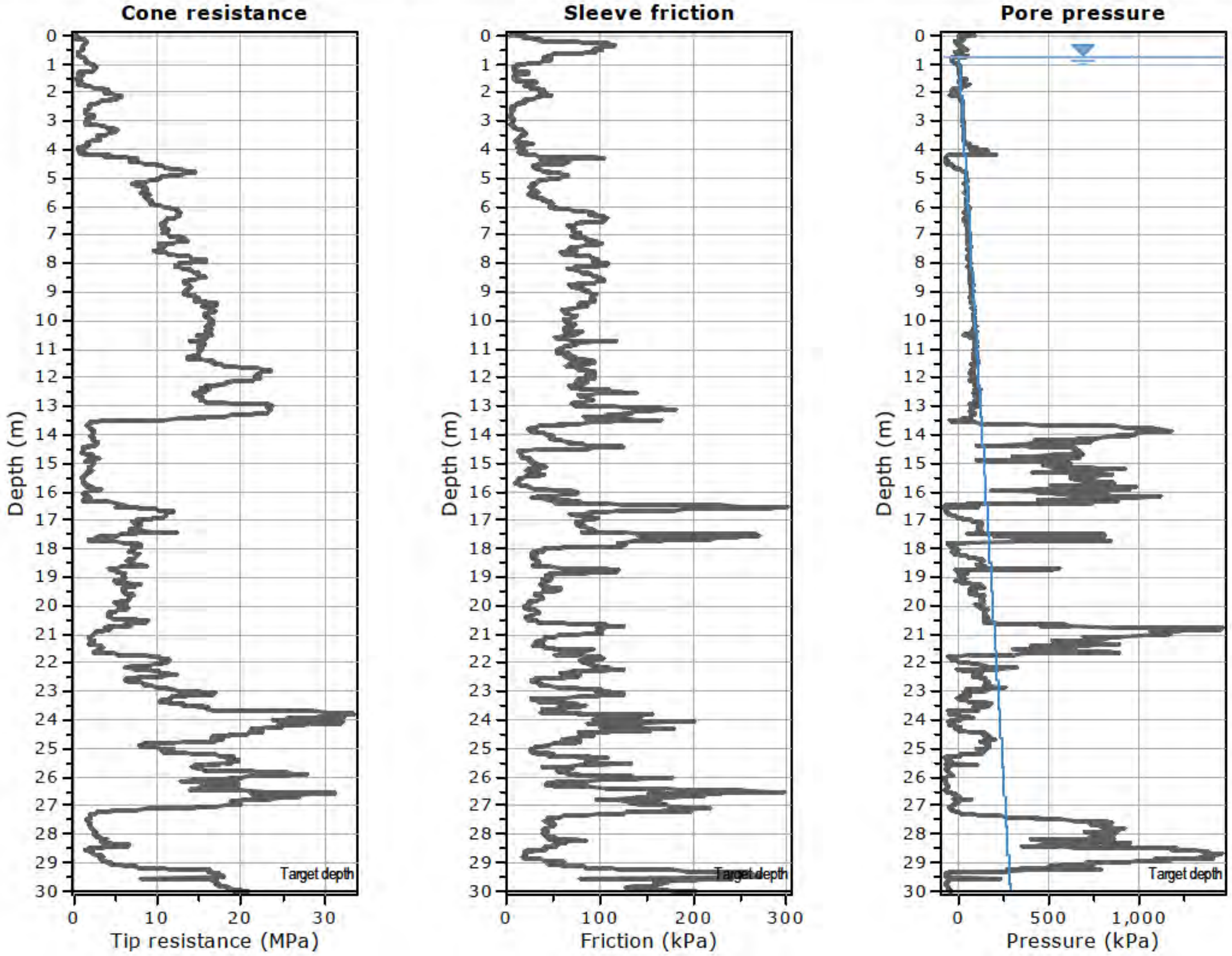
APPENDIX C: CPT INVESTIGATION RESULTS

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

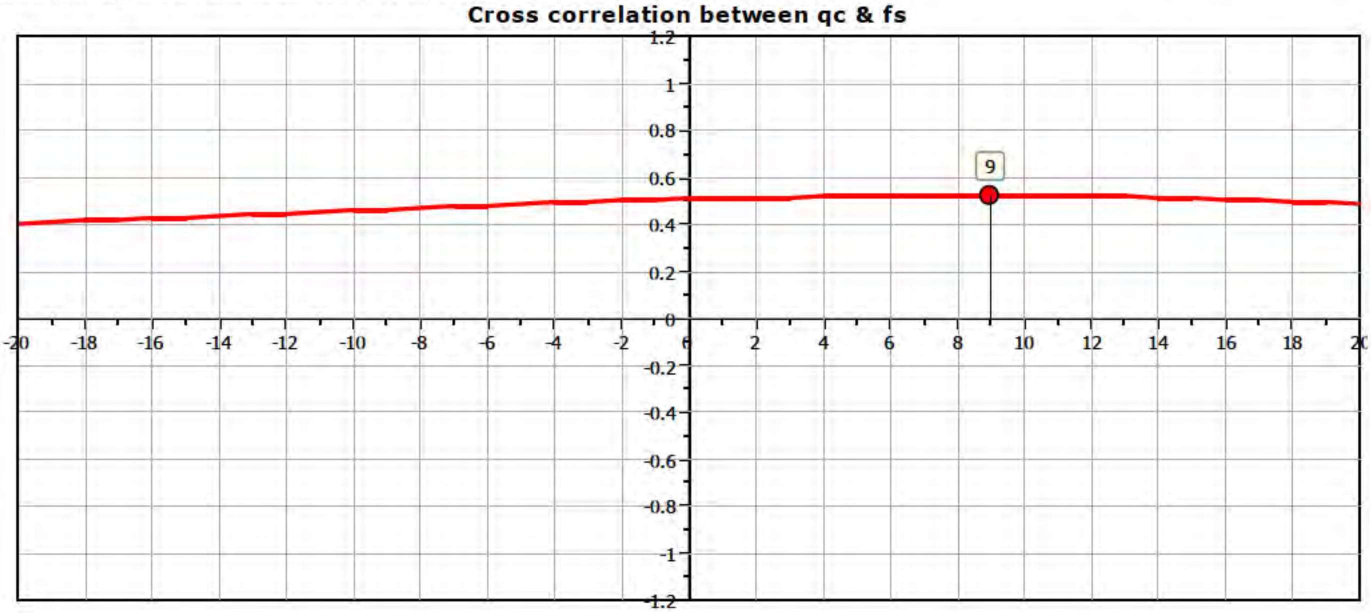
CPT: 23-01

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter**

Total depth: 30.01 m, Date: 24/11/2023
Coords: lat -37.820381° lon 175.759032°



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

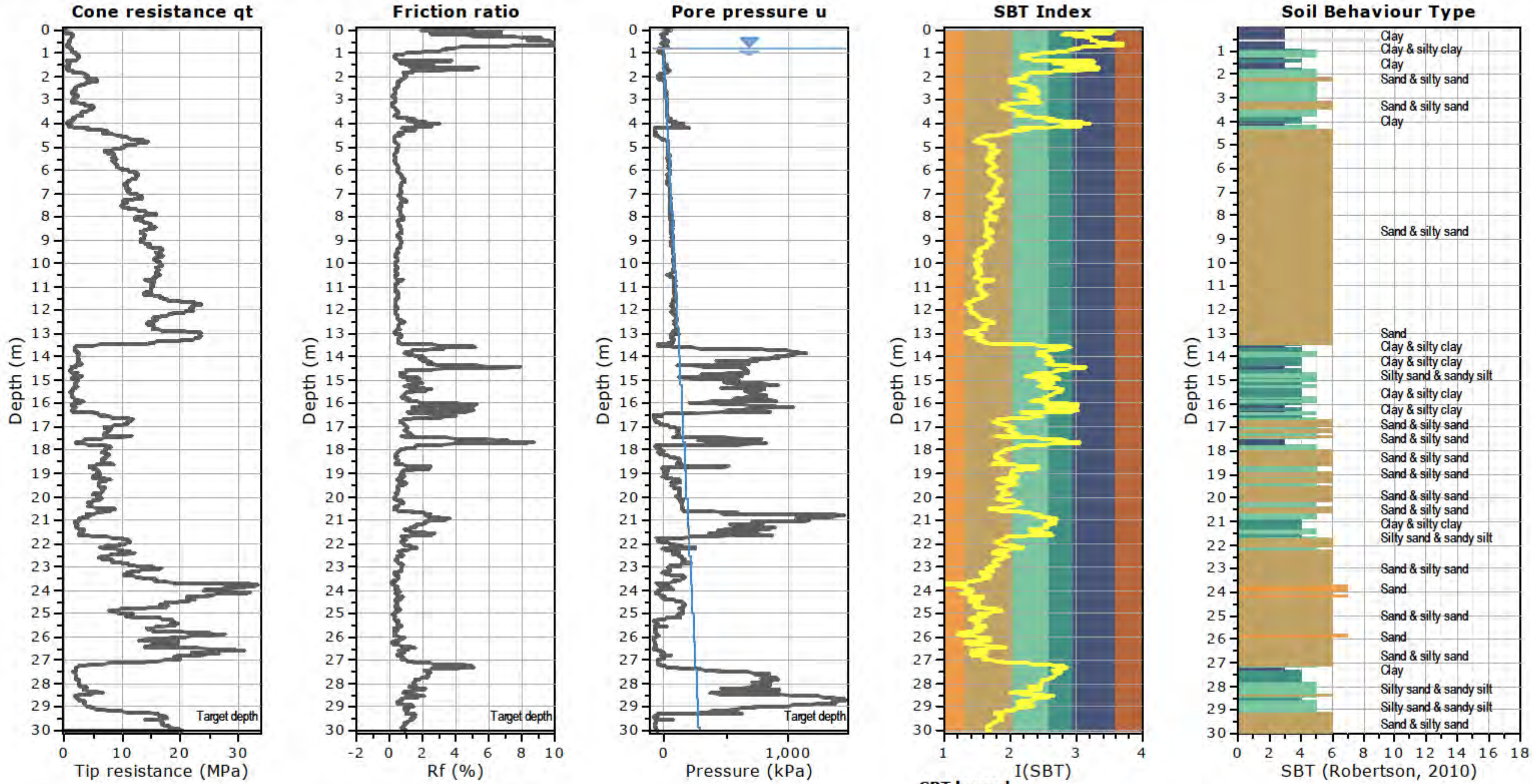
CPT: 23-01

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 30.01 m, Date: 24/11/2023

Coords: lat -37.820381° lon 175.759032°



SBT legend

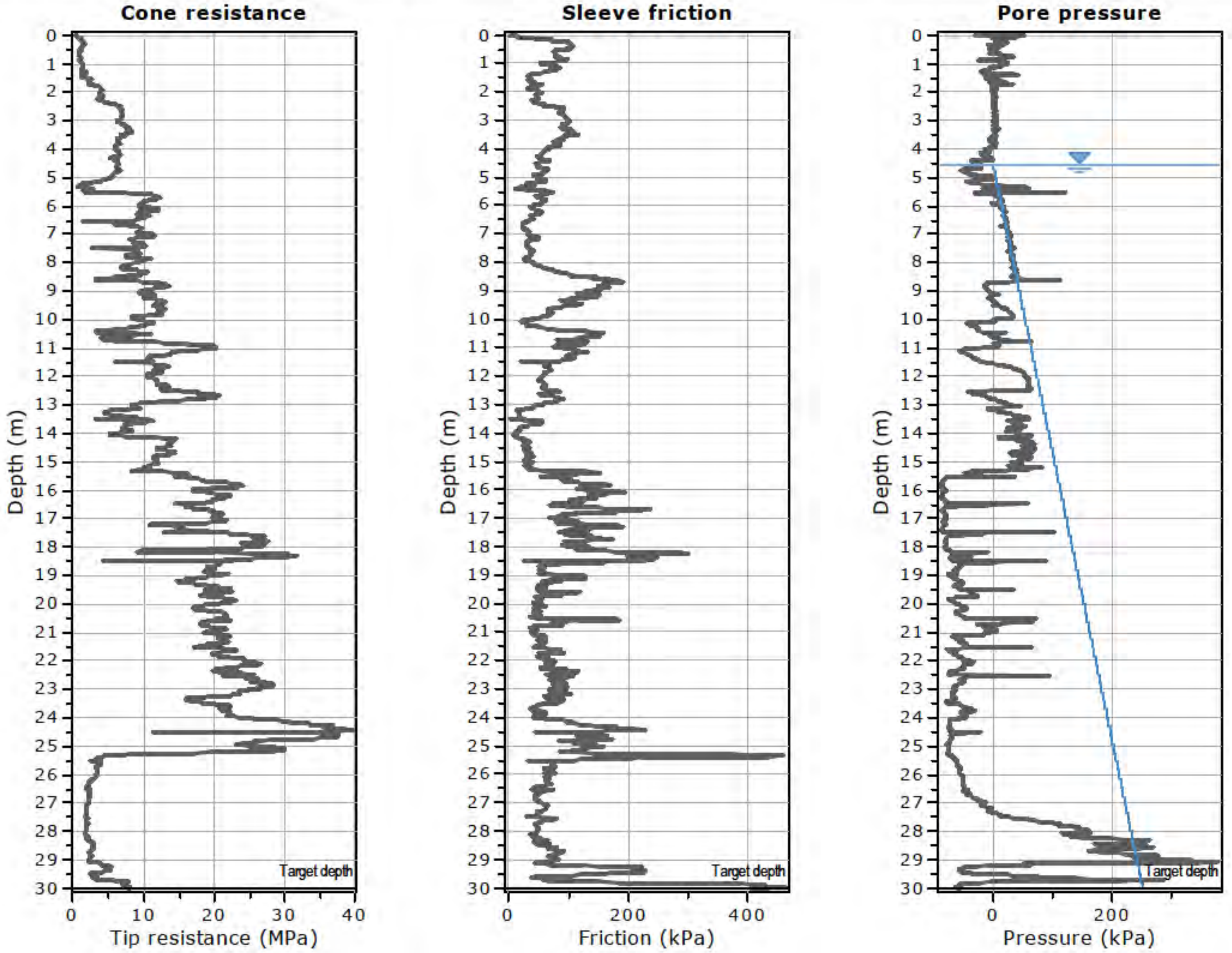
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

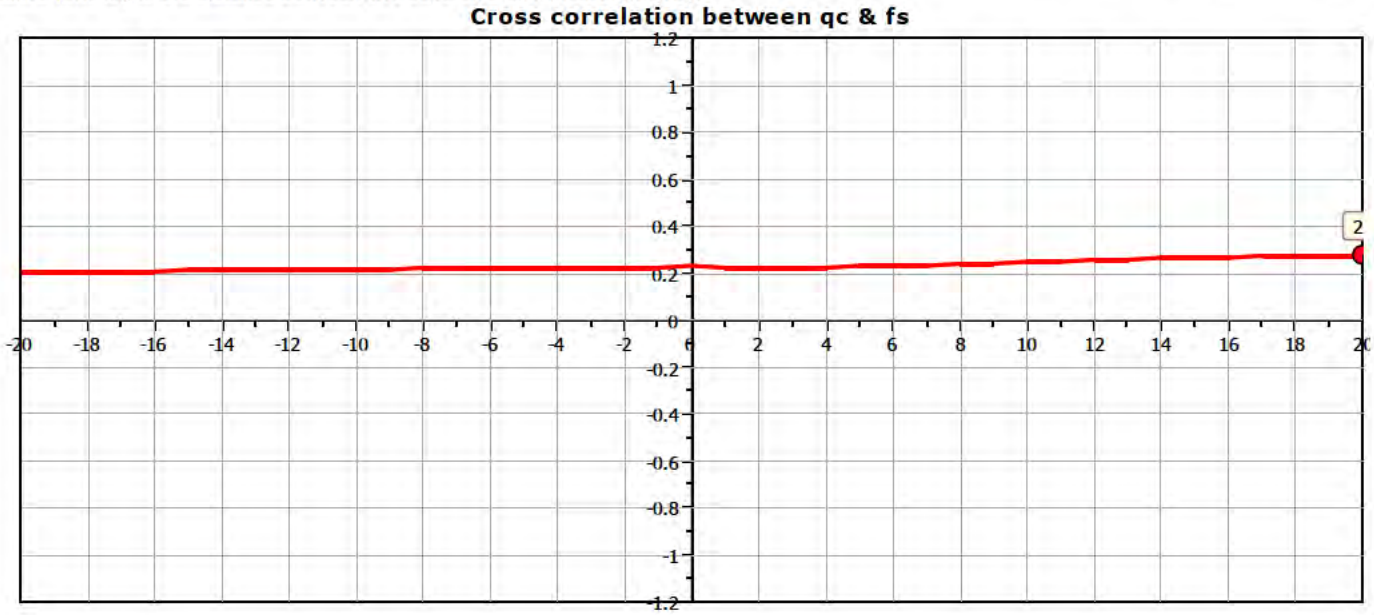
CPT: 23-02

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 30.02 m, Date: 24/11/2023
Coords: lat -37.825563° lon 175.762228°



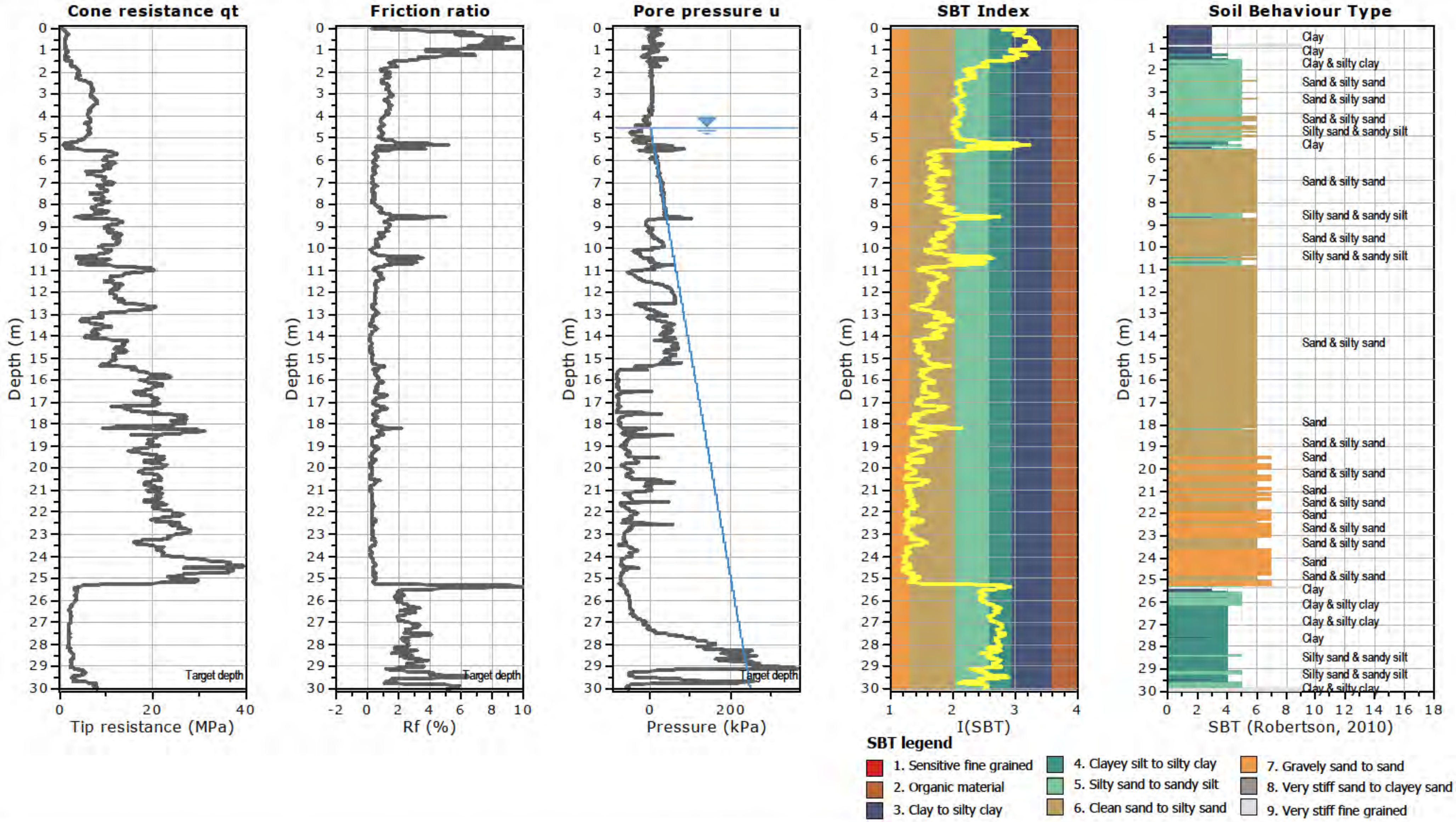
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



CPT: 23-02

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 30.02 m, Date: 24/11/2023
Coords: lat -37.825563° lon 175.762228°

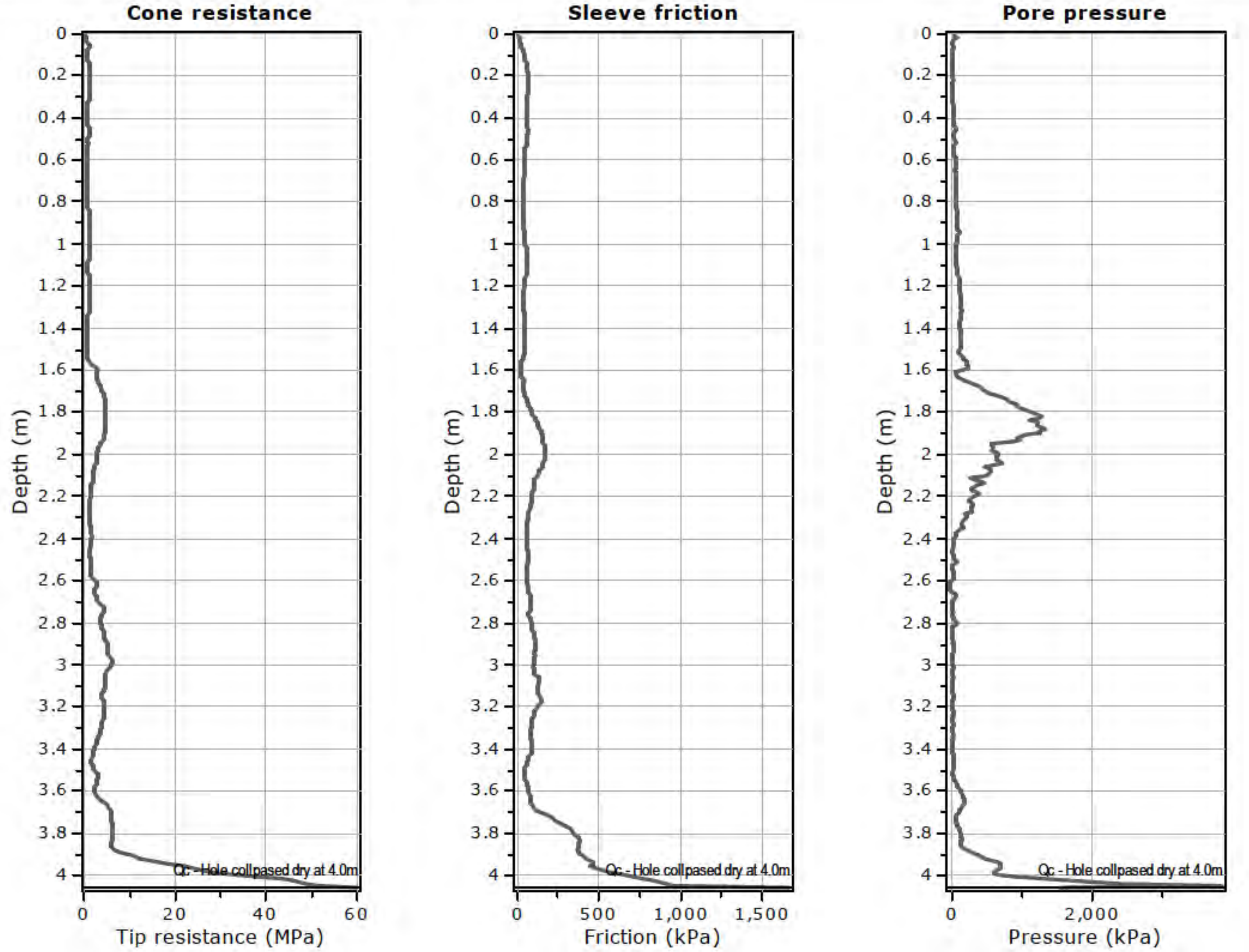


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

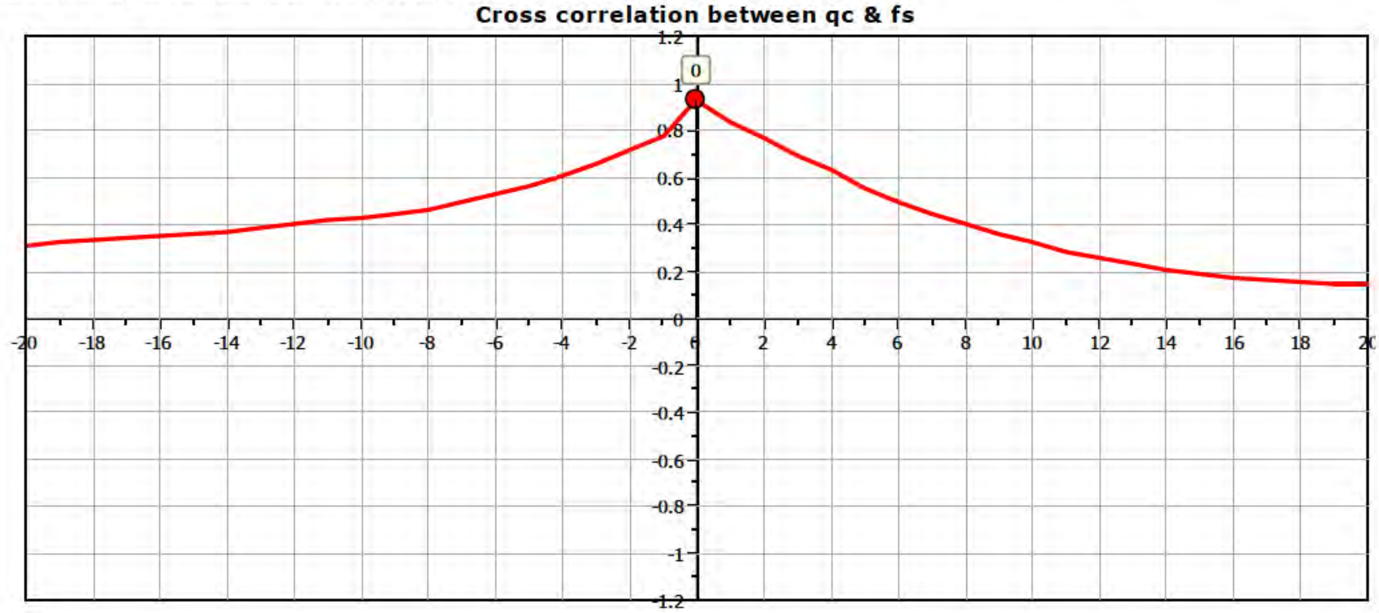
CPT: 23-03

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 4.06 m, Date: 24/11/2023
Coords: lat -37.826393° lon 175.75937°



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

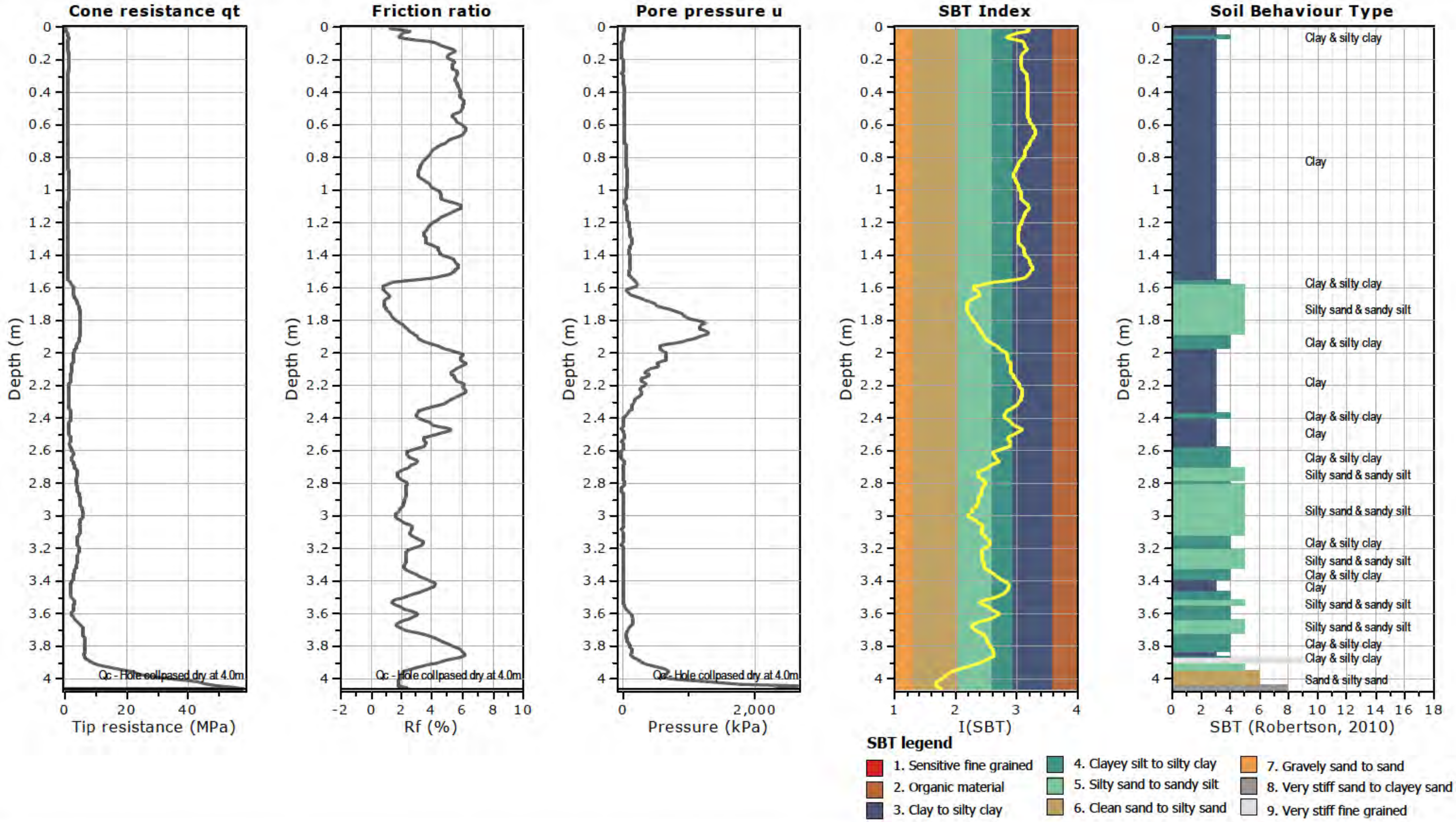
CPT: 23-03

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 4.06 m, Date: 24/11/2023

Coords: lat -37.826393° lon 175.75937°

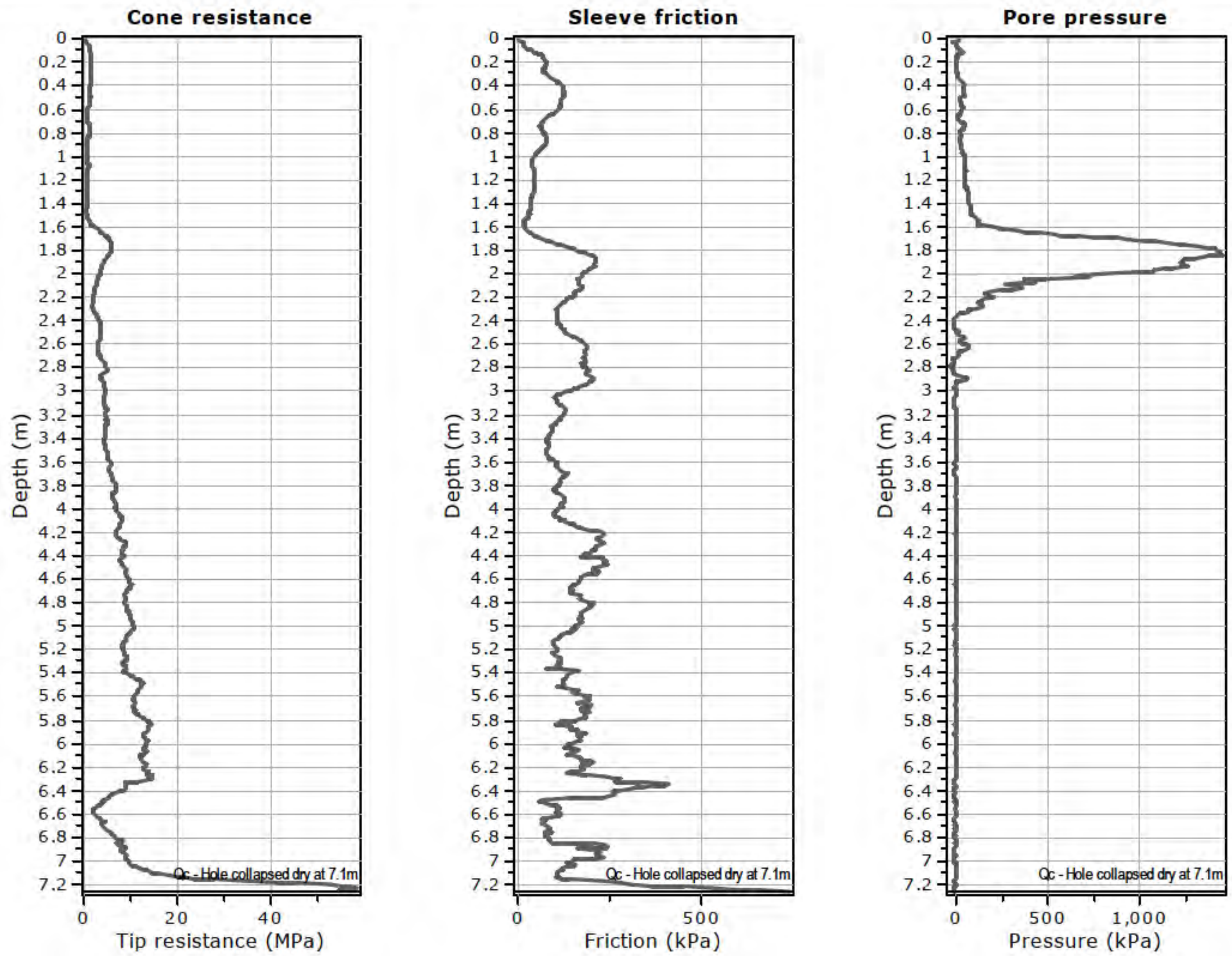


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

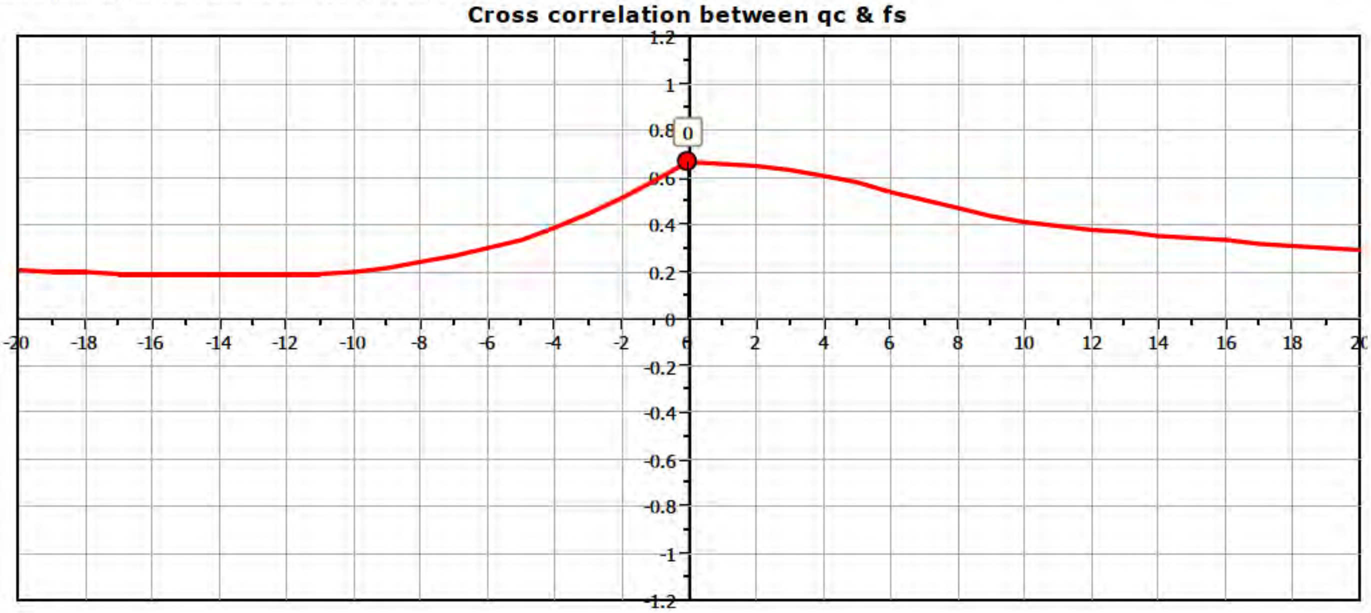
CPT: 23-03a

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Total depth: 7.26 m, Date: 24/11/2023

Location: **Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter**
Coords: lat -37.826395° lon 175.759397°



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

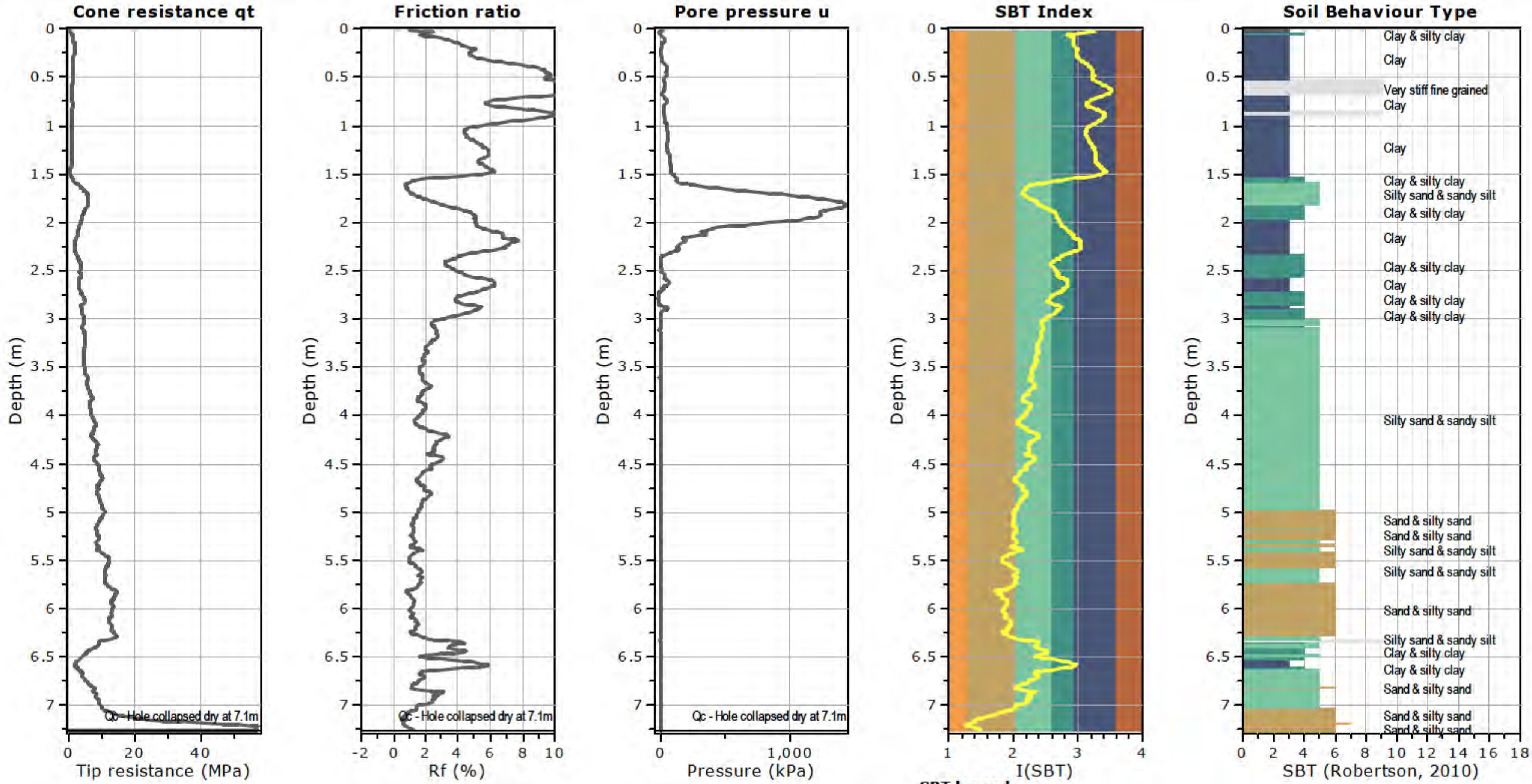


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 23-03a

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 7.26 m, Date: 24/11/2023
Coords: lat -37.826395° lon 175.759397°



SBT legend

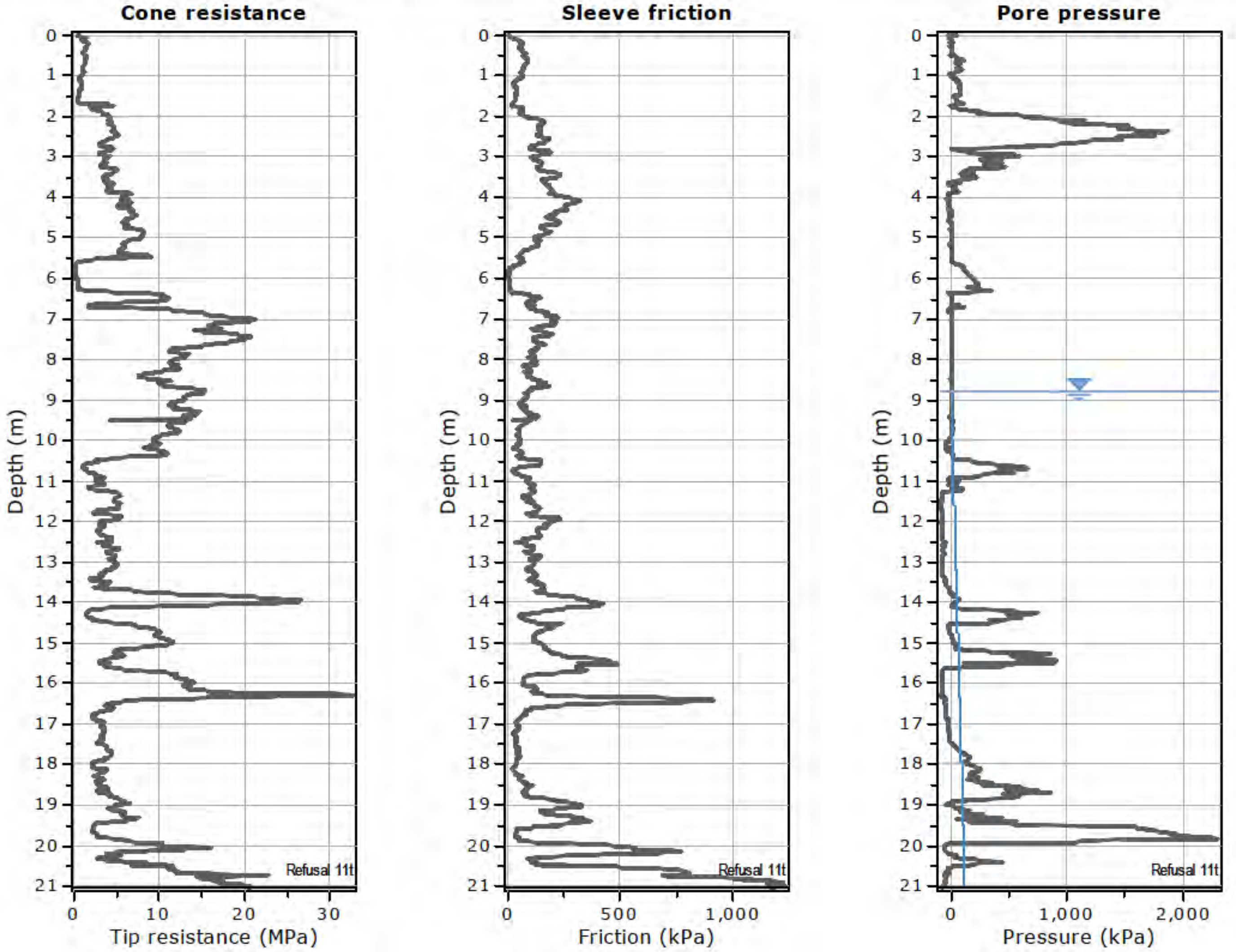
1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

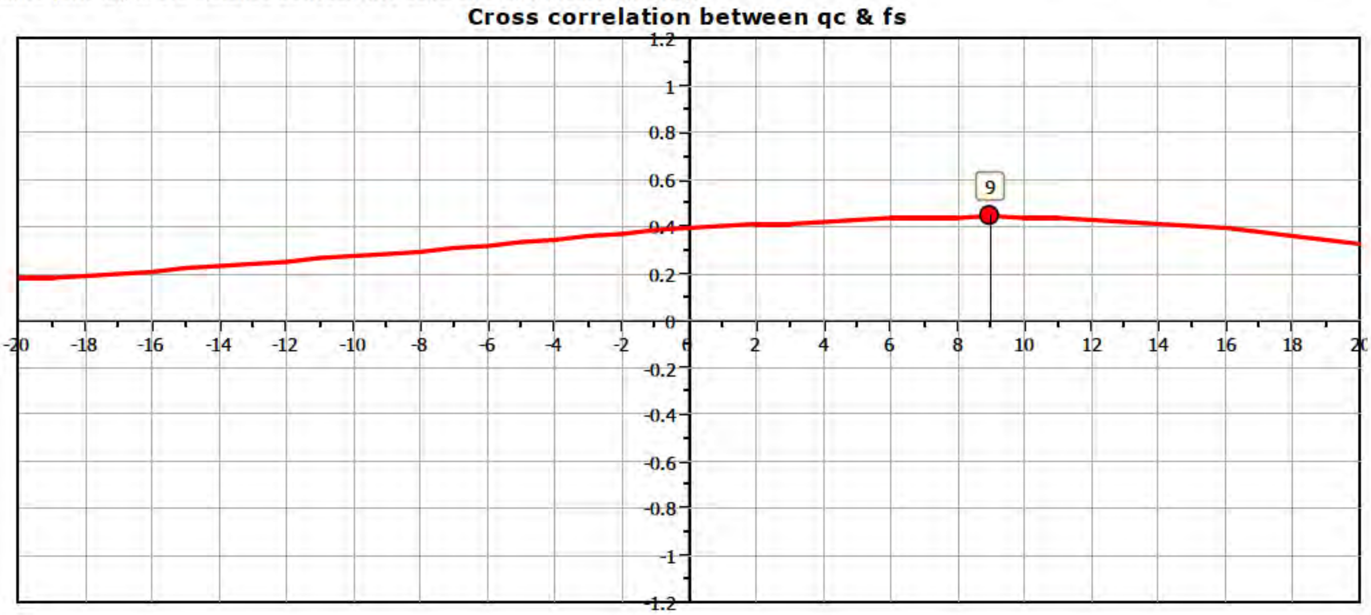
CPT: 23-03b

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 21.04 m, Date: 24/11/2023
Coords: lat -37.825805° lon 175.759309°



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



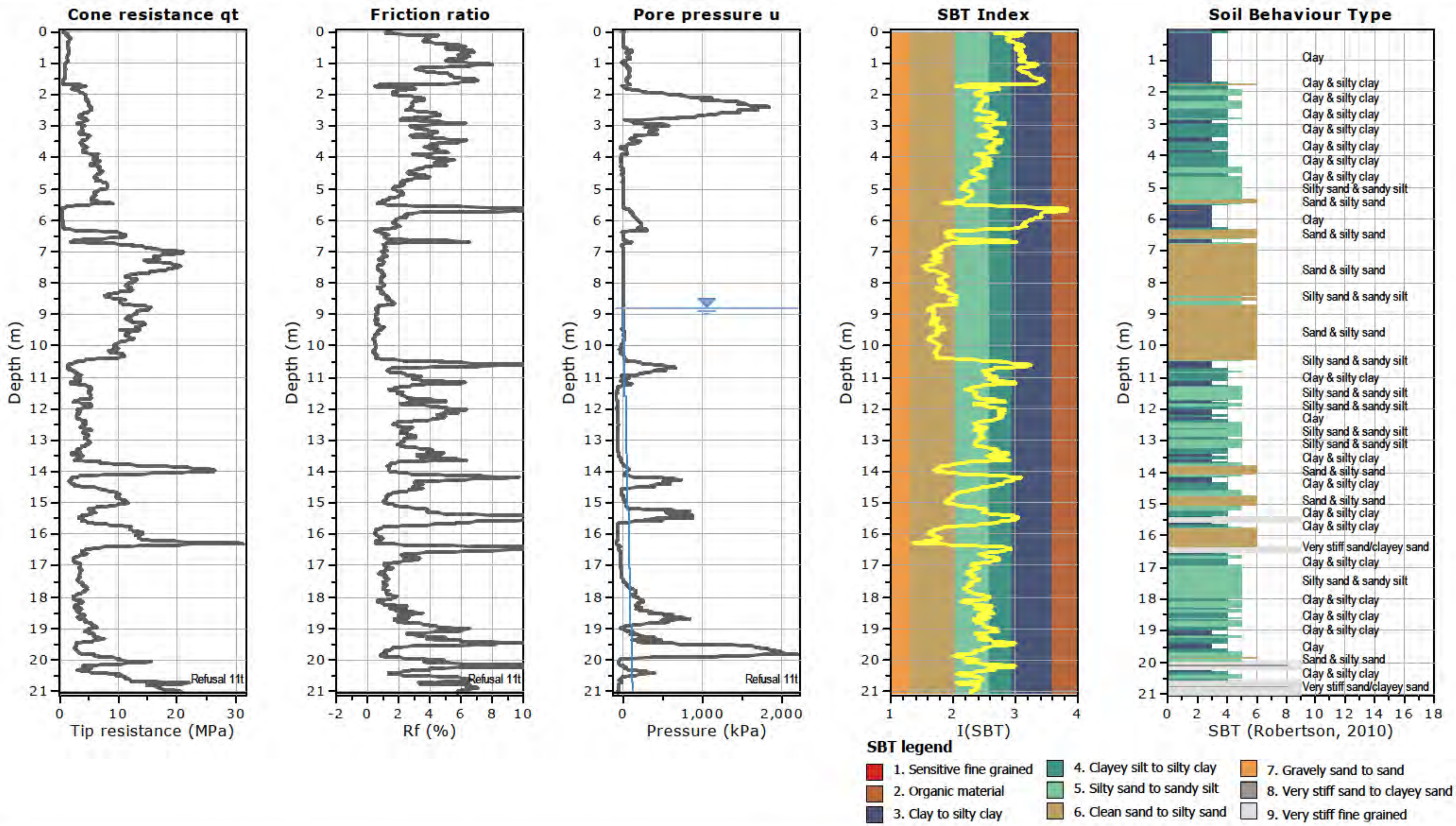
Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 23-03b

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: Peakdale Dr - Matamata | Holes dipped onsite using Dipmeter

Total depth: 21.04 m, Date: 24/11/2023
Coords: lat -37.825805° lon 175.759309°



APPENDIX D: IN-SITU PERMEABILITY TESTING RESULTS

CMW Geosciences	CLIENT: **Maven Associates Ltd**	DESIGNER: NK
	PROJECT: **Station Road, Matamata**	CHECKED: AS
		REVISION: 1
	TITLE: **SOA23-01 Falling Head Permeability Test**	DATE: 24/11/2023
		PROJECT: HAM2023-0124

Specifications - Open-Ended Tube

Length L_1:	0.8	m
Diameter:	90	mm
Non-Perm L_2:	0	m
Above Gnd L_3:	0	m

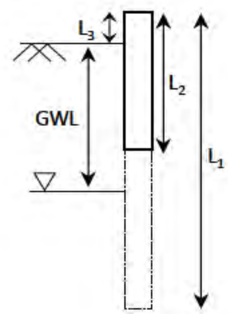
Ground Conditions

GWL: 1 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 0.80 m BGL



Hydraulic Conductivity (k)

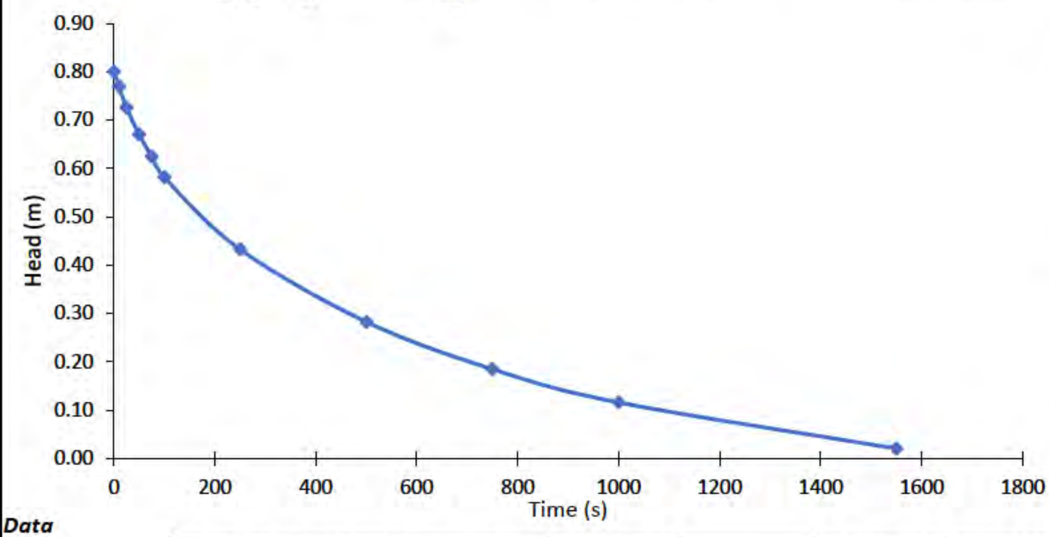
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

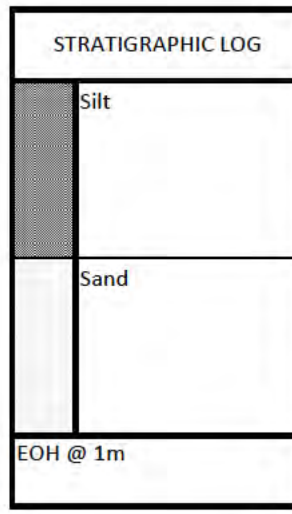
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1+d}{2h_2+d}\right)\cdot\frac{(h_1+h_2)}{2(t_2-t_1)} =$$ 4.74E-05 ms^{-1} = 4.10 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$ 1.47E-05 ms^{-1} = 1.27 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	0.800				
10	0.030	0.770	0.785		1.41E-05	7.04E-05
25	0.074	0.726	0.748		1.49E-05	7.23E-05
50	0.129	0.671	0.698		1.26E-05	5.83E-05
75	0.175	0.625	0.648		1.19E-05	5.20E-05
100	0.218	0.582	0.603		1.24E-05	5.18E-05
250	0.368	0.433	0.507		9.59E-06	3.59E-05
500	0.518	0.283	0.358		1.01E-05	3.03E-05
750	0.616	0.184	0.234		1.24E-05	2.86E-05
1000	0.684	0.116	0.150		1.62E-05	2.88E-05
1550	0.780	0.020	0.068		3.31E-05	4.55E-05

CMW Geosciences	CLIENT: **Maven Associates Ltd**	DESIGNER:	NK
	PROJECT: **Station Road, Matamata**	CHECKED:	AS
		REVISION:	1
	TITLE: **SOA23-02 Falling Head Permeability Test**	DATE:	24/11/2023
		PROJECT:	HAM2023-0124

Specifications - Open-Ended Tube

Length L_1: 2 m

Diameter: 90 mm

Non-Perm L_2: 0 m

Above Gnd L_3: 0 m

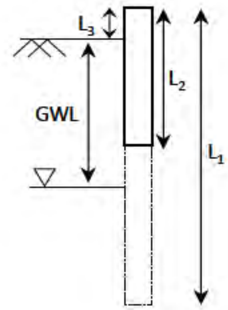
Ground Conditions

GWL: 2 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 2.00 m BGL



Hydraulic Conductivity (k)

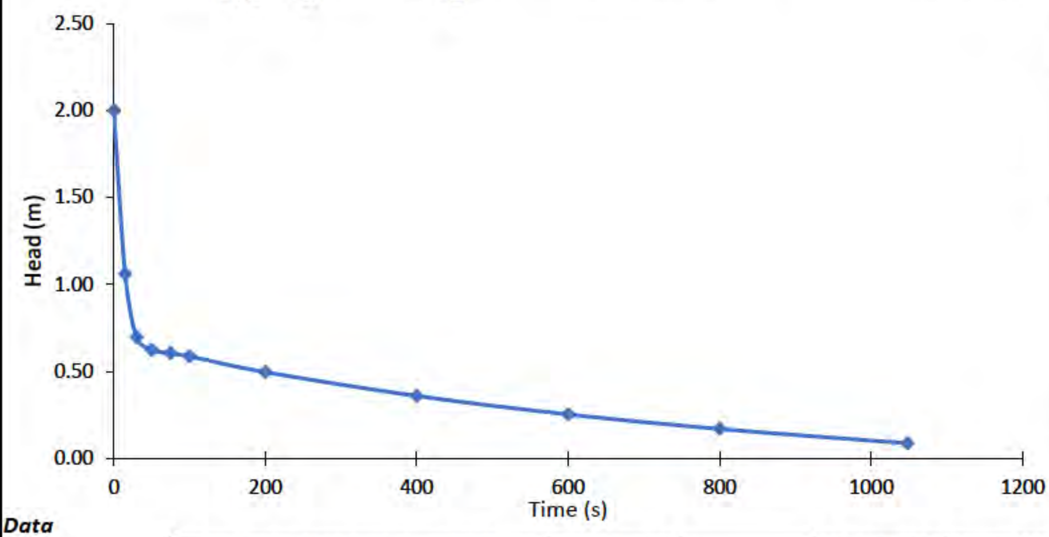
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(\log\frac{h_1}{h_2} - \log\frac{2h_1+d}{2h_2+d}\right)\cdot\frac{(h_1+h_2)}{2(t_2-t_1)} =$$ 1.70E-04 ms^{-1} = 14.70 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$ 2.96E-05 ms^{-1} = 2.56 m/day



STRATIGRAPHIC LOG
Silt
Sand
EOH @ 2m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	2.000				
15	0.941	1.060	1.530		9.89E-05	8.57E-04
30	1.305	0.695	0.878		9.63E-05	5.36E-04
50	1.376	0.624	0.660		2.25E-05	1.00E-04
75	1.396	0.604	0.614		5.52E-06	2.33E-05
100	1.414	0.586	0.595		5.24E-06	2.16E-05
200	1.504	0.496	0.541		7.82E-06	3.04E-05
400	1.641	0.359	0.427		8.67E-06	2.90E-05
600	1.747	0.253	0.306		1.13E-05	3.04E-05
800	1.831	0.169	0.211		1.53E-05	3.30E-05
1048	1.914	0.086	0.128		2.47E-05	4.10E-05

CLIENT: Maven Associates Ltd	DESIGNER: NK
PROJECT: Station Road, Matamata	CHECKED: AS
	REVISION: 1
TITLE: SOA23-03 Falling Head Permeability Test	DATE: 24/11/2023
	PROJECT: HAM2023-0124

CMW Geosciences

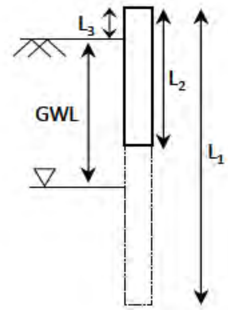
Specifications - Open-Ended Tube

Length L_1: 2 m
Diameter: 90 mm
Non-Perm L_2: 0 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 2 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 2.00 m BGL



Hydraulic Conductivity (k)

Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

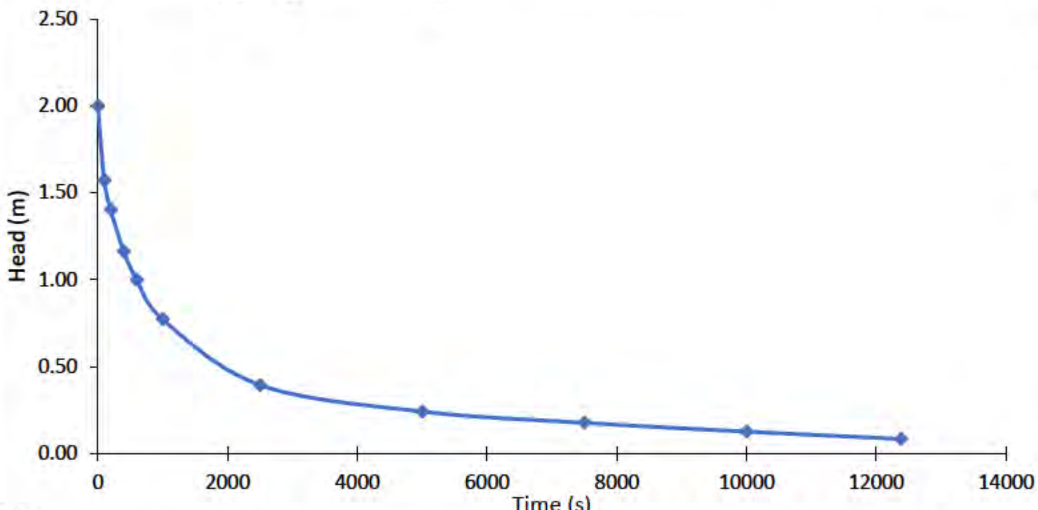
$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1+d}{2h_2+d}\right) \cdot \frac{(h_1+h_2)}{2(t_2-t_1)} =$$

1.31E-05 ms^{-1} = 1.13 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$

2.17E-06 ms^{-1} = 0.19 m/day



STRATIGRAPHIC LOG
Silt
Sand
EOH @ 2m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	2.000				
100	0.429	1.571	1.785		5.04E-06	4.65E-05
200	0.599	1.401	1.486		2.72E-06	2.17E-05
400	0.837	1.163	1.282		2.47E-06	1.77E-05
600	1.001	0.999	1.081		2.26E-06	1.43E-05
1000	1.229	0.771	0.885		2.21E-06	1.22E-05
2500	1.607	0.393	0.582		2.00E-06	8.70E-06
5000	1.759	0.241	0.317		1.24E-06	3.48E-06
7500	1.824	0.176	0.208		9.65E-07	2.05E-06
10000	1.875	0.125	0.150		1.17E-06	2.06E-06
12380	1.917	0.083	0.104		1.67E-06	2.41E-06

CLIENT:	Maven Associates Ltd	DESIGNER:	NK
PROJECT:	Station Road, Matamata	CHECKED:	AS
		REVISION:	1
TITLE:	SOA23-04 Falling Head Permeability Test	DATE:	24/11/2023
		PROJECT:	HAM2023-0124

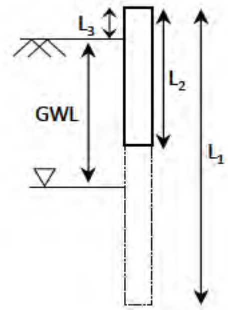
Specifications - Open-Ended Tube

Length L_1: 0.8 m
Diameter: 90 mm
Non-Perm L_2: 0 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 1 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 1.00 m BGL



Hydraulic Conductivity (k)

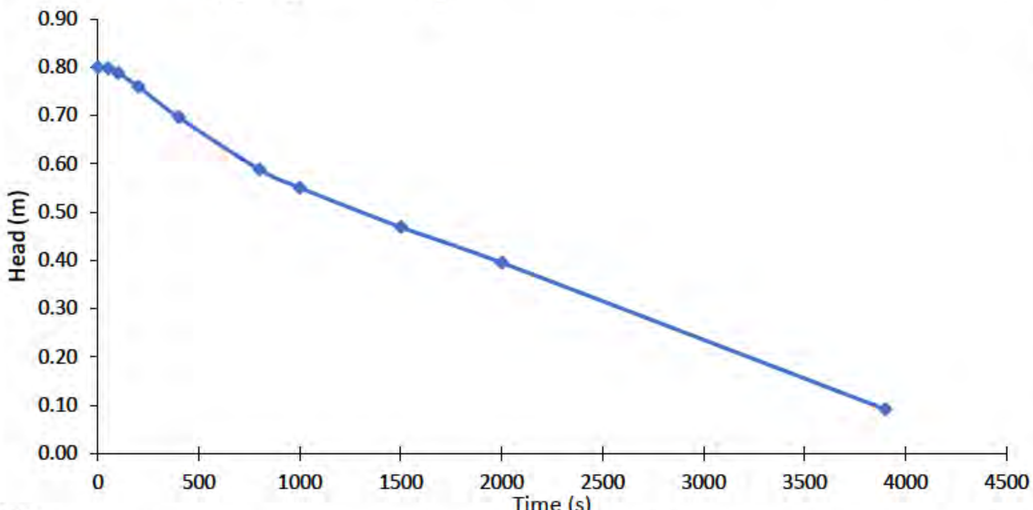
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 5.73E-06 ms^{-1} = 0.50 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2 - t_1)} \ln\frac{H_1}{H_2} =$$ 1.35E-06 ms^{-1} = 0.12 m/day



STRATIGRAPHIC LOG
Silt
Sand
EOH @ 3m

Data

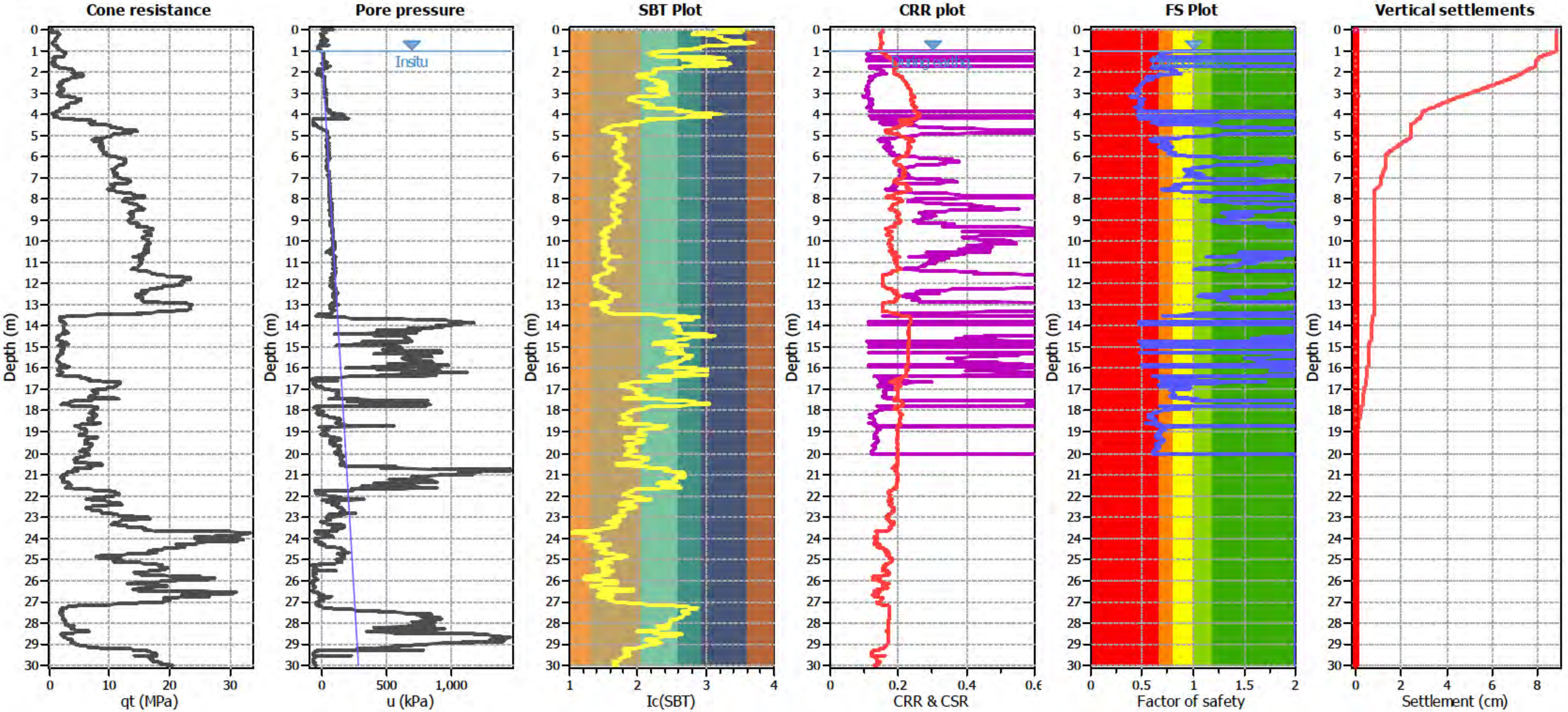
Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	0.800				
50	0.002	0.798	0.799		1.83E-07	9.26E-07
100	0.012	0.788	0.793		9.06E-07	4.57E-06
200	0.040	0.760	0.774		1.35E-06	6.68E-06
400	0.104	0.697	0.728		1.70E-06	8.06E-06
800	0.212	0.588	0.642		1.77E-06	7.75E-06
1000	0.250	0.550	0.569		1.50E-06	6.00E-06
1500	0.331	0.469	0.510		1.56E-06	5.80E-06
2000	0.405	0.395	0.432		1.82E-06	6.08E-06
3000						
3900	0.709	0.091				

APPENDIX E: LIQUEFACTION RESULTS

CMW Geosciences NZ Ltd
Suite 2, 5 Hill Street
Hamilton 3204
www.cmwgeosciences.com

Project:
Location:

CPT: CPT23-01
Total depth: 30.01 m

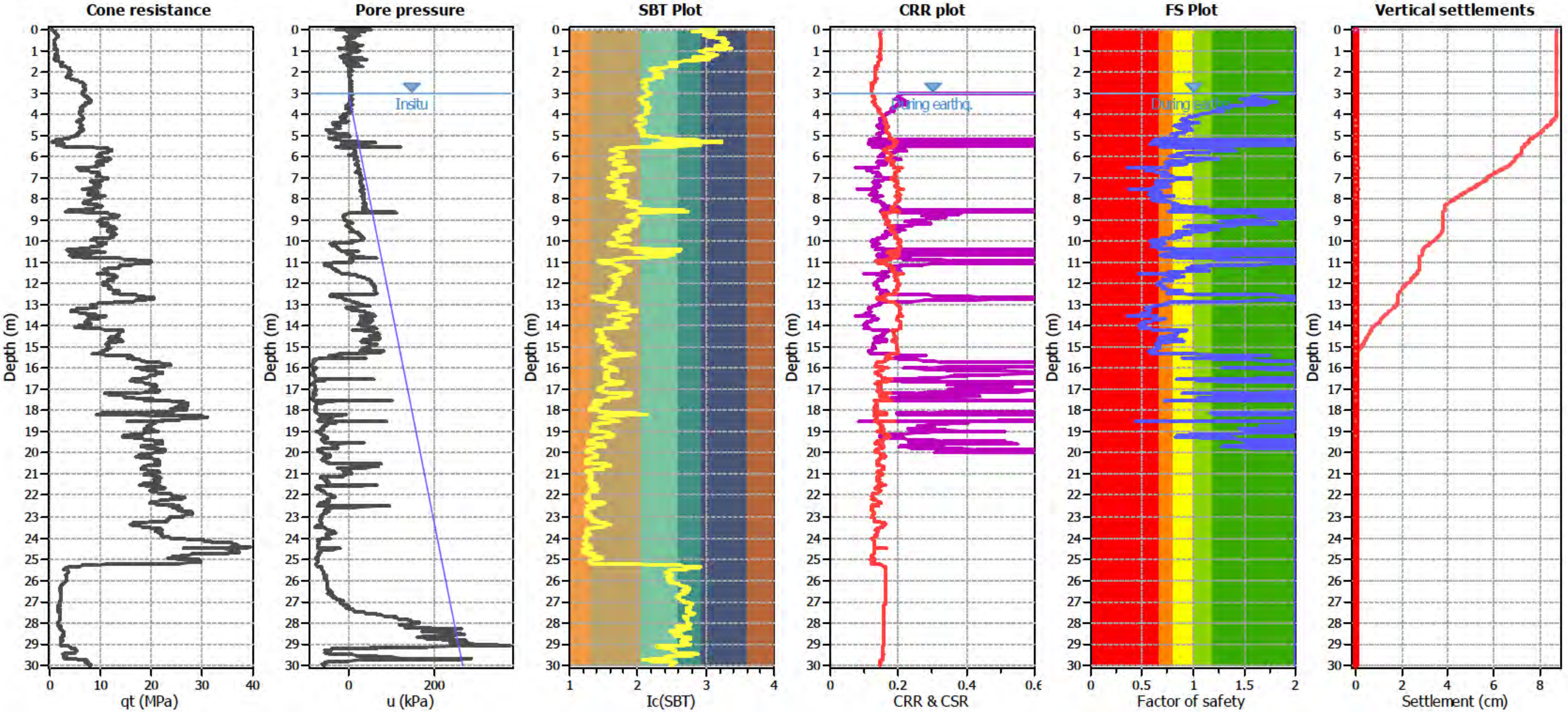


Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

CMW Geosciences NZ Ltd
Suite 2, 5 Hill Street
Hamilton 3204
www.cmwgeosciences.com

Project:
Location:

CPT: CPT23-02
Total depth: 30.02 m



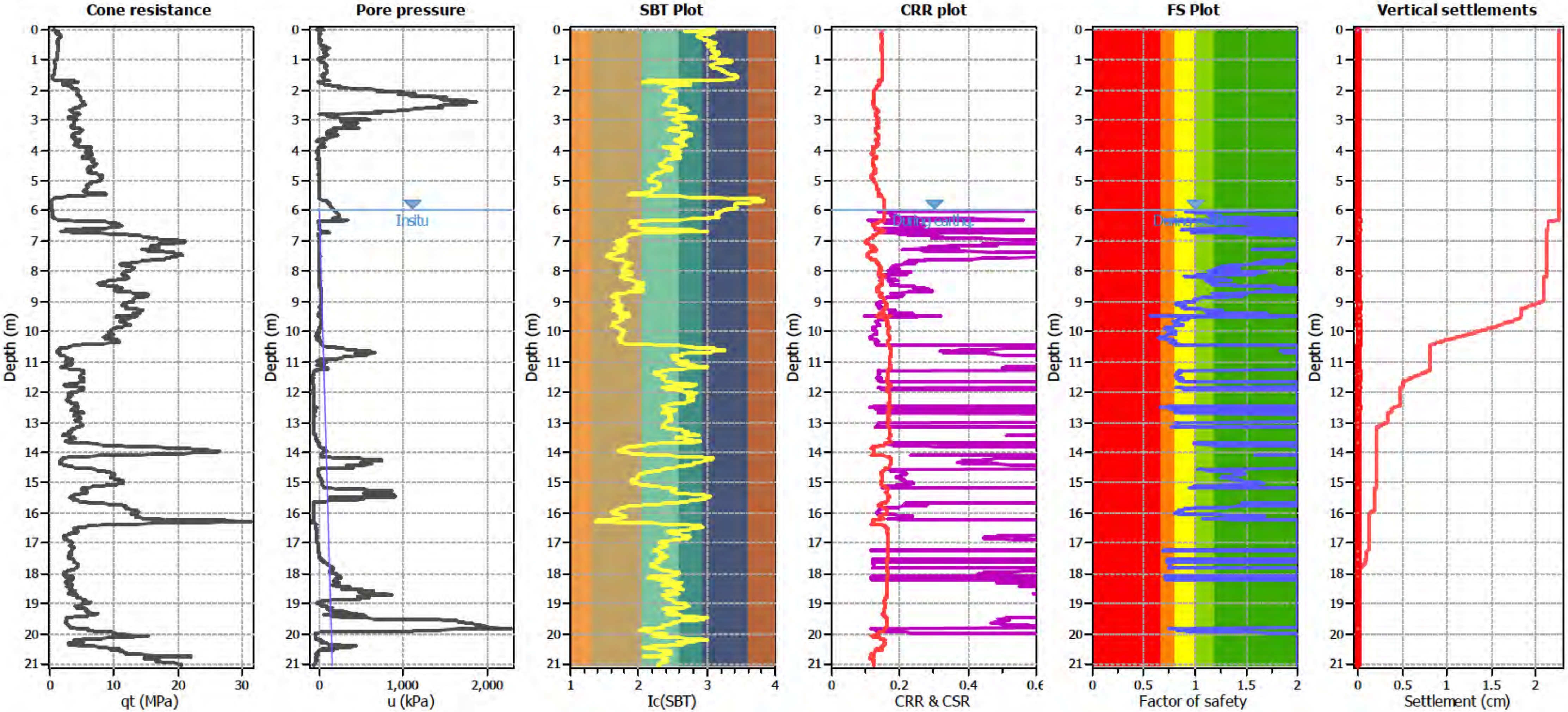
Analysis method:	B&I (2014)	G.W.T. (in-situ):	3.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	3.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

CMW Geosciences
Great People | Practical Solutions

CMW Geosciences NZ Ltd
Suite 2, 5 Hill Street
Hamilton 3204
www.cmwgeosciences.com

Project:
Location:

CPT: CPT23-03b
Total depth: 21.04 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	6.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	6.00 m	Fill height:	N/A	Limit depth applied:	Yes
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	20.00 m
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.28	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

APPENDIX F: GEOHAZARD ASSESSMENT TABLE

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
1	Earthquake	Seismicity	Entire Site	Site subsoil class = Class D due to less than >40m stiff soil profile ULS PGA = 0.28g Importance Level = 2	1	5	5	None	1	5	5
		Fault Rupture	Entire Site	Nearest active fault (Kerpehi fault) is approximately 5km from the site. Recurrence interval 10,000 years. (Refer to section 6.2)	1	5	5	Mitigation not required	1	5	5
		Liquefaction	Low-lying plains.	Refer to section 6.3	3	4	12	Low-lying area classified as Technical Category 2 (TC2) per the guidelines developed for the Canterbury earthquake rebuild – i.e. Ribraft foundations.	3	3	9
		Cyclic Softening	Entire Site	Not anticipated.	1	4	4	Mitigation not required.	1	4	4
2	Volcanic Activity	Ash and Pyroclastic Falls	Entire Site	Nearest active volcano is the Rotorua Caldera. Currently at alert level 0.	1	5	5	Mitigation not required.	1	5	5

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
3	Slope Instability / Landslide	Global Instability	Entire site	Due to the landform being generally near level to gently sloping, slope instability is not anticipated.	1	4	4	Mitigation not required.	1	4	4
4	Problematic Soils	Expansive Soils	Entire Site	Experience in similar soils indicate that the soils on site are non-expansive.	2	3	6	Mitigation not required.	2	3	6
5	Settlement	Compressible Soils	Entire Site	No compressible soils were encountered on site.	1	4	4	Mitigation not required.	1	4	4
		Fill Induced Settlement	Entire Site	No earthwork plans are available at the time of writing report. Site is primarily underlain with sand. It is anticipated any fill induced settlement would occur immediately and be built out during construction.	2	4	8	Install settlement monitoring plates prior to fill construction and monitor settlements weekly during construction or every 0.5m fill lift (whichever is most frequent) and then at fortnightly intervals thereafter. Results to be reviewed by Geotechnical Engineer prior to building construction to verify settlement rates have dissipated.	1	4	4

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
6	Bearing Capacity	Bearing Capacity Failure	Building Platform	Refer to Section 8.2 of the report	1	5	5	A preliminary geotechnical ultimate bearing capacity (GUBC) of 300kPa should be available.	1	5	5
7	Groundwater	Groundwater Impacts	Stormwater Controls.	Groundwater was encountered at shallow depths below the low-lying areas. Therefore, any formation of stormwater ponds, swales, etc. will require stability analyses.	2	4	8	Stability analysis required at design stage.	2	4	8
8	Construction Risks	Excavatability	Building Platform	Given the density of the soil units that will be encountered, excavation is expected to be readily achieved with normal earthworks plant. However, excavations may require temporary support due to high expected groundwater and granular soils leading to 'running sands'.	3	3	9	Consideration given to elevated groundwater level at design stage.	1	3	3
		Sediment Retention Ponds	Building Platform	Sediment retention ponds will require geotechnical input at design stage to	2	3	6	Consideration given to batter stability of proposed ponds at	1	3	3

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
				ensure batter stability is achievable.				design and construction phase.			
		Stockpile locations	Building Platform	There are no steep slopes proximate to the proposed development site. Stockpile areas can be nominated on site without any prior geotechnical considerations.	1	2	2	Mitigation not required.	1	3	2
		Subgrade Preparation	Building Platforms and Road Alignment	Topsoil and existing vegetation within the building footprints and road alignments will be cleared as part of the proposed development earthworks.	1	2	2	Mitigation not required.	1	2	2
		Service Trenches (trench collapse / long term settlement)	Building Platform and Road Alignment	Trench collapse may occur in surficial soils / if proposed service trenches extend below GW level.	3	3	9	Mitigation should be considered in the form of: - trench support - temporary dewatering, in the form of regularly spaced pumps	1	3	3

APPENDIX C – Wastewater Treatment Plant Case Study

RAATH AND ASSOCIATES

source to consumption

WASTEWATER SOLUTIONS

AS PURE AS NEW ZEALAND

DESIGN

REMEDIATION

WASTEWATER TREATMENT

WATER ENGINEERING DESIGNS

We do designs for pumpstations in potable water and wastewater as well as full reticulation systems. The latest project I have completed was for the Waipapa Sports Facility in Waipapa Northland. We were responsible for the complete design and operational philosophy.

We designed headworks and reticulation for 26 L/s headworks coupled to a 1 to 16 l/s irrigation pump set and reticulation system. We designed a 12.5 L/s 110 kPa fire reticulation system including water storage. We also designed an 8 L/s Purification with Temple Water and the reticulation system for the complete sports facility.

Figure 1 Below are some photos of the construction. The pumps are in operation and irrigation of the sports fields have been in operation for the last week without any hick ups. We will do official commissioning and hand over early in April.

Figure 1
Installations at Waipapa

BIOLOGICAL REMEDIATION OF WWTW PONDS AND LANDFILLS

One of our innovative solutions we have is the agency we have for BluePlanet Labs based in America. We are Also distributors of Moleaer Nanobubblers which is perfect for preventing algae blooms in Golf Estate ponds etc.

This is a microbial solution that does natural sludge reduction over a period of six months. We are busy with a trial at Whiritoa located in Hauraki District council and the results are extraordinary. We still have two months left but have managed to get better than anticipated results from the first three months.

We started implementing the first trial on 14 September 2023.

Figure 2 indicates the visible change in the condition of the facultative pond in the first two months of application.

Figure 2
Facultative-Primary Pond

Figure 3
Maturation-Secondary Pond

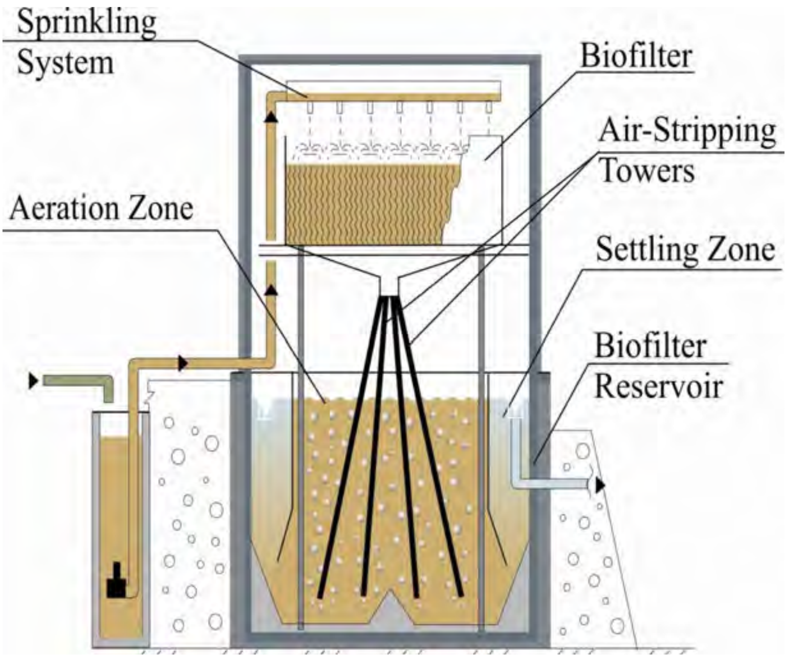
Figure 4
Sludge reduction

Figure 3 indicates the visible change in the condition of the maturation pond in the first two months of application.

Figure 4 indicates the visible change in the sludge volume of the facultative pond in the first two months of application. The method was using a tube taking a grab sample at exactly the same spot tin the pond at times indicated on the figure.

HOW DOES IT WORK?

- Waste water is mixed with activated sludge in mixing the chamber
- Sludge mixture is pumped to the biofilter sprinkling system by the circulation pump
- Falling drops are broken upon the disks and sprinkled across the biofilter feed
- Liquid exiting the biofilter feed is collected in collection tray
- Sludge mixture is conveyed by air-stripping towers to the aeration zone of the aeration tank
- Natural aeration with shock treatment and bubble flow in aeration zone
- Sludge from settling zone is pumped back to the mixing chamber completing the cycle
- Pure water is collected in the collection trays in the settling zones and gravitates to anoxic zone for denitrification



WASTE WATER TREATMENT TECHNOLOGY

I have attached an overview of our patented system. Very important to note is that it can be retrofitted.

Figure 7 is a photo of a 12.5 KL/day plant we constructed. The process remains the same for plants from 12 500 L/day up to 120 000 L/day. The blocks expand and increase parabolically as treatment capacity increases.

Please note that we possess the capability to design, Construct, Commision train and maintain/operate all of our technologies. We work with strategic partners where needed.

Figure 7
KL/day treatment plant

RAATH AND ASSOCIATES

source to consumption

www.allraath.com

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Email: marno@allraath.com

APPENDIX D – CMW GIR Report

CMW Geosciences
Great People | Practical Solutions

5 July 2024

PROPOSED RESIDENTIAL SUBDIVISION AND SOLAR FARM

STATION ROAD, MATAMATA

PRELIMINARY GEOTECHNICAL INVESTIGATION REPORT

Matamata Development Limited C/O Maven Associates

HAM2023-0124AE Rev 0

HAM2023-0124AE		
Date	**Revision**	**Comments**
02 July 2024	A	Initial draft for internal review
03 July 2024	B	Draft for final review
05 July 2024	0	Report Issue

	Name	Signature	Position
Prepared by	Rachel Tangiia	[signature]	Project Engineering Geologist
Reviewed by	Harshad Phadnis	[signature]	Associate Geotechnical Engineer CMEngNZ, CPEng
Authorised by	Sam Gibb	[signature]	Principal Geotechnical Engineer CMEngNZ, CPEng

EXECUTIVE SUMMARY

This report presents the results of a preliminary geotechnical investigation and geohazards assessment for a proposed residential subdivision and solar farm along Station Road, Matamata.

Based on the investigation results, the site is underlain by Hinuera Formation and Walton Subgroup soils.

Geotechnical recommendations for the proposed development are summarised as follows:

- Liquefaction analyses indicate the following liquefaction-induced settlement during a ULS event:
  - Between 20mm to 165mm for IL2 structures.
  - Between 100mm to 145mm IL3 structures.
- There is high potential for lateral spread near the swale at all three blocks and near the proposed greenway and the riverbank in the Western Block.
- TC2 foundations will be required for residential development in the Eastern Block and Hybrid TC2/TC3 foundations will be required for residential development in the Western Block. Foundations in the northern block will also be required to be designed to sustain liquefaction-induced settlement and lateral spreading effects.
- Static settlements are anticipated to be low risk due to the presence of dense to very dense sands and stiff to very stiff silts.

Additional investigations, testing and analysis will be required to support subdivision consent application, earthworks and building consent applications.

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APPENDICES

Appendix A: Drawings

Appendix B: Maven Associates development plan

Appendix C: Hand auger borehole logs

Appendix D: In-situ permeability testing results

Appendix E: CPT Investigation Results

Appendix F: Geohazards assessment table

Appendix G: Liquefaction results

Appendix H: Safety in design risk assessment

1 INTRODUCTION

1.1 Project Brief

CMW Geosciences (CMW) was engaged by Matamata Development Limited C/O Maven Associates to carry out a preliminary geotechnical investigation of a site located at Station Road, Matamata, which is being considered for the construction of a residential subdivision and a solar farm.

The scope of work and associated terms and conditions of our engagement were detailed in our services proposal letter referenced HAM2023-0124AD Rev0, dated 15 May 2024.

This report is to provide a preliminary geotechnical assessment, advice on the geotechnical risks present at the site and possible mitigation measures that are relevant for the proposed residential subdivision and solar farm. At the time of writing this report, the project was in the early stages of planning, and it was anticipated that the geotechnical investigation will inform site suitability and development options. Further investigations and analyses are expected as the project progresses.

1.2 Scope of Work

As detailed in our proposal letter, the agreed scope of work to be conducted by CMW was defined as follows:

- Arrange and perform a geotechnical site investigation (SI).
- Evaluate and develop a ground model.
- Perform a geohazards assessment and provide relevant geotechnical recommendations.
- Compile the above details into a geotechnical report.

2 SITE DESCRIPTION

2.1 Site Location

The site comprises three blocks of land on Station Road as shown on Figure 1 and comprises the following:

- Northern Block – legally described as Lot 2 DP 567678, with an area of approximately 13.5ha.
- Eastern Block, 127 Station Road – legally described as Lot 1 DPS 65481, with an area of approximately 4.2ha.
- Western Block, 243 Station Road – legally described as Lot 1 DP 21055, Lot 2 DP 21055 and Lot 3 DPS 14362, with an area of approximately 73ha.

CMW have previously undertaken a geotechnical investigation on the adjacent site to the east of the Western Block (CMW Ref. HAM2023-0124AB Rev 1, dated 12 Dec 2023).

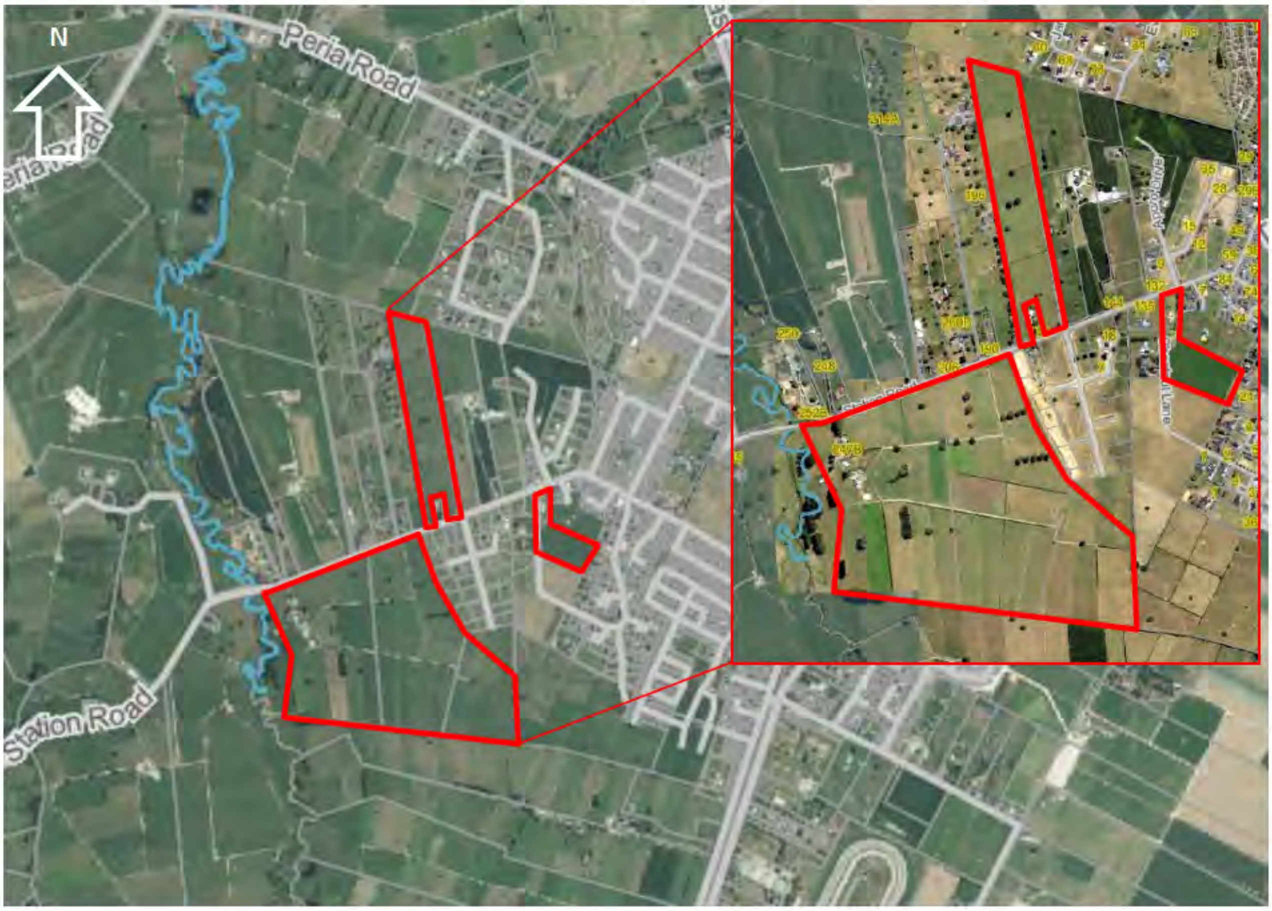

Figure 1: Site Location Plan (Google Maps)

2.2 Landform

The current general landform, together with associated features located within and adjacent to the site is presented on the attached Site Plan as ***Drawing 01.***

- The site can generally be described as near level with existing ground levels ranging from RL68m in the east (Moturiki Datum) to RL72m in the west within the Western Block. Along the western boundary the slope trends in a general east to west direction with a maximum slope gradient of 1(V):5(H) to RL59m towards the Waitoa River which runs parallel to the western site boundary.
- Each Block is adjoined by Station Road (Western and Eastern Blocks to the north, Northern Block to the south). Pastoral land surrounds the Northern Block and the Western Block in all remaining directions.
- Residential development is located to the east of the Eastern Block.
- Early subdivision formation is evident in the land between the Western and Eastern Blocks.
- Each Block is currently utilised as pastoral land and predominantly grass covered with sporadic mature trees. Grazing stock was present during our site visits.
- Landform and use remains consistent within the last 50 years with historical aerial photographs observed (Retrolens images circa 1971)
- Residential dwellings are present on the northern portion of the Eastern Block and the northwestern portion of the Western Block with additional farm buildings noted on the Western Block (milking shed, storage sheds etc).
- A stormwater swale is located along the eastern and northern boundaries of the Western Block and the northern boundary of the Northern Block to a maximum depth of approximately 2m.

- Additional swale drains within each block were observed along edges of paddocks. It is assumed that these drains will be infilled as part of the subdivision earthworks.

3 PROPOSED DEVELOPMENT

A preliminary development plan was provided (prepared by Maven Associates Ref. 289001, dated May 2024) which details the preliminary layout for the proposed development. Residential development (one- and two-storey) is proposed on the Eastern Block and the Western Block with associated roads and infrastructure. It is understood that a greenway is proposed centrally across the Western Block which is to collect stormwater runoff from the subdivision. This greenway is oriented in a general east to west direction and flows towards the river. A copy of this plan is presented within ***Appendix B***. It is understood that a solar farm is proposed on the Northern Block.

As no architectural or engineering design drawings have been supplied to date, we have prepared this report on the basis that a future development will broadly comprise minor cuts and fills to form a near level site supporting residential buildings on the Eastern and Western Blocks.

4 INVESTIGATION SCOPE

4.1 Field Investigation

Following a dial before you dig search, and onsite service location, the field investigation was carried out between 31 May 2024 and 7 June 2024. All fieldwork was carried out under the direction of CMW Geosciences in general accordance with the NZGS specifications[1] and logged in accordance with NZGS guidance[2]. The scope of fieldwork completed was as follows:

- Undertook a walkover survey of the site to assess the general landform, site conditions and adjacent structures / infrastructure;
- An on-site services search was carried out by a specialist contractor to identify the presence of any underground obstructions or hazards prior to the field investigation program commencing;
- 17 no. hand auger boreholes, denoted HA24-09 to HA24-25, were drilled using a 50mm diameter auger to target depths of up to 5.0m below existing ground levels to visually observe the near surface soil profile and to facilitate in-situ permeability / vane shear strength testing. Hand auger HA24-16 met the target depth, with remaining boreholes terminating at depths ranging between 1.7m and 4.6m due to refusal / hole collapse. Engineering logs of the hand auger boreholes, together with peak and remoulded vane shear strengths are presented in ***Appendix C***;
- Dynamic cone (Scala) penetrometer (DCP) tests were carried out adjacent to each hand auger borehole to depths of up to 5m to provide soil density profiles, for use as a comparison with the CPT data and to provide a subgrade CBR value for pavement design purposes. Graphical results of the DCP testing are presented on the borehole logs in ***Appendix C***;
- Eight in-situ falling head permeability tests were completed in the open standpipe piezometers denotated SOA24-05 to SOA24-12 at depths ranging between 1.4m in SOA24-05 to 3.0m in SOA24-08, SOA24-09 and SOA24-12. Results of the permeability tests are presented in ***Appendix D***;

[1] NZ Geotechnical Society (2017) NZ Ground Investigation Specification, Volume 1 – Master Specification.

[2] NZ Geotechnical Society (2005), Field Description of Soil and Rock, Guideline for the field classification and description of soil and rock for engineering purposes.

- Seven Cone Penetrometer Tests (CPT) and four seismic CPT's denoted CPT24-04 to CPT24-10 and SCPT24-01 to SCPT-04 respectively, were pushed to depths ranging between 16.8m to 30m to define the ground model at depths. Results of the tests are presented as traces of tip resistance (q_c), friction resistance (f_s) and friction ratio are presented in ***Appendix E***;

The approximate locations of the respective investigation sites referred to above are shown on the Site Plan presented within ***Appendix A***. Test locations were recorded using handheld GPS.

5 GROUND MODEL

5.1 Published Geology

Published geological maps[3] for the area depict the regional geology as comprising cross-bedded pumice sand, silt and gravel of the Hinuera Formation.

5.2 Stratigraphic Units

The ground conditions encountered and inferred from the investigation were generally consistent with the published geology for the area as well as CMW's aforementioned report (HAM2023-0124AB) and can be generalised according to the following subsurface sequences.

The distribution of the various units encountered is presented in the appended Geological Sections A to C presented as Drawings 2 to 5 within ***Appendix A***.

5.2.1 Summary

The distribution of these units is illustrated on the appended Geological Cross Sections and presented below in Table 1.

Table 1: Summary of Strata Encountered

Unit	Depth to base (m)		Thickness (m)**	
	Min	Max	Min	Max
Topsoil/Fill	0.1	0.5	0.1	0.5
Stiff to Very Stiff Silt (Hinuera Formation)	1.0	1.1	0.5	1
Dense to Very Dense Sand with interbedded Silt (Hinuera Formation)	5.9	17.3	4.9	16.3
Very Stiff to Hard Silt/Clay (Walton Subgroup)	0.1	18.1	9*	18*
Very Dense Silty Sand (Walton Subgroup)	-	-	**	**
Notes: * Strata not encountered within all test locations. **Thickness only recorded were base of strata has been confirmed.				

[3] Edbrooke, S.W (compiler) 2005: Geology of the Waikato area. Institute of Geological & Nuclear Scienced 1:250,000 Geological Map 4.

5.3 Groundwater

During the investigation, which were completed in early winter conditions (May / June 2024), groundwater was encountered within the CPTs and boreholes at the depths provided in Table 2.

Table 2: Groundwater Monitoring Data		
Area	**Minimum Depth (mbgl)**	**Maximum Depth (mbgl)**
Eastern Block	1.4	2.6
Northern Block	1.8	4.2
Western Block	1.6	5+

Groundwater was not encountered within HA24-15 or HA24-16 (located within Western Block). It is noted that groundwater levels do fluctuate seasonally and following periods of heavy / extended periods of rain by up to a metre.

6 GEOHAZARDS ASSESSMENT

6.1 Context

The following sections of this report provide an assessment of the geohazards relevant to this site and provide the basis for the Natural Hazards Risk Assessment presented in ***Appendix F.***

6.2 Seismicity

Reference to NZGS Guidance[4] was made to determine peak horizontal ground acceleration or PGA (a_{max}) values based on a 50-year design life in accordance with the New Zealand Building Code[5] and importance level (IL) 2 for the residential development and IL3 structures for the proposed solar farm. The PGA values for the serviceability limit state (SLS) and ultimate limit state (ULS) earthquake scenarios are as follows:

Table 3: Design Peak Ground Acceleration (PGA) for Various Limit States			
Limit State	**AEP**	**PGA(g)**	**Magnitude$_{eff}$**
	IL2 Structures		
SLS	1/25	0.07	5.9
ULS	1/500	0.28	5.9
	IL3 Structures		
SLS	1/25	0.07	5.9
ULS	1/1,000	0.36	5.9

4 NZ Geotechnical Society publication "Earthquake geotechnical engineering practice, Module 1: Overview of the standards", (March 2016).
5 Ministry of Business, Innovation and Employment (1992) NZ Building Code Handbook, Third Edition, Amendment 13 (effective from 14 February 2014)

6.3 Fault Rupture

The nearest active fault to the site is the Kerepehi Fault. This fault is approximately 5km east of the site. The Kerepehi Fault has a recurrence interval of between 2,000 years to 3,500 years. We consider the site to be low risk, with respect to fault rupture.

6.4 Liquefaction

6.4.1 Methodology

In accordance with MBIE/NZGS guidance[6] the liquefaction susceptibility of the soils at this site was assessed with respect to geological age and compositional (soil fabric and density) criteria, based on the following assumptions:

- Saturated soils below 1.5m to 2.25m depth were modelled as being susceptible to liquefaction. Saturated soils below 3.5m and 4.75m depth were modelled at SCPT24-03 and SCPT24-04.
- A site-specific assessment was carried out using the seismic CPT's to account for soil microstructure in accordance with Robertson[7]. Results in ***Appendix G*** suggest that "no soil microstructure can be justified" and therefore no strength gain factor has been applied.
- Soils are also classified with respect to their grain size and plasticity to assess liquefaction susceptibility. For this project, a cut-off threshold soil behaviour type index value (I_c) of 2.6 was used to distinguish between liquefiable (I_c<2.6) and non-liquefiable (I_c>2.6) soils.
- Specific liquefaction analyses were undertaken for IL2 and IL3 structures, using the software package CLiq using the Boulanger and Idriss (2014) method. The cyclic stress ratio (CSR), being a function of the earthquake magnitude for the design return period event, was compared to the cyclic resistance ratio (CRR), being a function of the CPT cone resistance (q_c) and friction ratio (F_r).
- Free-field liquefaction induced settlements were determined in accordance with Zhang et al. (2002). With respect to liquefaction response, consideration was given to a 10m cut-off depth to estimate index settlements as per MBIE[8] guidance (foundation technical categories). These were compared to liquefaction settlement estimates over the full depth range of the CPT's with a depth weighting factor ranging from 1 at the ground surface to 0 at 18m depth applied to the volumetric strains (e_v) in accordance with Cetin et al (2009)[9].

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[6] Earthquake Geotechnical Engineering Practice, Module 3: Identification, assessment and mitigation of liquefaction hazards", (November 2021)

[7] P.K. Robertson (2015). Comparing CPT and Vs Liquefaction Triggering Methods, Journal of Geotechnical and Geoenvironmental Engineering.

[8] Repairing and Rebuilding House affected by the Canterbury Earthquakes", (December 2012)

[9] Cetin, K., Bilge, H., Wu, J., Kammerer, A., and Seed, R. (2009). Probabilistic Model for the Assessment of Cyclically Induced Reconsolidation (Volumetric) Settlements, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 135(3), pp. 387-398.

6.4.2 Results

Results are presented in ***Appendix G*** and can be summarised as in Table 4:

Table 4: Liquefaction Analyses Results					
Development	SLS Settlement (mm)	IL2 Structures		IL3 Structures	
		Total Settlement (mm)	Index Settlement (mm)	Total Settlement (mm)	Index Settlement (mm)
Residential Development in the Eastern and Western Blocks	<5	20 - 165	25 – 185	-	-
Solar Farm in the Northern Block	<5	-	-	100 - 145	85 - 150

Note: All settlements and depths based on existing ground profile.

Index settlements are calculated based on the upper 10m of the soil profile using no depth weighting factor.

Total ULS settlements are based on the full depth of the CPT trace with a depth weighting factor applied.

Index settlements are for assessment of the site against the MBIE site Technical Category guidelines and are not comparable to the total ULS settlements.

The calculations indicate that liquefaction may occur in some soil layers during a ULS earthquake event. In the ULS cases, the liquefaction results indicate a high risk of liquefaction occurring at the site. Recommendations to mitigate effects of liquefaction settlements on the proposed development are provided below in Section 7.

6.5 Lateral Spread

Following the onset of liquefaction, the liquefied soils behave as a very weak undrained material, which can give rise to lateral spreading where a free face is present within the vicinity of the site or where proposed cut and fill batters are proposed over or within liquefied soils.

The boundary swale depths were assumed to be 2m and were considered for all three blocks. Smaller drains between farm paddocks were assumed to be infilled during subdivision formation. The proposed greenway through the Western Block was assumed to be 2m deep. The riverbank along the western boundary of the Western Block is approximately 5m high. Based on the current landform, free face heights of the swales, proposed greenway and the riverbank and depths to liquefiable layers, there is high potential for lateral spread near the swale at all three blocks and near the greenway and the riverbank in the Western Block.

6.6 Slope Stability

The general landform across the site is flat to gently grading, therefore we do not consider slope stability will be problematic on this site.

6.7 Load Induced Settlement

The predominantly stiff to very still nature of the subsoils dictates that the soils encountered across the majority of the site is generally not prone to excessive load-induced or 'static' settlements under typical residential development proposed fill and building loads.

The majority of the site is recorded to be underlain by predominantly dense to very dense sandy soils which will see any settlement built out during construction.

6.8 Sensitive Soils

The Hinuera Formation silt unit present across the site and encountered within the upper 1m is typically considered moderately sensitive to sensitive. These characteristics may make the silt unit challenging to earthwork and will require special consideration to plant movements during the construction period where exposed.

7 RECOMMENDATIONS

7.1 Seismic Site Subsoil Category

The geological units encountered beneath the development areas comprise soil strength materials, which with respect to the seismic site subsoil category defined in Section 3.1.3 of NZS1170.5, is defined as having a UCS < 1MPa. Therefore, the seismic site subsoil category is assessed as being Class D (deep soil site).

7.2 Liquefaction Mitigation

Based on the analysis results presented in Section 6.4, we consider the risk of liquefaction and liquefaction induced settlements to be high for the ULS cases. Foundation recommendations are provided in Section 7.5.

Liquefaction effects can possibly be reduced by performing laboratory testing to assess the fines content and plastic nature of the fine-grained soils at the site and/ or by performing additional investigations and laboratory testing to take in to account the pumiceous sands at the site.

7.3 Lateral Spread Mitigation

Based on the analysis results presented in Section 6.4 and Section 6.5, we consider the risk of lateral spreading to be high for the ULS cases, in areas adjacent to existing swales, proposed greenway and riverbank.

Appropriate setbacks will have to provided at the detailed design stage. Ground improvement in the form of rammed aggregate piers might be required based on the severity of lateral spreading.

Lateral spreading can possibly be reduced by performing laboratory testing to assess the fines content and plastic nature of the fine-grained soils at the site and/ or by performing additional investigations and laboratory testing to take in to account the pumiceous sands at the site.

7.4 Stormwater Soakage

8 no. falling head permeability tests were undertaken across the site to provide soakage rates. Results indicated that the permeability of soils ranged between 2×10^{-6} and 5×10^{-6} m/sec for the silty material and between 7×10^{-6} to 6×10^{-7} m/sec for the sandier material. HAS24-12 has not been considered based on low soakage rate for the insitu sandy soil. Results of testing are presented as ***Appendix D***. The soils at this site are considered suitable to provide rain gardens / attenuation ponds.

7.5 Foundations

On this site, our provisional expectation is that provided earthworks are completed in accordance with the standards, the following will apply:

- A preliminary geotechnical ultimate bearing pressure of 300 kPa should be available in the static case for shallow strip and pad foundations constructed within both the natural cut ground and engineered fill areas. Geotechnical ultimate bearing pressure in the ULS seismic case will be < 300 kPa based on the shallow liquefiable layers.

- There may be areas where localised variations in shear strength within the natural cut ground occur, particularly where the depth of cut varies across the building platforms. Further confirmation of available bearing pressures will be addressed at the time of post earthworks soil testing and will be presented in the Geotechnical Completion Report.
- To accommodate the liquefaction potential on the site, TC2 foundations are anticipated for residential development in the Eastern Block and Hybrid TC2/TC3 foundations will are anticipated for residential development in the Western Block based on liquefaction-induced settlements presented in Section 6.4. Foundations for the solar farm development in the Northern Block should be able to sustain liquefaction-induced settlements as per Section 6.4. Foundations near the swale should also be able to sustain lateral spreading effects.
- As required by section B1/VM4[10] of the New Zealand Building Code Handbook, the following strength reduction factors must be applied to all recommended geotechnical ultimate soil capacities in conjunction with their use in factored design load cases:
  - 0.8 for load combinations involving earthquake overstrength;
  - 0.5 for all other load combinations.

8 SAFETY IN DESIGN

The design landform requires site excavations that may include geotechnical works such as undercuts, temporary excavations, fill batters. Exposure to these works forms a significant safety risk for contractors and inspectors / testers.

In conducting our scope of work, we have considered and addressed Safety in Design (SiD) aspects relevant to our understanding of the proposed design and construction work. SiD must consider the construction, operation, maintenance, and ultimate demolition phases of the relevant works.

It is noted that CMW are focussed on design aspects, and whilst we have attempted to be comprehensive in our assessment, it is the Contractors responsibility to cover construction related risks in a more comprehensive manner (being the competent party in that respect).

Our SiD risk assessment is presented in ***Appendix H***. This risk assessment must be communicated with all affected parties involved with the project and dealt with through specific on-site risk assessment plans.

9 FURTHER WORK

- Additional investigation, laboratory testing and analysis to further define geohazards such as liquefaction, lateral spreading and static settlements below and near housing areas and infrastructure.
- Geotechnical analysis and reporting suitable to support future project stages including a subdivision consent application, and detailed design to support building consent applications.
- Preparation of an earthworks specification, followed by observations, testing, certification and preparation of a Geotechnical Completion Report for the proposed development.

[10] Ministry of Business, Innovation and Employment (2019) *Acceptable Solutions and Verification Methods for NZ Building Code Clause B1 Structure,* B1/VM4, Amendment 19.

10 CLOSURE

Additional important information regarding the use of your CMW report is provided in the '*Using your CMW Report*' document attached to this report.

This report has been prepared for use by Matamata Development Limited C/O Maven Associates in relation to the Proposed Residential Subdivision and Solar Farm Station Road, Matamata project in accordance with the scope, proposed uses and limitations described in the report. Should you have further questions relating to the use of your report please do not hesitate to contact us.

Where a party other than Matamata Development Limited C/O Maven Associates seeks to rely upon or otherwise use this report, the consent of CMW should be sought prior to any such use. CMW can then advise whether the report and its contents are suitable for the intended use by the other party.

USING YOUR CMW GEOTECHNICAL REPORT

Geotechnical reporting relies on interpretation of facts and collected information using experience, professional judgement, and opinion. As such it generally has a level of uncertainty attached to it, which is often far less exact than other engineering design disciplines. The notes below provide general advice on what can be reasonably expected from your report and the inherent limitations of a geotechnical report.

Preparation of your report

Your geotechnical report has been written for your use on your project. The contents of your report may not meet the needs of others who may have different objectives or requirements. The report has been prepared using generally accepted Geotechnical Engineering and Engineering Geology practices and procedures. The opinions and conclusions reached in your report are made in accordance with these accepted principles. Specific items of geotechnical or geological importance are highlighted in the report.

In producing your report, we have relied on the information which is referenced or summarised in the report. If further information becomes available or the nature of your project changes, then the findings in this report may no longer be appropriate. In such cases the report must be reviewed, and any necessary changes must be made by us.

Your geotechnical report is based on your project's requirements

Your geotechnical report has been developed based on your specific project requirements and only applies to the site in this report. Project requirements could include the type of works being undertaken; project locality, size and configuration; the location of any structures on or around the site; the presence of underground utilities; proposed design methodology; the duration or design life of the works; and construction method and/or sequencing.

The information or advice in your geotechnical report should not be applied to any other project given the intrinsic differences between different projects and site locations. Similarly geotechnical information, data and conclusions from other sites and projects may not be relevant or appropriate for your project.

Interpretation of geotechnical data

Site investigations identify subsurface conditions at discrete locations. Additional geotechnical information (e.g. literature and external data source review, laboratory testing etc) are interpreted by Geologists or Engineers to provide an opinion about a site specific ground models, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist due to the variability of geological environments. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. Interpretation of factual data can be influenced by design and/or construction methods. Where these methods change review of the interpretation in the report may be required.

Subsurface conditions can change

Subsurface conditions are created by natural processes and then can be altered anthropically or over time. For example, groundwater levels can vary with time or activities adjacent to your site, fill may be placed on a site, or the consistency of near surface conditions might be susceptible to seasonal changes. The report is based on conditions which existed at the time of investigation. It is important to confirm whether conditions may have changed, particularly when large periods of time have elapsed since the investigations were performed.

Interpretation and use by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical report. To help avoid misinterpretations, it is important to retain the assistance of CMW to work with other project design professionals who are affected by the contents of your report. CMW staff can explain the report implications to design professionals and then review design plans and specifications to see that they have correctly incorporated the findings of this report.

Your report's recommendations require confirmation during construction

Your report is based on site conditions as revealed through selective point sampling. Engineering judgement is then applied to assess how indicative of actual conditions throughout an area the point sampling might be. Any assumptions made cannot be substantiated until construction is complete. For this reason, you should retain geotechnical services throughout the construction stage, to identify variances from previous assumption, conduct additional tests if required and recommend solutions to problems encountered on site.

A Geotechnical Engineer, who is fully familiar with the site and the background information, can assess whether the report's recommendations remain valid and whether changes should be considered as the project develops. An unfamiliar party using this report increases the risk that the report will be misinterpreted.

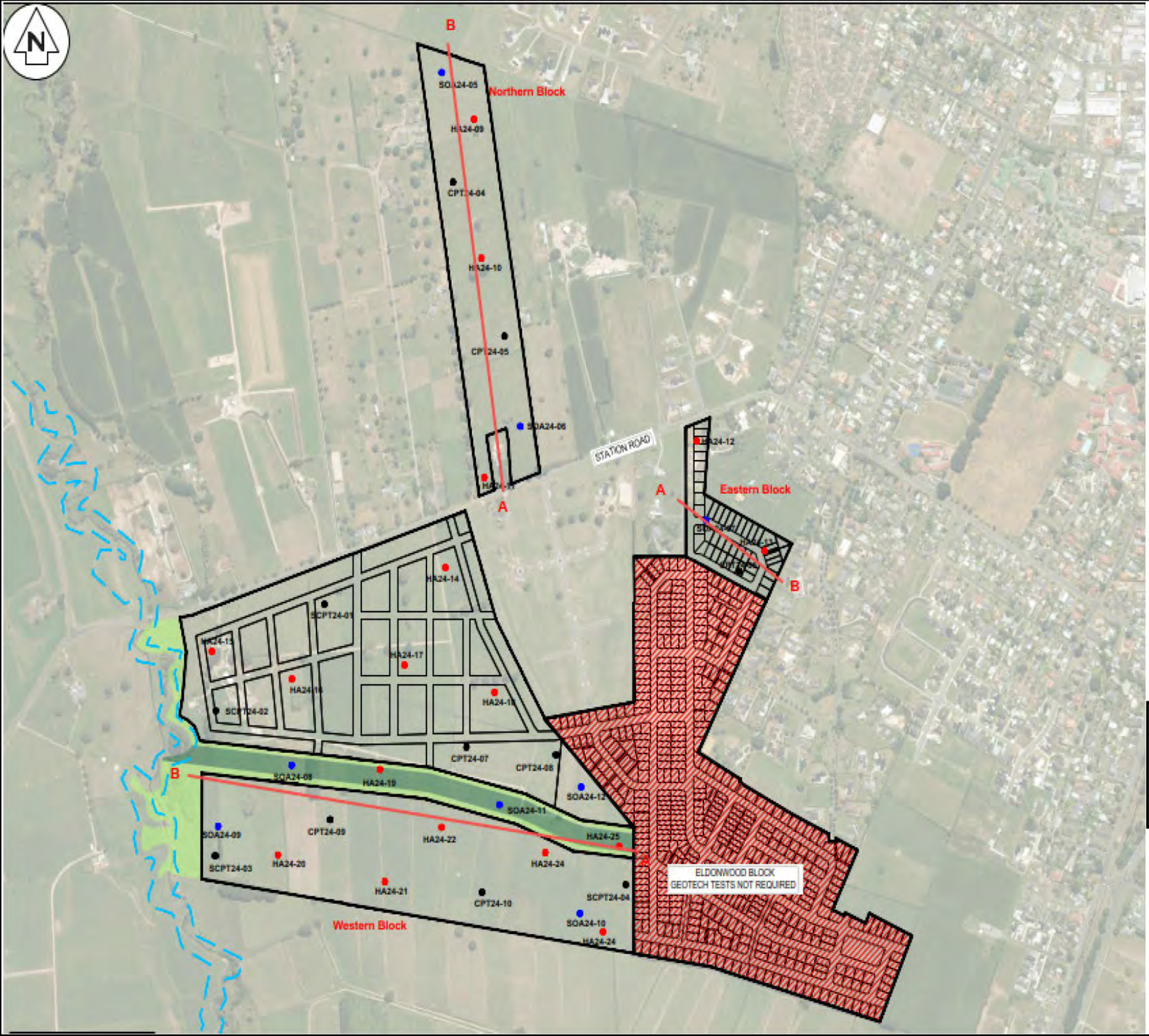
Environmental Matters Are Not Covered

Unless specifically discussed in your report environmental matters are not covered by a CMW Geotechnical Report. Environmental matters might include the level of contaminants present of the site covered by this report, potential uses or treatment of contaminated materials or the disposal of contaminated materials. These matters can be complex and are often governed by specific legislation.

The personnel, equipment, and techniques used to perform an environmental study can differ significantly from those used in this report. For that reason, our report does not provide environmental recommendations. Unanticipated subsurface environmental problems can have large consequences for your site. If you have not obtained your own environmental information about the project site, ask your CMW contact about how to find environmental risk-management guidance.

APPENDIX A: DRAWINGS

Title	Reference No.	Date	Revision
Site Investigation Plan	1	05/07/2024	0
Cross Section A – Eastern Block	2	05/07/2024	0
Cross Section B – Northern Block	3	05/07/2024	0
Cross Section C – Western Block	4	05/07/2024	0



Legend

- PR BOUNDARY
- PROP LOT BDY
- HAND AUGER
- SOAKAGE HOLE
- CPT

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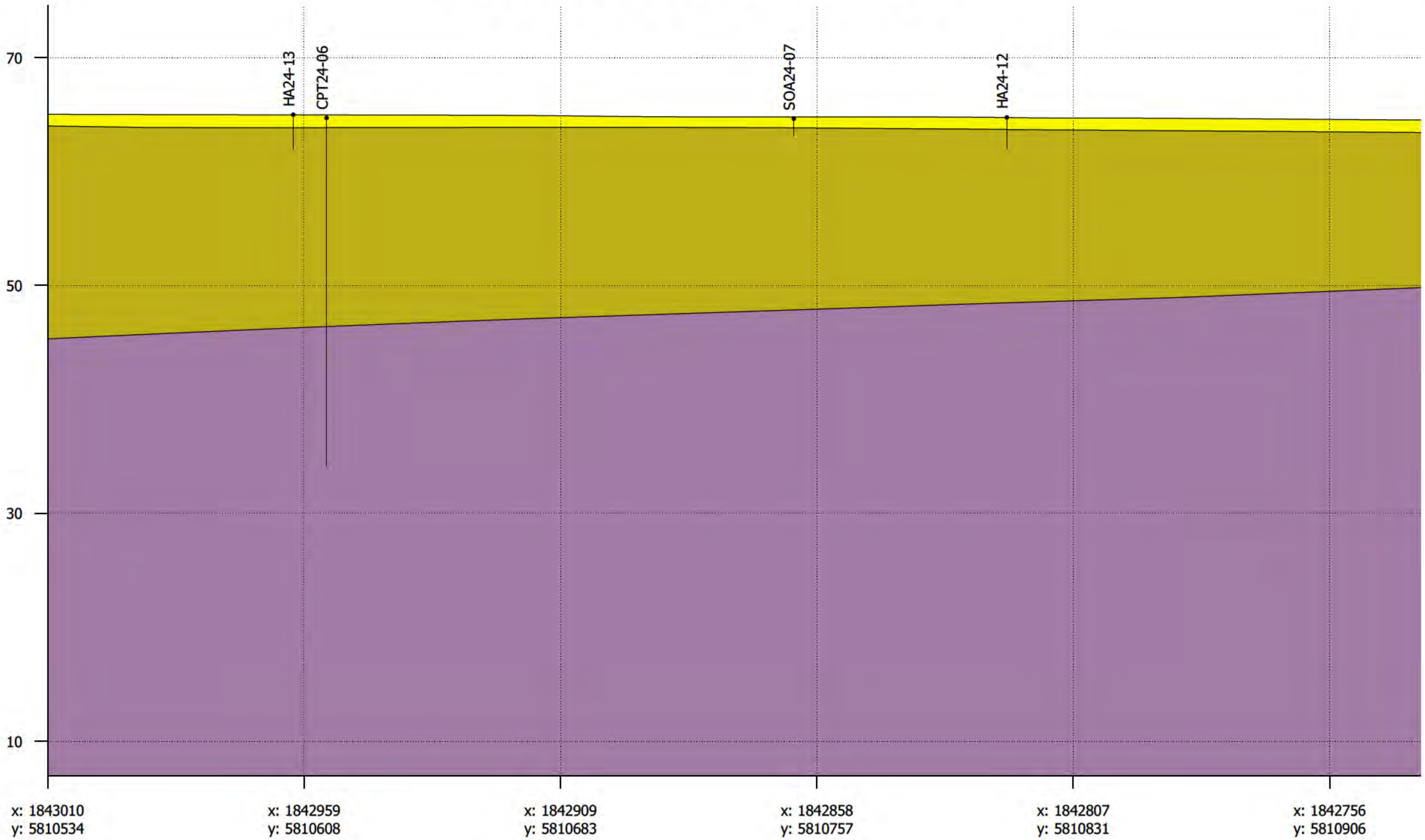
CLIENT:	MATAMATA DEVELOPMENT LTD
PROJECT:	STATION ROAD, MATAMATA
TITLE:	SITE INVESTIGATION PLAN

Cross Section - Eastern Block



Legend

GM

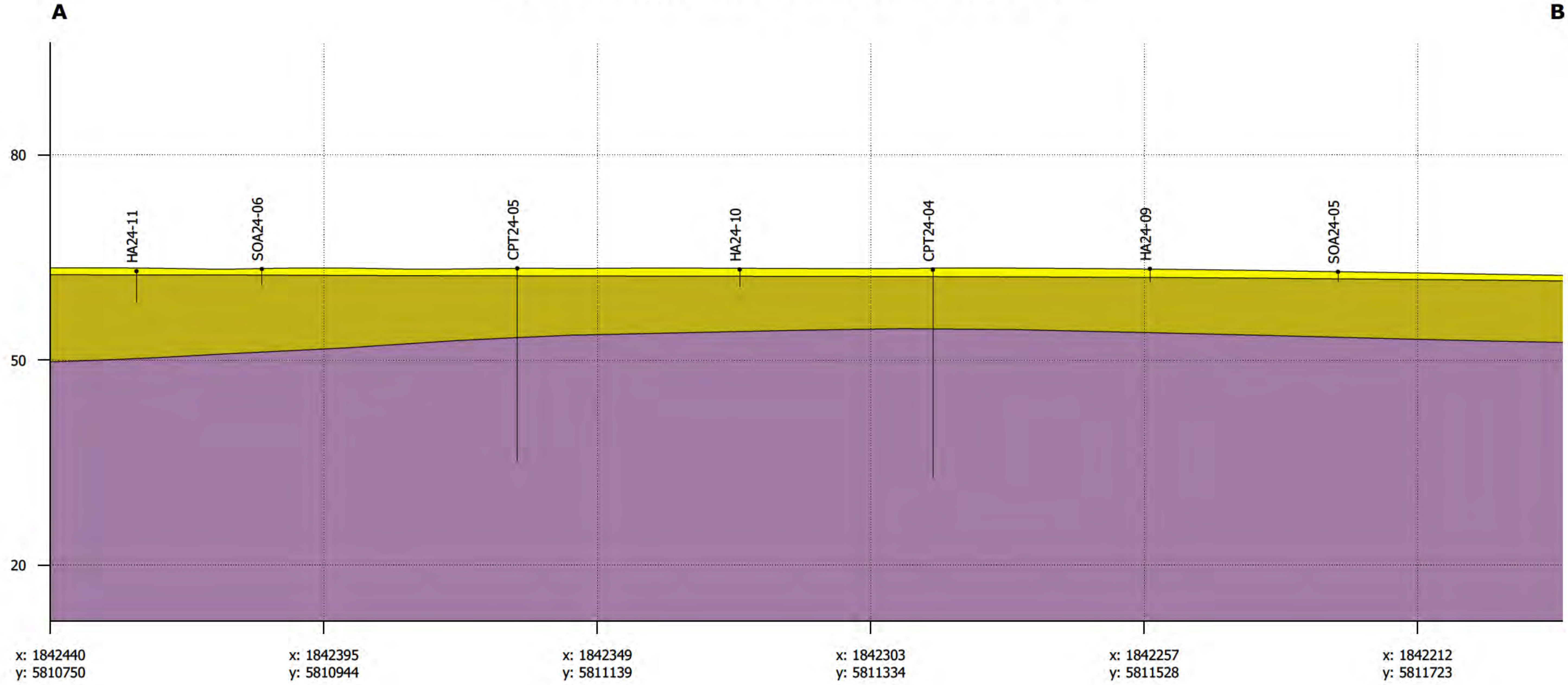
- Stiff to Very Stiff SILT (Hinuera Formation)
- Dense to Very Dense SAND with interbedded SILT (Hinuera Formation)
- Very Dense Silty SAND (Walton Subgroup)

Scale: 1:1,500

Vertical exaggeration: 4x

0m 50m

Cross Section - Northern Block



Legend

GM

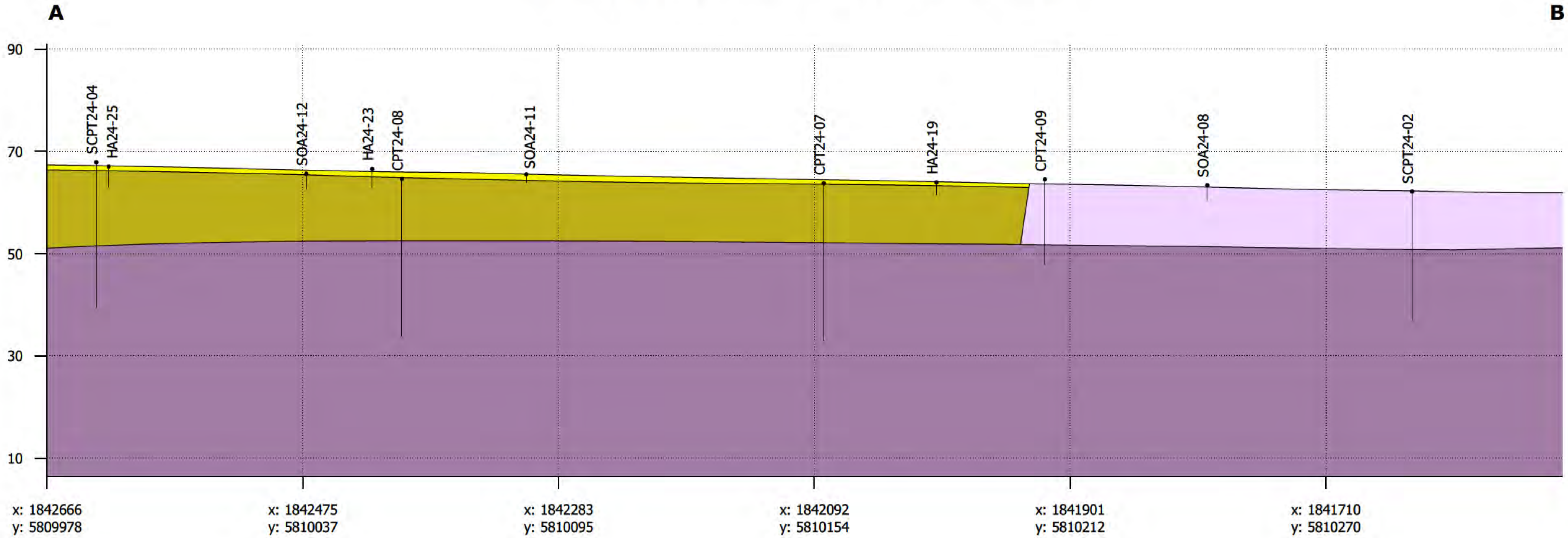
- Stiff to Very Stiff SILT (Hinuera Formation)
- Dense to Very Dense SAND with interbedded SILT (Hinuera Formation)
- Very Stiff to Hard SILT/CLAY (Walton Subgroup)
- Very Dense Silty SAND (Walton Subgroup)

Scale: 1:3,000

Vertical exaggeration: 5x

0m 200m

Cross Section - Western Block



Legend

GM

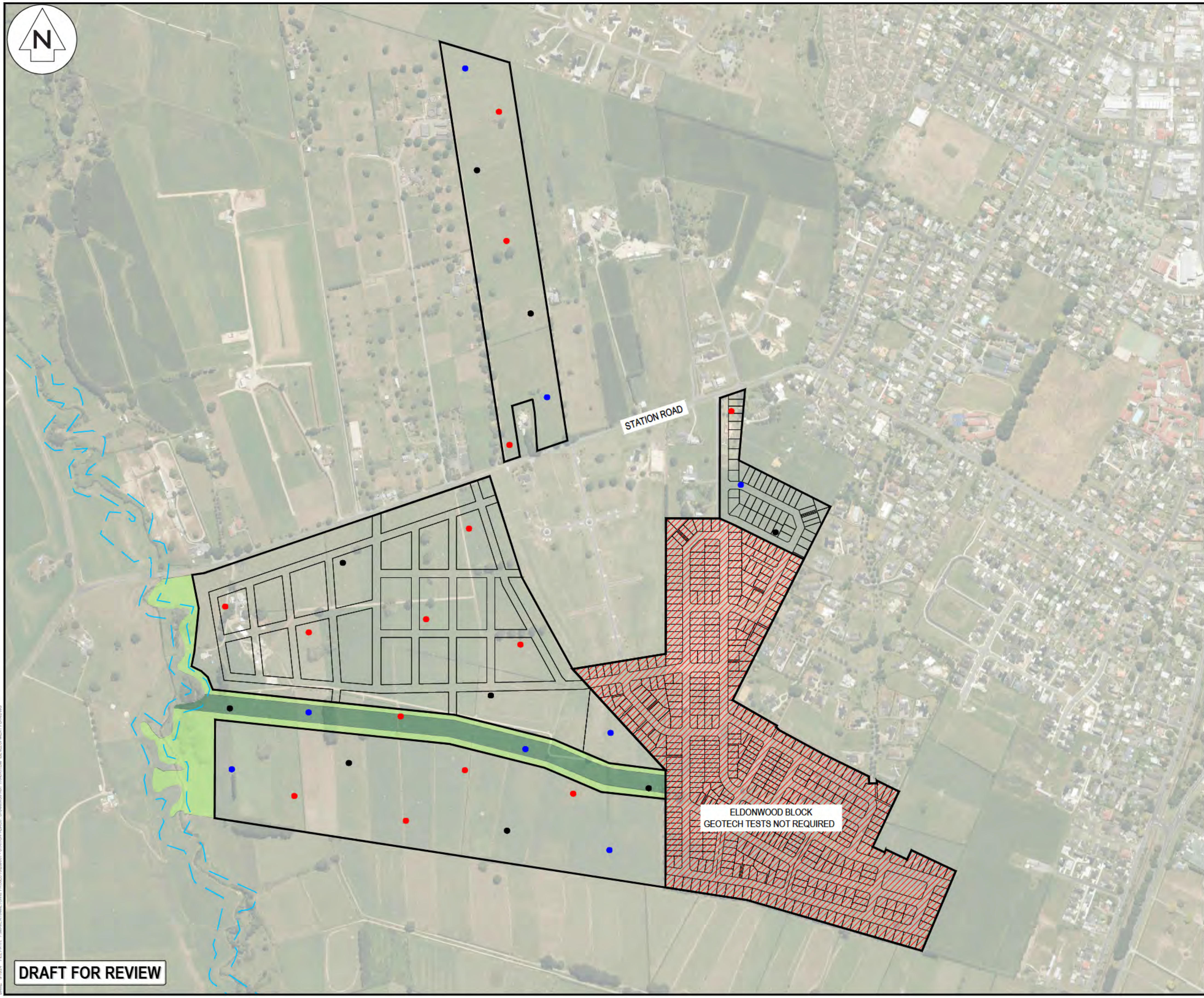
- Stiff to Very Stiff SILT (Hinuera Formation)
- Dense to Very Dense SAND with interbedded SILT (Hinuera Formation)
- Very Stiff to Hard SILT/CLAY (Walton Subgroup)
- Very Dense Silty SAND (Walton Subgroup)

Scale: 1:3,200

Vertical exaggeration: 4x

0m 200m

APPENDIX B: MAVEN ASSOCIATES DEVELOPMENT PLAN



Legend

- PR BOUNDARY
- PROP LOT BDY
- HAND AUGER
- SOAKAGE HOLE
- CPT

Ground investigation locations superseded. Refer to CMW Drawing 01.

Rev	Description	By	Date
B	DRAFT	MKS	05/2024
A	DRAFT	MKS	05/2024

	By	Date
Survey	LINZ	02/2024
Design	MKS	05/2024
Drawn	MKS	05/2024
Checked	DJM	05/2024

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

Project
ELDONWOOD MATAMATA FOR MATAMATA DEVELOPMENTS

Title
PROPOSED GEOTECH WORKS SCOPE

Project no.	289001
Scale	1:8000 @ A3
Cad file	DEVELOPMENT PLAN.DWG
Drawing no.	SCOPE — Rev B

DATE: 5/13/24 FILE PATH: F:\MAVEN HAMILTON\6 PROJECTS\289001 - STATION ROAD\7. DRAWING\FAST TRACK\TEMP\DEVELOPMENT PLAN.DWG

APPENDIX C: HAND AUGER BOREHOLE LOGS

HAND AUGER BOREHOLE LOG - HA24-09

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position: | Projection:
Datum: | Survey Source: Site Plan

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Samples & Insitu Tests
0.0–0.5	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M		
0.5–0.9	ML: SILT: grey mottled orange. Low plasticity. (Hinuera Formation)	M	H	0.6 Peak = UTP
0.9–1.2	SM: Silty fine to medium SAND: light brownish grey. Poorly graded, sub rounded. (Hinuera Formation)	M to W	D	
1.2–1.7	SP: Fine SAND: light grey streaked orange. Poorly graded, sub rounded. (Hinuera Formation)	M to W / W	MD to D	
1.7–1.75	ML: SILT: grey. Low plasticity. (Hinuera Formation)	W	St	
1.75–1.9	SW: Fine to coarse SAND: grey. Well graded, sub rounded. (Hinuera Formation)	S	D	

Borehole terminated at 1.9 m

Groundwater: 05-06-2024 (at 1.8 m)

Dynamic Cone Penetrometer (Blows/100mm):

Depth interval	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	2
0.3–0.4	3
0.4–0.5	4
0.5–0.6	5
0.6–0.7	4
0.7–0.8	5
0.8–0.9	6
0.9–1.0	10
1.0–1.1	9
1.1–1.2	13
1.2–1.3	5
1.3–1.4	9
1.4–1.5	13
1.5–1.6	13
1.6–1.7	12
1.7–1.8	9
1.8–1.9	8
1.9–2.0	8
2.0–2.1	7
2.1–2.2	9
2.2–2.3	8
2.3–2.4	5
2.4–2.5	8
2.5–2.6	6
2.6–2.7	7
2.7–2.8	8
2.8–2.9	7
2.9–3.0	6
3.0–3.1	6
3.1–3.2	5
3.2–3.3	4
3.3–3.4	4
3.4–3.5	7
3.5–3.6	12
3.6–3.7	10
3.7–3.8	10
3.8–3.9	13
3.9–4.0	5
4.0–4.1	4
4.1–4.2	4
4.2–4.3	10
4.3–4.4	12
4.4–4.5	10
4.5–4.6	10
4.6–4.7	14
4.7–4.8	10
4.8–4.9	12

Termination Reason: No retrieval.
Shear Vane No: 2087 | DCP No: 25
Remarks: Groundwater encountered at 1.8m.

HAND AUGER BOREHOLE LOG - HA24-10

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position: | Projection:
Datum: | Survey Source: Site Plan

Groundwater	Depth (m)	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
	0.0–0.4	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.4–0.7	ML: Fine to medium Sandy SILT: light grey streaked orange brown. Low plasticity. Sensitive. (Hinuera Formation)	M	St to VSt
	0.7–1.4	CH: Silty CLAY: with trace fine sand; light grey streaked dark orange brown. High plasticity. Moderately sensitive. (Hinuera Formation) *... at 1.00m, becoming light grey.*	M	St to VSt
	1.4–1.7	SW: Fine to coarse SAND: with minor silt; light grey. Well graded. (Hinuera Formation)	M	MD
05-06-2024 (at 2.0 m)	1.7–2.0	ML: SILT: with some fine to coarse sand; light grey. Low plasticity. Moderately sensitive. Dilatant. (Hinuera Formation)	W	VSt
	2.0–2.5	SW: Fine to coarse SAND: with some silt; grey. Well graded. (Hinuera Formation) *... at 2.20m, becoming greyish brown, poor retention.* *... at 2.40m, becoming brown fine to medium sand.*	S	MD to D
	2.5	Borehole terminated at 2.5 m		

Samples & Insitu Tests

Depth	Type & Results
0.6	Peak = 178kPa Residual = 39kPa
0.9	Peak = 192kPa Residual = 36kPa
1.3	Peak = 92kPa Residual = 44kPa
1.8	Peak = 111kPa Residual = 42kPa

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows
0.0–0.1	1
0.1–0.2	2
0.2–0.3	2
0.3–0.4	3
0.4–0.5	3
0.5–0.6	3
0.6–0.7	2
0.8–0.9	1
0.9–1.0	1
1.0–1.1	2
1.1–1.2	5
1.2–1.3	5
1.3–1.4	4
1.4–1.5	4
1.5–1.6	4
1.6–1.7	5
1.7–1.8	4
1.8–1.9	3
1.9–2.0	4
2.0–2.1	5
2.1–2.2	10
2.2–2.3	8
2.3–2.4	7
2.4–2.5	5
2.5–2.6	5
2.6–2.7	3
2.7–2.8	4
2.8–2.9	4
2.9–3.0	4
3.0–3.1	5
3.1–3.2	7
3.2–3.3	5
3.3–3.4	4
3.4–3.5	4
3.5–3.6	10
3.6–3.7	8
3.7–3.8	11
3.8–3.9	10
3.9–4.0	10
4.0–4.1	12
4.1–4.2	12
4.2–4.3	13
4.3–4.4	9
4.4–4.5	8
4.5–4.6	10
4.6–4.7	9
4.7–4.8	10
4.8–4.9	12

Termination Reason: Hole collapse/no retrieval
Shear Vane No: 2560 | DCP No: 34
Remarks: Groundwater encountered at 2.0m.

HAND AUGER BOREHOLE LOG - HA24-11

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 120kPa Residual = 25kPa
0.6	Peak = 78kPa Residual = 17kPa
0.9	Peak = 58kPa Residual = 19kPa

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Material Description	Moisture Condition	Consistency/ Relative Density
OL: Organic SILT: brown. No plasticity. (Topsoil)		
ML: SILT: orange brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	M	St to VSt
SM: Silty Fine to medium SAND: orange brown. Well graded. (Hinuera Formation)	M to W	
SW: Fine to coarse SAND: with trace fine gravel; greyish brown. Well graded. Gravel; subangular. (Hinuera Formation)	M	MD to D
... at 1.40m, thin lens of silty fine sand.		
... at 2.20m, becoming brownish grey.		
... from 2.50m to 2.60m, mottled black.		
... at 2.80m, becoming dark orange brown.		
... at 3.10m, becoming greyish brown with grey.		
... at 3.80m, with trace silt.	W	
... at 3.90m, becoming dark brown with brownish grey.		
... at 4.40m, becoming dark reddish brown, with some silt.	S	
Borehole terminated at 4.6 m		

Groundwater: 05-06-2024 (approx. 4.2 m)

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	0.0–0.1	0.1–0.2	0.2–0.3	0.3–0.4	0.4–0.5	0.5–0.6	0.6–0.7	0.7–0.8	0.8–0.9	0.9–1.0
0–1 m	2	3	1	3	2	1	2	1	1	2
1–2 m	3	3	4	3	5	6	4	3	2	6
2–3 m	6	5	6	8	7	8	7	7	5	5
3–4 m	8	8	8	9	9	9	13	15	14	15
4–5 m	20									

Termination Reason: Hole collapse
Shear Vane No: 2560 DCP No: 34
Remarks: Groundwater encountered at 4.2m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-12

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer site plan. Logged by: PM Checked by: DM Scale: 1:25 Sheet 1 of 1

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Position: Projection:
Datum: Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.1	OL: Organic SILT: with some medium gravel; dark brown. No plasticity. (Topsoil)	M	
				0.1–0.3	SW: Fine to coarse SAND: light brown. Well graded, sub angular. (Possible Fill)	M	MD
	0.4	Peak = 129kPa Residual = 26kPa		0.3–1.1	ML: SILT: with minor fine sand; brownish orange. Low plasticity. Sensitive. (Hinuera Formation)	M	VSt to H
	0.7	Peak = 167kPa Residual = 29kPa					
	1.0	Peak = UTP		1			
				1.1–1.7	SM: Silty fine to coarse SAND: light yellowish brown. Well graded, sub rounded. (Hinuera Formation)	M to W	MD
	1.8	Peak = 205kPa		1.7–1.8	ML: SILT: grey mottled orange. Low plasticity. (Hinuera Formation)	W	H
				1.8–2.7	SW: Fine to coarse SAND: light brown mottled grey and streaked dark red. Well graded, sub rounded. (Hinuera Formation)	W	L to MD
				2	... *at 2.10m, Becomes grey.*	W	
05-06-2024 (2.6 m)				2.6–2.7		S	
				2.7	Borehole terminated at 2.7 m		

Dynamic Cone Penetrometer (Blows/100mm), scale 5, 10, 15:

4, 7, 7, 6, 2, 2, 2, 2, 2, 2, 4, 5, 7, 5, 5, 3, 3, 3, 2, 3, 2, 5, 5, 5, 4, 3, 3, 4, 3, 4, 5, 5, 5, 6, 6, 8, 9, 9, 10, 12, 13, 13, 13, 10, 13, 10, 10, 9, 10

Termination Reason: Hole Collapse
Shear Vane No: 2087 DCP No: 25
Remarks: Groundwater encountered at 2.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-13

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Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer to site plan — Logged by: WD — Checked by: DM — Scale: 1:25 — Sheet 1 of 1

Position: — Projection: — Datum: — Survey Source: Site Plan

Depth (m)	Material Description	Moisture Condition	Consistency/Relative Density
0.0	OL: Organic SILT: brown. No plasticity. (Topsoil)	D to M	
0.25	ML: SILT: orange brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	D to M	VSt
	... at 0.60m, becoming light orange brown.		
0.9	SM: Silty Fine to medium SAND: with trace fine pumiceous gravel; light orange brown. Well graded. (Hinuera Formation)	D to M / M	MD
	... at 1.20m, becoming fine sand.		
1.4	CH: Silty CLAY: light grey. High plasticity. Moderately sensitive. (Hinuera Formation)	M	VSt
1.5	SM: Silty Fine SAND: grey. Poorly graded. (Hinuera Formation)	M	MD
1.7	SW: Fine to medium SAND: with some silt and minor fine gravel; brownish grey with grey. Well graded. Gravel; subangular. (Hinuera Formation)	M	MD
2.1	SW: Fine to coarse SAND: with some silt and trace fine gravel; grey. Well graded. Gravel; subangular. (Hinuera Formation)	M / W	MD
	... at 2.60m, poor retention.	S	
3.0	Borehole terminated at 3.0 m		

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 167kPa, Residual = 28kPa
0.6	Peak = 133kPa, Residual = 22kPa
0.9	Peak = 111kPa, Residual = 39kPa
1.4	Peak = 108kPa, Residual = 53kPa

Groundwater: 05-06-2024 (at approx. 2.6 m)

Dynamic Cone Penetrometer (Blows/100mm) (scale: 5, 10, 15)

2, 2, 2, 2, 1, 2, 2, 2, 3, 5, 7, 7, 4, 4, 4, 4, 4, 4, 3, 4, 6, 4, 3, 3, 4, 4, 4, 3, 3, 4, 4, 5, 4, 4, 6, 7, 4, 6, 5, 5, 6, 6, 7, 5, 7, 8, 7, 5, 9

Termination Reason: Hole collapse/no retrieval
Shear Vane No: 2560 — DCP No: 34
Remarks: Groundwater encountered at 2.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-14

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests – Depth	Samples & Insitu Tests – Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density
				0.0–0.1	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
				0.1–0.5	SM: Silty fine to medium SAND: light grey mottled dark orange. Poorly graded, rub rounded. (Hinuera Formation)	M	L to MD
				0.5–0.9	SM: Silty fine SAND: brownish orange mottled dark brown. Poorly graded, sub rounded. (Hinuera Formation)	M	MD
06-06-2024 (1.6 m)				0.9–1.7	SW: Fine to medium SAND: grey. Well graded, sub rounded. (Hinuera Formation) ... *at 1.50m, Becomes blueish grey.*	W (S from 1.6 m)	MD to D
				1.7	Borehole terminated at 1.7 m		

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows
0.0–0.1	1
0.1–0.2	3
0.2–0.3	2
0.3–0.4	4
0.4–0.5	7
0.5–0.6	5
0.6–0.7	3
0.7–0.8	3
0.8–0.9	3
0.9–1.0	4
1.0–1.1	4
1.1–1.2	5
1.2–1.3	10
1.3–1.4	11
1.4–1.5	11
1.5–1.6	8
1.6–1.7	3
1.7–1.8	3
1.8–1.9	3
1.9–2.0	4
2.0–2.1	9
2.1–2.2	8
2.2–2.3	8
2.3–2.4	9
2.4–2.5	8
2.5–2.6	6
2.6–2.7	5
2.7–2.8	2
2.8–2.9	2
2.9–3.0	5
3.0–3.1	8
3.1–3.2	8
3.2–3.3	7
3.3–3.4	7
3.4–3.5	10
3.5–3.6	11
3.6–3.7	10
3.7–3.8	9
3.8–3.9	10
3.9–4.0	10
4.0–4.1	12
4.1–4.2	11
4.2–4.3	9
4.3–4.4	12
4.4–4.5	10
4.5–4.6	10
4.6–4.7	11
4.7–4.8	9
4.8–4.9	13

Termination Reason: Hole Collapse
Shear Vane No:
DCP No: 34
Remarks: Groundwater encountered at 1.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-15

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 05/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
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Position:
Projection:
Datum:
Survey Source: Site Plan

Depth (m)	Samples & Insitu Tests: Type & Results	Material Description	Moisture Condition	Consistency/Relative Density
0.0–0.3		OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
0.3–1.1	0.4: Peak = 59kPa, Residual = 15kPa; 0.7: Peak = 59kPa, Residual = 15kPa; 1.0: Peak = 105kPa, Residual = 15kPa	ML: SILT: light brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation) ... *at 0.90m, Becoming a light greyish brown.*	M	St to VSt
1.1–2.4		SM: Silty fine SAND: light brown. Poorly graded, sub rounded. Dilatant. (Hinuera Formation) ... *at 1.40m, Becoming a light grey streaked yellow.*	M; W; M to W	MD
2.4–2.5		ML: SILT: grey streaked yellow. Low plasticity. Moderately sensitive. (Hinuera Formation)	M to W	VSt
2.5–3.0	2.5: Peak = 167kPa, Residual = 59kPa; 2.7: Peak = UTP; 3.0: Peak = UTP	ML: Clayey SILT: brown. Low plasticity. (Walton Subgroup)	M to W; M	H
		Borehole terminated at 3.0 m		

Dynamic Cone Penetrometer (Blows/100mm), 0.0–3.0 m in 100 mm increments:

Depth (m)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0
Blows	2	2	1	1	2	2	1	1	2	1	2	4	4	3	4	4	5	4	4	4	4	5	6	10	4	9	10	12	17	20

Termination Reason: Refusal on hard material.
Shear Vane No: 2087 DCP No: 25
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-16

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Great People | Practical Solutions

Position: | Projection: | Datum: | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/Relative Density	Dynamic Cone Penetrometer (Blows/100mm) 5 10 15
					OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M		
	0.3	Peak = 100kPa Residual = 23kPa			ML: SILT: orange brown. Low plasticity. Sensitive. (Walton Subgroup) ... at 0.40m, becoming light orange brown, with some clay.	M	VSt to H	
	0.6	Peak = 160kPa Residual = 30kPa			CH: Silty CLAY: light orange brown. High plasticity. Sensitive. (Walton Subgroup)	M	VSt to H	
	0.9	Peak = 123kPa Residual = 28kPa		1	... at 1.00m, becoming light orange grey.	M	VSt to H	
	1.3	Peak = UTP			ML: SILT: light orange grey. Low plasticity. (Walton Subgroup)	M	VSt to H	
					SM: Silty Fine SAND: light brownish grey. Poorly graded. (Walton Subgroup)	M	VSt to H	
	1.6	Peak = 150kPa Residual = 28kPa			CH: Silty CLAY: light brownish grey. High plasticity. Sensitive. (Walton Subgroup)	W	St to VSt	
	1.9	Peak = 85kPa Residual = 20kPa		2	... at 2.00m, becoming light grey, with trace fine sand. ... at 2.10m, becoming light brown grey. ... at 2.20m, becoming light greyish brown.	W	St to VSt	
	2.3	Peak = UTP			ML: SILT: with some clay; greyish brown. Low plasticity. (Walton Subgroup)	D to M	VSt to H	
	2.6	Peak = 175+			CH: Silty CLAY: greyish brown. High plasticity. Moderately sensitive. (Walton Subgroup)	M	VSt to H	
	2.9	Peak = 160kPa Residual = 43kPa		3		M to W	VSt to H	
	3.3	Peak = 158kPa Residual = 45kPa				M to W	VSt to H	
	3.6	Peak = 125kPa Residual = 33kPa				M to W	VSt to H	
	3.9	Peak = 125kPa Residual = 35kPa		4	... at 3.80m, becoming light orange brown.	M to W	VSt to H	
	4.3	Peak = 175+			ML: Clayey SILT: orange brown mottled black. Low plasticity. (Walton Subgroup)	M to W	VSt to H	
	4.6	Peak = 50kPa Residual = 25kPa			CH: Silty CLAY: light greyish brown. High plasticity. Insensitive to moderately sensitive. (Walton Subgroup)	M to W	St	
	4.9	Peak = 60kPa Residual = 50kPa		5		M to W	St	
					Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 3434 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-17

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position: | Projection: | Datum: | Survey Source: Site Plan

Groundwater	Sample Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.3	Peak = 63kPa Residual = 20kPa		0.2–1.1	ML: SILT: orange brown. Low plasticity. (Hinuera Formation)	M	St to VSt
	0.6	Peak = 108kPa Residual = 25kPa					
					... at 0.70m, with some clay.		
	0.9	Peak = 160kPa Residual = 35kPa					
					... at 1.00m, with trace fine sand.		
				1.1–3.0	SW: Fine to coarse SAND: minor fine gravel. orange brown. Well graded. Gravel; black, subangular. (Hinuera Formation)	M	D to VD
					... at 1.30m, becoming dark orange brown.		
					... at 1.40m, becoming orange brown with yellow grey.		
					... at 1.60m, becoming dark reddish brown, with some fine gravel; highly iron stained.		
					... at 2.00m, becoming brownish grey with grey.		
					... at 2.10m, becoming dark reddish brown.		
					... at 2.30m, becoming dark reddish dark brown, with trace medium gravel.		
06-06-2024 (2.6 m)						W	
					... at 2.70m, with some silt.	S	
	3.1	Peak = 158kPa Residual = 60kPa		3.0–3.8	ML: SILT: light grey. Low plasticity. Moderately sensitive. (Hinuera Formation)	S	VSt to H
	3.7	Peak = UTP					
				3.8	Borehole terminated at 3.8 m		

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	1
0.3–0.4	2
0.4–0.5	2
0.5–0.6	2
0.6–0.7	2
0.7–0.8	1
0.8–0.9	1
0.9–1.0	3
1.0–1.1	6
1.1–1.2	8
1.2–1.3	13
1.3–1.4	17
1.4–1.5	24
1.5–1.6	22

Termination Reason: No retrieval
Shear Vane No: 3434 DCP No: 34
Remarks: Groundwater encountered at 2.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-18

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan. Logged by: PM Checked by: DM Scale: 1:25 Sheet 1 of 1

Position: Projection:
Datum: Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.3	Peak = 83kPa Residual = 19kPa		0.2–0.5	ML: Sandy SILT: greyish brown. Low plasticity. Moderately sensitive. (Hinuera Formation)	M to W	St
	0.6	Peak = 97kPa Residual = 28kPa		0.5–0.8	ML: SILT: light grey streaked orange. Low plasticity. Moderately sensitive. (Hinuera Formation)	M to W	St
				0.8–1.4	SM: Silty fine SAND: light grey streaked yellow. Poorly graded, sub rounded. (Hinuera Formation)	M to W	MD to D
06-06-2024 (groundwater at 1.6 m)				1.4–1.7	SW: Fine to medium SAND: grey. Well graded, sub rounded. (Hinuera Formation)	W / S	D
				1.7	Borehole terminated at 1.7 m		

Dynamic Cone Penetrometer (Blows/100mm):

Depth interval	Blows
1	2
2	2
3	2
4	2
5	2
6	2
7	2
8	3
9	5
10	5
11	7
12	9
13	7
14	9
15	7
16	10
17	7
18	7
19	8
20	7
21	7
22	8
23	9
24	8
25	5
26	7
27	5
28	4
29	5
30	7
31	10
32	10
33	12
34	12
35	6
36	5
37	10
38	9
39	11
40	10
41	12
42	12
43	13
44	15
45	16
46	12
47	10
48	11
49	12

Termination Reason: Hole Collapse
Shear Vane No: 2560 DCP No: 34
Remarks: Groundwater encountered at 1.6m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-19

CMW Geosciences
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Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan

Logged by: WD   Checked by: DM   Scale: 1:25   Sheet 1 of 1

Position:
Projection:
Datum:
Survey Source: Site Plan

Columns: Groundwater | Samples & Insitu Tests (Depth, Type & Results) | RL (m) | Depth (m) | Graphic Log | Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit); Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)) | Moisture Condition | Consistency/Relative Density | Dynamic Cone Penetrometer (Blows/100mm)

Material Description	Moisture Condition	Consistency/Relative Density
OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M to W	
ML: SILT: with some clay; light brown. (Hinuera Formation)	M to W	
SM: Silty Fine SAND: light grey streaked light orange brown. Poorly graded. (Hinuera Formation)	M to W	MD
ML: Fine SAndy SILT: light grey streaked light orange brown. Low plasticity. (Hinuera Formation)	M to W	St
SM: Silty Fine SAND: light grey streaked light orange brown. Poorly graded. (Hinuera Formation)	M to W	MD
... *at 0.90m, light yellowish grey with brown grey.*	M to W	MD
... *at 1.20m, becoming light grey.*	W	MD
ML: SILT: light grey. Low plasticity. Dilatant. (Hinuera Formation)	W	VSt
SM: Silty Fine to medium SAND: light grey. Well graded. Pumiceous. (Hinuera Formation)	S	MD to D
... *at 2.00m, poor retention.*	S	MD to D
ML: SILT: with some fine sand; light grey. Low plasticity. (Hinuera Formation)	S	H
SM: Silty Fine SAND: light grey. Poorly graded. (Hinuera Formation)	S	D
Borehole terminated at 2.4 m		

Groundwater: 06-06-2024 (at approx. 1.6 m)

Dynamic Cone Penetrometer (Blows/100mm), axis ticks 5, 10, 15:

Depth (m)	Blows/100mm
0.0–0.1	1
0.1–0.2	2
0.2–0.3	3
0.3–0.4	3
0.4–0.5	4
0.5–0.6	4
0.6–0.7	3
0.7–0.8	3
0.8–0.9	5
0.9–1.0	4
1.0–1.1	6
1.1–1.2	5
1.2–1.3	4
1.3–1.4	5
1.4–1.5	6
1.5–1.6	6
1.6–1.7	5
1.7–1.8	6
1.8–1.9	5
1.9–2.0	5
2.0–2.1	8
2.1–2.2	7
2.2–2.3	14
2.3–2.4	9
2.4–2.5	13
2.5–2.6	12
2.6–2.7	6
2.7–2.8	4
2.8–2.9	5
2.9–3.0	5
3.0–3.1	6
3.1–3.2	8
3.2–3.3	8
3.3–3.4	14
3.4–3.5	17
3.5–3.6	14
3.6–3.7	13
3.7–3.8	12
3.8–3.9	14
3.9–4.0	17
4.0–4.1	14
4.1–4.2	13
4.2–4.3	17
4.3–4.4	16
4.4–4.5	20
4.5–4.6	17
4.6–4.7	17
4.7–4.8	16
4.8–4.9	15

Termination Reason: No retrieval
Shear Vane No: DCP No: 34
Remarks: Groundwater encountered at 1.6m.

HAND AUGER BOREHOLE LOG - HA24-20

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan — Logged by: PM — Checked by: DM — Scale: 1:25 — Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0 – 0.3	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
0.3 – 1.8	ML: SILT: light brown. Low plasticity. Sensitive. (Hinuera Formation) ... at 1.30m, Becomes light greyish brown.	M (to 1.3 m); M to W (below 1.3 m)	St to VSt
1.8 – 2.2	SM: Silty fine to coarse SAND: light greyish yellow. Well graded, sub rounded to sub angular. (Hinuera Formation)	M to W	MD
2.2 – 2.5	CH: Sandy CLAY: brown. High plasticity. (Walton Subgroup)	M	H
2.5 – 3.4	SW: Fiine to coarse SAND: with minor clay and trace fine gravel; Brownish orange mottled black and speckled grey. Well graded sub angular. (Walton Subgroup)	M	D

Borehole terminated at 3.4 m

Samples & Insitu Tests

Depth	Type & Results
0.4	Peak = 97kPa Residual = 19kPa
0.7	Peak = 89kPa Residual = 19kPa
1.0	Peak = 181kPa Residual = 28kPa
1.5	Peak = 97kPa Residual = 36kPa
2.3	Peak = UTP

Dynamic Cone Penetrometer (Blows/100mm)

Depth interval (m)	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	2
0.3–0.4	1
0.4–0.5	1
0.5–0.6	1
0.6–0.7	2
0.7–0.8	2
0.8–0.9	2
0.9–1.0	3
1.0–1.1	4
1.1–1.2	4
1.2–1.3	2
1.3–1.4	3
1.4–1.5	3
1.5–1.6	3
1.6–1.7	3
1.7–1.8	3
1.8–1.9	3
1.9–2.0	4
2.0–2.1	4
2.1–2.2	5
2.2–2.3	6
2.3–2.4	7
2.4–2.5	7
2.5–2.6	10
2.6–2.7	13
2.7–2.8	12
2.8–2.9	12
2.9–3.0	13
3.0–3.1	14
3.1–3.2	12
3.2–3.3	16
3.3–3.4	15
3.4–3.5	18
3.5–3.6	13
3.6–3.7	17
3.7–3.8	20

Termination Reason: Hard Material.
Shear Vane No: 2560 — DCP No: 34
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-21

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.7	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
06-06-2024 (▼ at 1.3 m)	0.8	Peak = 97kPa Residual = 14kPa		0.7–1.5	ML: Sandy SILT: light brownish grey. Low plasticity. Sensitive. (Hinuera Formation)	W	St
				1.5–1.8	SM: Silty fine SAND: light grey. Poorly graded, sub rounded. (Hinuera Formation)	S	MD
				1.8	Borehole terminated at 1.8 m		

Material Description — Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/ geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Dynamic Cone Penetrometer (Blows/100mm), from top down: 2, 2, 1, 1, 2, 1, 1, 1, 2, 2, 2, 2, 3, 3, 4, 3, 4, 4, 3, 4, 4, 4, 6, 6, 4, 3, 3, 2, 2, 3, 3, 4, 4, 6, 8, 7, 8, 3, 3, 3, 3, 5, 5, 5, 4, 3, 3, 3, 3

Termination Reason: Hole collapse
Shear Vane No: 2560 | DCP No: 34
Remarks: Groundwater encountered at 1.3m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-22

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater: 06-06-2024 (water level at approx. 1.3 m)

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 108kPa Residual = 20kPa
0.6	Peak = 55kPa Residual = 13kPa
0.9	Peak = 110kPa Residual = 20kPa
2.5	Peak = 65kPa Residual = 38kPa
3.3	Peak = 50kPa Residual = 40kPa
4.0	Peak = 60kPa Residual = 33kPa

Material Description
Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit)
Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0 – 0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
0.2 – 0.8	CH: Silty CLAY: brown. High plasticity. Sensitive. (Hinuera Formation)	M to W	St to VSt
0.8 – 1.5	ML: Clayey SILT: light brown. Low plasticity. Sensitive. (Hinuera Formation) ... *at 1.00m, becoming light grey streaked orange brown.*	W	St to VSt
1.5 – 2.3	SM: Silty Fine SAND: light grey. Poorly graded. (Hinuera Formation) ... *at 1.60m, poor retention.*	S	MD to D
2.3 – 2.6	ML: SILT: with some organic silt; light grey with greyish brown. Low plasticity. Insensitive. Dilatant. (Hinuera Formation)	S	St
2.6 – 3.0	SM: Silty Fine SAND: light grey. Poorly graded. (Hinuera Formation) ... *at 2.60m, poor retention.* ... *at 2.70m, with trace fine sand.*	S	MD to D
3.0 – 4.0	OL: Organic SILT: with some silt; dark greyish brown with light grey. Low plasticity. Insensitive. (Hinuera Formation)	S	F to St
4.0 – 4.3	SM: Silty Fine to medium SAND: dark grey. Well graded. (Hinuera Formation)	S	D

Borehole terminated at 4.3 m

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows per 100 mm
0.0 – 1.0	1, 3, 1, 2, 1, 2, 1, 1, 2, 2
1.0 – 2.0	6, 5, 8, 8, 9, 6, 12, 16, 15, 6
2.0 – 3.0	4, 5, 7, 8, 16, 11, 8, 9, 8, 5
3.0 – 4.0	8, 6, 7, 7, 10, 10, 8, 11, 12, 11
4.0 – 4.6	10, 11, 10, 13, 17, 20

Termination Reason: No retrieval
Shear Vane No: 3434 | DCP No: 34
Remarks: Groundwater encountered at 1.3m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-23

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 06/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/ geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density
				0.0	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.4	Peak = 153kPa Residual = 33kPa			ML: SILT: light greyish brown. Low plasticity. Sensitive. (Hinuera Formation)	M	St to VSt
	0.7	Peak = 89kPa Residual = 19kPa					
	1.0	Peak = 181kPa Residual = 28kPa		1	ML: Sandy SILT: light grey mottled black and streaked yellow. Low plasticity. Sensitive. (Hinuera Formation)	M	VSt
					SW: Fine to coarse SAND: brown. Well graded, sub rounded. (Hinuera Formation)	M	L to MD
					SM: Silty fine SAND: light brownish grey. Poorly graded, sub rounded. (Hinuera Formation)	W	MD
				2	... from 2.00m to 2.05m, Silt.		
					... from 2.80m to 2.90m, Silt		
				3			
06-06-2024 ▼					SW: Fine to coarse SAND : light brown. Well graded, sub rounded. (Hinuera Formation)	S	
					Borehole terminated at 3.6 m		
				4			
				5			

Dynamic Cone Penetrometer (Blows/100mm) (scale: 5, 10, 15):

2, 2, 2, 2, 1, 1, 1, 1, 2, 2, 2, 6, 4, 4, 2, 3, 2, 3, 2, 3, 4, 4, 4, 5, 4, 5, 5, 5, 5, 4, 5, 4, 5, 5, 6, 6, 5, 6, 6, 5, 6, 6, 7, 6, 6, 5, 7, 6, 6

Termination Reason: No Retrieval.
Shear Vane No: 2560 | DCP No: 34
Remarks: Groundwater encountered at 3.5m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-24

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 04/06/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

CMW Geosciences
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Position: | Projection: | Datum: | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.3	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.4	Peak = 74kPa Residual = 18kPa		0.3–0.5	ML: SILT: brown. Low plasticity. Moderately sensitive. (Hinuera Formation)	M	St
	0.6	Peak = UTP		0.5–1.5	ML: SILT: light brown streaked orange. Low plasticity. Sensitive. (Hinuera Formation)	M; M to W	VSt to H
	1.0	Peak = 133kPa Residual = 18kPa					
	1.2	Peak = 166kPa Residual = 33kPa			... at 1.10m, Becoming grey mottled orange.		
				1.5–1.7	SP: Fine SAND: with some silt; grey mottled orange. Poorly graded, sub rounded. (Hinuera Formation)	W	L
	1.8	Peak = 178kPa Residual = 33kPa		1.7–1.8	ML: SILT: light grey. Low plasticity. Sensitive. (Hinuera Formation)	W	VSt
				1.8–2.8	SM: Silty fine to medium SAND: grey. Poorly graded, sub rounded. (Hinuera Formation)	W	L to MD
04-06-2024 (at 3.3 m)				2.8–3.6	SW: Fine to medium SAND: with minor silt; grey. Well graded, sub rounded. (Hinuera Formation)	W to S; S	MD
				3.6	Borehole terminated at 3.6 m		

Dynamic Cone Penetrometer (Blows/100mm), 0.0–5.0 m depth:
2, 1, 1, 1, 2, 2, 1, 1, 2, 2, 2, 3, 3, 2, 4, 2, 2, 3, 2, 2, 4, 3, 2, 2, 4, 4, 4, 3, 4, 5, 5, 5, 5, 5, 5, 6, 6, 6, 6, 3, 7, 6, 8, 7, 8, 7, 7, 8, 8

Termination Reason: Hole Collapse.
Shear Vane No: 2955 | DCP No: 34
Remarks: Groundwater encountered at 3.3m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - HA24-25

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 04/06/2024

CMW Geosciences
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Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Position: | Projection: | Datum: | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.3	Peak = 109kPa Residual = 25kPa		0.2–0.8	ML: Clayey SILT: orange brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	M	VSt
					... at 0.50m, becoming light orange brown.		
	0.6	Peak = 109kPa Residual = 31kPa			... at 0.70m, with some fine to coarse sand.		
				0.8–4.0	SW: Fine to coarse SAND: with minor fine gravel; brownish grey. Well graded. Gravel; subangular, pumiceous and rhyolitic. (Hinuera Formation)	M	MD to D
					... at 1.80m, becoming light greyish brown.		
					... at 2.20m, becoming orange brown with trace silt.		
					... from 2.40m to 2.45m, thin band of grey silty fine sand.		
					... at 2.50m, becoming greyish brown.		
					... from 3.20m to 3.40m, becoming grey with greyish brown.	M to W (≈3.5m)	
04-06-2024 ▼ (≈3.8m)						W	
					... at 3.80m, becoming medium to coarse; grey with brownish grey.	S	
				4.0	Borehole terminated at 4.0 m		

Dynamic Cone Penetrometer (Blows/100mm), from top: 2, 3, 1, 1, 2, 1, 1, 2, 3, 6, 6, 6, 6, 5, 5, 6, 5, 4, 5, 5, 7, 7, 5, 5, 6, 7, 8, 5, 4, 5, 6, 7, 6, 6, 5, 7, 5, 5, 4, 4, 7, 5, 7, 5, 5, 5, 6, 5, 7

Termination Reason: Hole collapse/no retrieval
Shear Vane No: 2993 DCP No: 34
Remarks: Groundwater encountered at 3.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-05

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024

CMW Geosciences
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Borehole Location: Refer to site plan | Logged by: NK | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit)	Moisture Condition	Consistency/ Relative Density
				0.0–0.3		OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	M	
				0.3–0.7		SM: Silty fine SAND: light grey. Poorly graded. (Hinuera Formation)	M	MD
				0.7–1.0		SM: Silty fine to coarse SAND: with minor fine gravel; brownish grey. Well graded, subrounded. (Hinuera Formation) *... at 0.90m, thin band of iron staining fine sand.*	M	MD
				1.0–1.2		ML: SILT: light grey. Low plasticity. Dilatant. (Hinuera Formation)	M	F
				1.2–1.4		SM: Silty fine SAND: light grey. Poorly graded. Dilatant. (Hinuera Formation)	M to W	MD
				1.4		Borehole terminated at 1.4 m		

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows/100mm
0.2–0.3	6
0.3–0.4	7
0.4–0.5	5
0.5–0.6	5
0.6–0.7	5
0.7–0.8	4
0.8–0.9	3
0.9–1.0	5
1.0–1.1	3
1.1–1.2	3
1.2–1.3	3
1.3–1.4	3
1.4–1.5	4
1.5–1.6	5
1.6–1.7	4
1.7–1.8	5
1.8–1.9	3
1.9–2.0	3
2.0–2.1	6
2.1–2.2	6
2.2–2.3	3
2.3–2.4	4
2.4–2.5	4
2.5–2.6	3
2.6–2.7	5
2.7–2.8	5
2.8–2.9	5

Termination Reason: Target Depth Reached
Shear Vane No: | DCP No: 34
Remarks: Groundwater encountered at 1.4m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-06

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024

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Borehole Location: Refer to site plan | Logged by: NK | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Position: | Projection: | Datum: | Survey Source: Site Plan

Groundwater	Samples & Insitu Tests – Depth	Samples & Insitu Tests – Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density
						OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	M	
	0.3	Peak = 121kPa Residual = 41kPa				ML: SILT: brown. Low plasticity. Moderately sensitive to sensitive. (Hinuera Formation)	M	VSt
	0.6	Peak = 148kPa Residual = 36kPa						
				1		SM: Silty fine to coarse SAND: with minor fine gravel; brown. Well graded, subrounded. (Hinuera Formation)	M	MD
						SM: Silty fine SAND: light grey. Poorly graded. Dilatant. (Hinuera Formation)	M to W	L to MD
	1.8	Peak = UTP				ML: SILT: light grey. Low plasticity. (Hinuera Formation)	M	H
				2		SW: Fine to coarse SAND: brown. Well graded, subrounded. (Hinuera Formation)	M / S	MD
						Borehole terminated at 2.3 m		
				3				
				4				
				5				

Dynamic Cone Penetrometer (Blows/100mm) (scale 5, 10, 15): 2, 2, 1, 1, 1, 1, 1, 1, 3, 3, 3, 3, 4, 3, 3, 4, 2, 4, 4, 6, 6, 5, 4, 6, 4, 3, 2, 4, 4

Termination Reason: Target Depth Reached
Shear Vane No: 2955 DCP No: 34
Remarks: Groundwater encountered at 2.2m.

HAND AUGER BOREHOLE LOG - SOA24-07

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024
Borehole Location: Refer to site plan | Logged by: NK | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	M	
	0.3	Peak = 193kPa Residual = 44kPa		0.2–0.6	ML: SILT: light brown mottled orange. Low plasticity. (Hinuera Formation)	M	VSt
				0.6–0.8	SM: Silty fine to medium SAND: light grey mottled orange. Well graded, subrounded. (Hinuera Formation)	M	L to MD
				0.8–1.5	SW: Fine to coarse SAND: with minor fine pumice gravel; light grey. Well graded, subrounded. (Hinuera Formation)	M; W to S	MD
				1.5	Borehole terminated at 1.5 m		

Dynamic Cone Penetrometer (Blows/100mm), from surface at 0.1 m intervals:

Depth interval	Blows
0.0–0.1	1
0.1–0.2	1
0.2–0.3	1
0.3–0.4	2
0.4–0.5	2
0.5–0.6	2
0.6–0.7	2
0.7–0.8	3
0.8–0.9	3
0.9–1.0	4
1.0–1.1	3
1.1–1.2	3
1.2–1.3	3
1.3–1.4	3
1.4–1.5	4
1.5–1.6	3
1.6–1.7	4
1.7–1.8	4
1.8–1.9	5
1.9–2.0	3
2.0–2.1	3
2.1–2.2	4
2.2–2.3	13
2.3–2.4	8
2.4–2.5	7
2.5–2.6	9
2.6–2.7	6
2.7–2.8	8
2.8–2.9	9

Termination Reason: Target Depth Reached
Shear Vane No: 2955 DCP No: 34
Remarks: Groundwater encountered at 1.4m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-08

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
				0.0–0.5	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M		
	0.4	Peak = 89kPa Residual = 30kPa		0.5–0.8	ML: SILT: with some clay; light brown. Low plasticity. Moderately sensitive. (Walton Subgroup)	M	St	
	0.6	Peak = 44kPa Residual = 21kPa		0.8–1.9	ML: SILT: with some fine to medium sand; greyish brown. Low plasticity. Moderately sensitive. (Walton Subgroup)	M to W	F	
	1.0	Peak = 133kPa Residual = 44kPa					VSt	
	1.5	Peak = 119kPa Residual = 44kPa					VSt	
	2.0	Peak = UTP		1.9–3.0	CH: Silty CLAY: dark brown. High plasticity. (Walton Subgroup) *... from 1.90m to 2.00m, Becomes mottled black.*	M	H	
	2.5	Peak = UTP						
	3.0	Peak = 208kPa		3.0	Borehole terminated at 3.0 m			

Termination Reason: Target Depth Reached
Shear Vane No: 2993 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-09

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024
Borehole Location: Refer to site plan | Logged by: NK | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position: | Projection: | Datum: | Survey Source: Site Plan

Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
0.0–0.2	OL: Organic SILT: dark brown. Low plasticity. (Topsoil)	M	
0.2–0.8	ML: SILT: brown. Low plasticity. (Walton Subgroup)	M	VSt to St
0.8–1.2	ML: Sandy SILT: with trace fine pumice gravel. Low plasticity. (Walton Subgroup)	M	VSt to H
1.2–1.6	SM: Silty fine to coarse SAND: with trace fine gravel; reddish brown. Well graded, subrounded. (Walton Subgroup)	M	
1.6–1.9	ML: Sandy SILT: light yellow mottled orange. Low plasticity. (Walton Subgroup)	M	
1.9–2.6	ML: SILT: light grey. Low plasticity. (Walton Subgroup)	M	
2.6–3.0	CH: Silty CLAY: brown. High plasticity. (Walton Subgroup)	M	
3.0	Borehole terminated at 3.0 m		

Samples & Insitu Tests

Depth	Type & Results
0.3	Peak = 89kPa Residual = 21kPa
0.6	Peak = 160kPa Residual = 30kPa
0.9	Peak = 121kPa Residual = 24kPa
1.2	Peak = UTP
1.6	Peak = 148kPa Residual = 33kPa
2.0	Peak = 136kPa Residual = 24kPa
2.3	Peak = 178kPa Residual = 24kPa
2.6	Peak = UTP
3.0	Peak = 207kPa

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows
0.0–0.1	2
0.1–0.2	1
0.2–0.3	1
0.3–0.4	1
0.4–0.5	1
0.5–0.6	1
0.6–0.7	1
0.8–0.9	1
0.9–1.0	1
1.0–1.1	3
1.1–1.2	6
1.2–1.3	13
1.3–1.4	18
1.4–1.5	20

Termination Reason: Target Depth Reached
Shear Vane No: 2955 | DCP No: 34
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-10

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 04/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Sample Depth	Type & Results	RL (m)	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
				0.0 – 0.3	OL: Organic SILT: dark brown with dark orange brown. No plasticity. (Topsoil)	M	
	0.3	Peak = 101kPa Residual = 15kPa		0.3 – 0.5	OH: Organic CLAY: dark brown. High plasticity. Sensitive. (Hinuera Formation)	M	St to VSt
	0.6	Peak = 89kPa Residual = 21kPa		0.5 – 1.3	CH: Silty CLAY: dark brown. High plasticity. Sensitive. (Hinuera Formation) ... at 0.80m, becoming yellowish grey.	M	St to VSt
	1.0	Peak = 127kPa Residual = 30kPa			... from 1.20m to 1.25m, lens of silty fine sand. ... from 1.25m to 1.30m, thin lens of silt.	M	St to VSt
				1.3 – 1.6	SM: Silty Fine to medium SAND: light grey streaked orange brown. Well graded. (Hinuera Formation)	M	MD to D
04-06-2024 (groundwater at 1.8 m)				1.6 – 1.8	SW: Fine to coarse SAND: with some silt and minor fine pumiceous gravel; light grey. Well graded. (Hinuera Formation) ... at 1.70m, becoming grey.	W	MD to D
				1.8	Borehole terminated at 1.8 m		

Dynamic Cone Penetrometer (Blows/100mm):

Depth interval (m)	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	2
0.3–0.4	
0.4–0.5	1
0.5–0.6	1
0.6–0.7	
0.7–0.8	1
0.8–0.9	1
0.9–1.0	3
1.0–1.1	5
1.1–1.2	4
1.2–1.3	4
1.3–1.4	4
1.4–1.5	5
1.5–1.6	8
1.6–1.7	4
1.7–1.8	6
1.8–1.9	5
1.9–2.0	6
2.0–2.1	3
2.1–2.2	5
2.2–2.3	3
2.3–2.4	3
2.4–2.5	3
2.5–2.6	5
2.6–2.7	5
2.7–2.8	4
2.8–2.9	5

Termination Reason: Target Depth Reached
Shear Vane No: 2993 DCP No: 34
Remarks: Groundwater encountered at 1.8m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-11

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 04/06/2024
Borehole Location: Refer to site plan | Logged by: WD | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Depth (m)	Material Description	Moisture Condition	Consistency/ Relative Density
	0.0–0.4	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.4–1.2	CH: Silty CLAY: brown. High plasticity. (Hinuera Formation) *... at 0.60m, becoming light brownish grey.* *... at 0.70m, becoming light grey streaked light orange brown.*	M	St
04-06-2024 (1.4 m)	1.2–1.6	SM: Silty Fine SAND: light grey. Poorly graded. Pumiceous. (Hinuera Formation) *... from 1.20m to 1.30m, becoming fine to coarse with trace fine pumiceous gravel.*	W / S	MD to D
	1.6	Borehole terminated at 1.6 m		

Samples & Insitu Tests (Depth; Type & Results): none recorded. RL (m): none recorded.

Dynamic Cone Penetrometer (Blows/100mm):

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

Termination Reason: Target Depth Reached
Shear Vane No: DCP No: 34
Remarks: Groundwater encountered at 1.4m.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

HAND AUGER BOREHOLE LOG - SOA24-12

Client: Maven Associates Ltd
Project: Station Road, Matamata
Site Location: 127-247A Station Road, Matamata, 3400
Project No.: HAM2023-0124
Date: 31/05/2024
Borehole Location: Refer to site plan | Logged by: PM | Checked by: DM | Scale: 1:25 | Sheet 1 of 1

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Position:
Projection:
Datum:
Survey Source: Site Plan

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit); Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density
				0.0–0.2	OL: Organic SILT: dark brown. No plasticity. (Topsoil)	M	
	0.3	Peak = 104kPa Residual = 30kPa		0.2–0.7	ML: SILT: brown. Low plasticity. Moderately sensitive. (Hinuera Formation)	M	St to VSt
	0.6	Peak = 74kPa Residual = 44kPa					
				0.7–3.0	SW: Fine to coarse SAND: light brown. Well graded, sub rounded. (Hinuera Formation)	M	VL; MD to D
				2.5	... *at 2.50m, Becoming light grey.*	W	
				3.0	Borehole terminated at 3.0 m		

Dynamic Cone Penetrometer (Blows/100mm)

Depth (m)	Blows
0.0–0.1	2
0.1–0.2	2
0.2–0.3	2
0.3–0.4	2
0.4–0.5	2
0.5–0.6	2
0.6–0.7	2
0.7–0.8	1
0.8–0.9	3
0.9–1.0	6
1.0–1.1	8
1.1–1.2	8
1.2–1.3	10
1.3–1.4	8
1.4–1.5	8
1.5–1.6	8
1.6–1.7	8
1.7–1.8	6
1.8–1.9	6
1.9–2.0	8
2.0–2.1	10
2.1–2.2	8
2.2–2.3	11
2.3–2.4	8
2.4–2.5	6
2.5–2.6	6
2.6–2.7	8
2.7–2.8	7

Termination Reason: Target Depth Reached
Shear Vane No: 2993 DCP No: 34
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 4 - April 2023.

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APPENDIX D: IN-SITU PERMEABILITY TESTING RESULTS

CMW Geosciences	CLIENT:	DESIGNER:	NK
	PROJECT: 124 Station Road, Matamata	CHECKED:	DM
		REVISION:	0
	TITLE: HAS24-05 Falling Head Permeability Test	DATE:	10/06/2024
		PROJECT:	HAM2023-0124

Specifications - Open-Ended Tube

Length L_1: 1.4 m

Diameter: 90 mm

Non-Perm L_2: 0.5 m

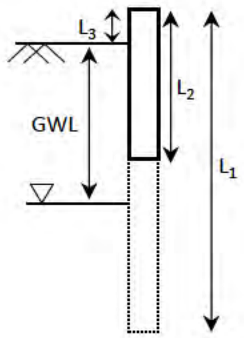
Above Gnd L_3: 0 m

Ground Conditions

GWL: 1.4 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h/k_v}$



Bottom of Test Hole: 1.40 m BGL

Hydraulic Conductivity (k)

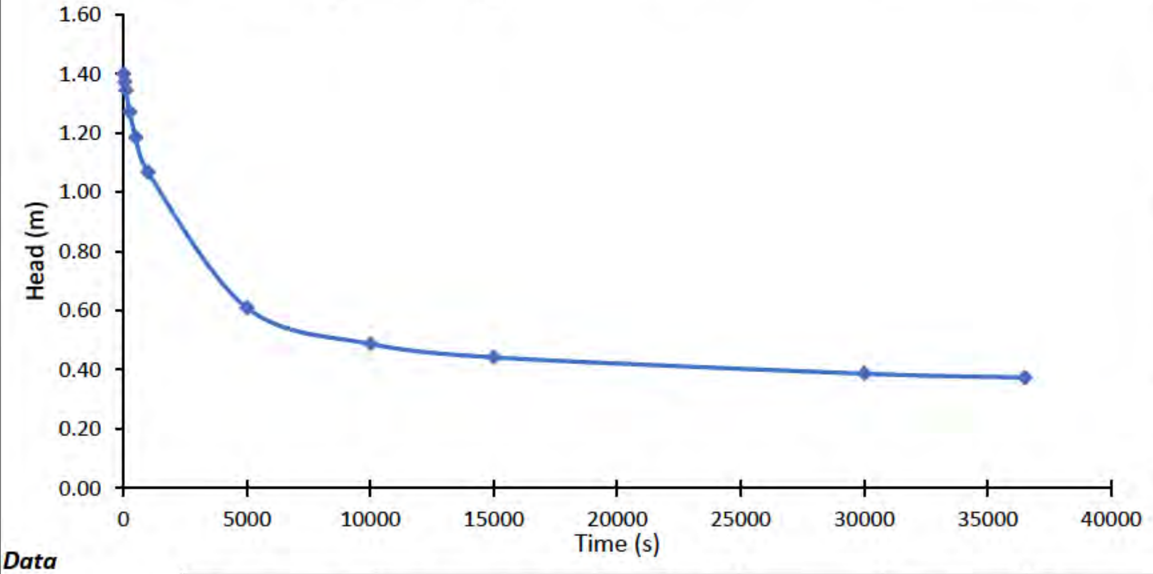
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(\log\frac{h_1}{h_2} - \log\frac{2h_1+d}{2h_2+d}\right)\cdot\frac{(h_1+h_2)}{2(t_2-t_1)} =$$ 3.58E-06 ms^{-1} = 0.31 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$ 6.54E-07 ms^{-1} = 0.06 m/day



STRATIGRAPHIC LOG
Silt
Sand
Silt
Sand
EOH @ 1.4m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	1.400				
50	0.027	1.373	0.900		1.32E-06	7.40E-06
100	0.056	1.344	0.900		1.42E-06	7.97E-06
250	0.129	1.271	0.900		1.26E-06	7.04E-06
500	0.216	1.184	0.900		9.56E-07	5.35E-06
1000	0.333	1.067	0.900		7.05E-07	3.93E-06
5000	0.791	0.609	0.838		4.95E-07	2.72E-06
10000	0.913	0.487	0.548		2.07E-07	8.13E-07
15000	0.958	0.442	0.465		9.99E-08	3.49E-07
30000	1.013	0.387	0.414		4.83E-08	1.57E-07
36510	1.026	0.374	0.380		3.07E-08	9.39E-08

CMW Geosciences	CLIENT:	DESIGNER: NK
	PROJECT: **124 Station Road, Matamata**	CHECKED: DM
		REVISION: 0
	TITLE: **HAS24-06 Falling Head Permeability Test**	DATE: 10/06/2024
		PROJECT: HAM2023-0124

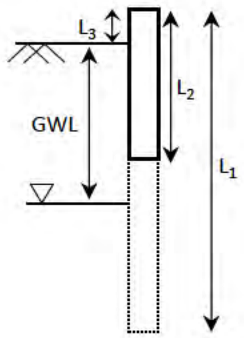
Specifications - Open-Ended Tube

Length L_1: 2.3 m
Diameter: 90 mm
Non-Perm L_2: 0 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 2.2 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h/k_v}$

Bottom of Test Hole: 2.30 m BGL



Hydraulic Conductivity (k)

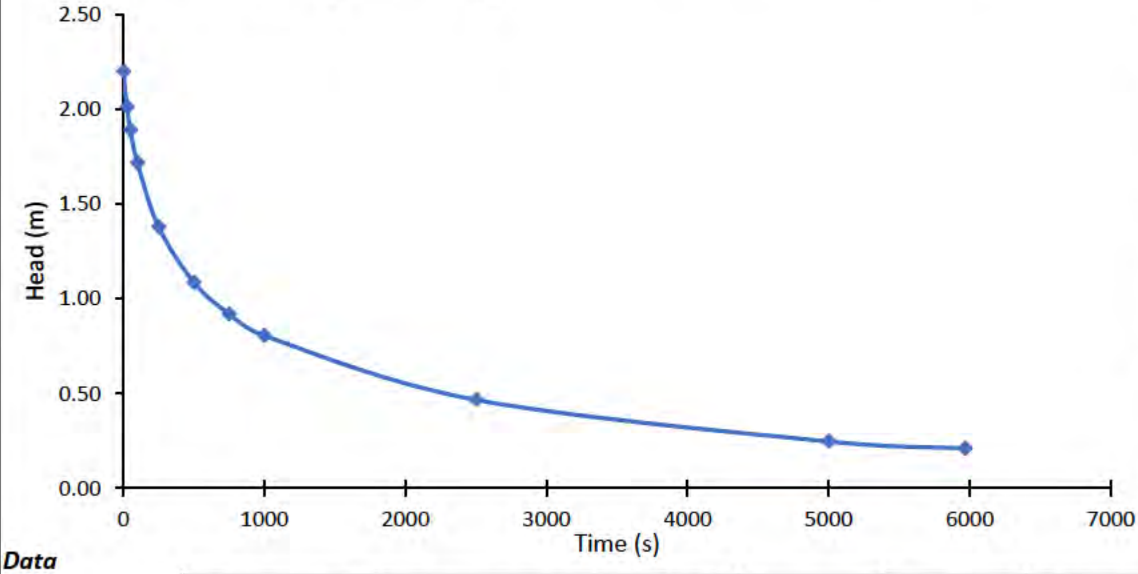
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1+d}{2h_2+d} \right) \cdot \frac{(h_1+h_2)}{2(t_2-t_1)} =$$ 2.35E-05 ms^{-1} = 2.03 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$ 2.80E-06 ms^{-1} = 0.24 m/day



STRATIGRAPHIC LOG
Silt
Sand
Silt
Sand
EOH @ 2.3m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	2.200				
25	0.186	2.014	2.207		6.32E-06	6.78E-05
50	0.308	1.892	2.053		4.71E-06	4.77E-05
100	0.483	1.718	1.905		3.85E-06	3.69E-05
250	0.820	1.380	1.649		3.23E-06	2.80E-05
500	1.114	1.086	1.333		2.46E-06	1.82E-05
750	1.280	0.920	1.103		1.96E-06	1.25E-05
1000	1.395	0.805	0.963		1.71E-06	9.90E-06
2500	1.734	0.466	0.736		1.40E-06	6.95E-06
5000	1.954	0.246	0.456		1.32E-06	4.68E-06
5970	1.990	0.210	0.328		1.03E-06	2.72E-06

CMW Geosciences	CLIENT:	DESIGNER:	NK
	PROJECT: 124 Station Road, Matamata	CHECKED:	DM
		REVISION:	0
	TITLE: HAS24-07 Falling Head Permeability Test	DATE:	10/06/2024
		PROJECT:	HAM2023-0124

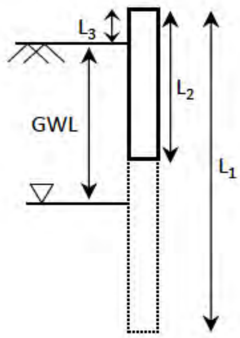
Specifications - Open-Ended Tube

Length L_1: 1.5 m
Diameter: 90 mm
Non-Perm L_2: 0.5 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 1.4 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 1.50 m BGL



Hydraulic Conductivity (k)

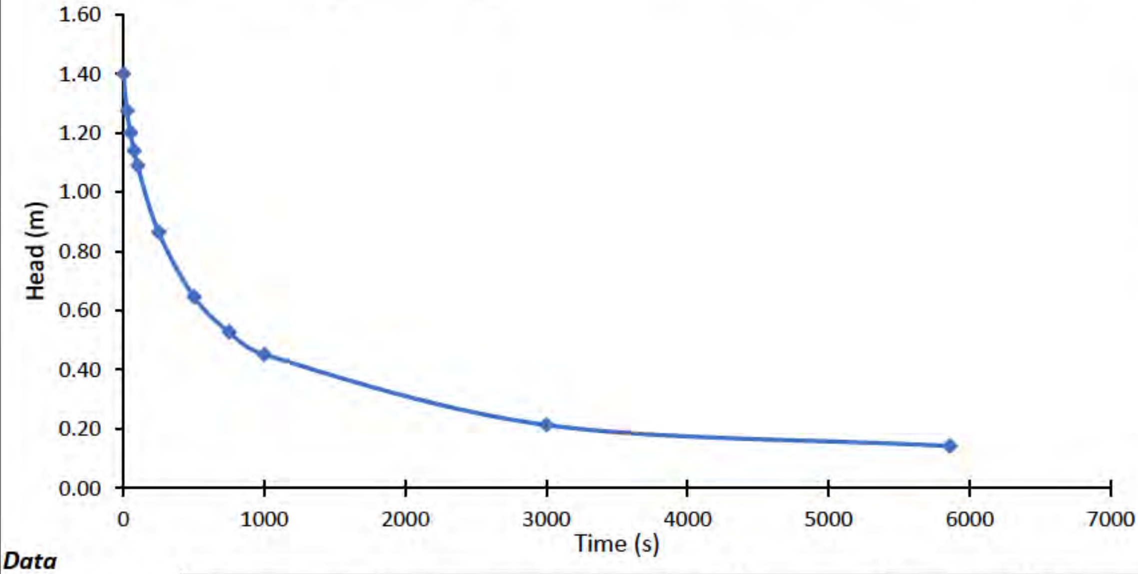
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d} \right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} = \quad 2.76E\text{-}05\ ms^{-1} = 2.38\ m/day$$

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2 - t_1)} \ln\frac{H_1}{H_2} = \quad 4.94E\text{-}06\ ms^{-1} = 0.43\ m/day$$



STRATIGRAPHIC LOG
Silt
Sand
EOH @ 1.5m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	1.400				
25	0.125	1.275	1.000		1.17E-05	7.07E-05
50	0.199	1.201	1.000		7.58E-06	4.55E-05
75	0.260	1.140	1.000		6.49E-06	3.89E-05
100	0.311	1.089	1.000		5.79E-06	3.46E-05
250	0.535	0.865	1.000		4.83E-06	2.90E-05
500	0.753	0.647	0.856		4.04E-06	2.17E-05
750	0.873	0.527	0.687		3.29E-06	1.49E-05
1000	0.949	0.451	0.589		2.76E-06	1.12E-05
3000	1.187	0.213	0.432		1.99E-06	6.94E-06
5860	1.258	0.142	0.278		9.56E-07	2.26E-06

CMW Geosciences	CLIENT:	DESIGNER:	NK
	PROJECT: **124 Station Road, Matamata**	CHECKED:	DM
		REVISION:	0
	TITLE: **HAS24-08 Falling Head Permeability Test**	DATE:	10/06/2024
		PROJECT:	HAM2023-0124

Specifications - Open-Ended Tube

Length L_1: 3 m

Diameter: 90 mm

Non-Perm L_2: 0 m

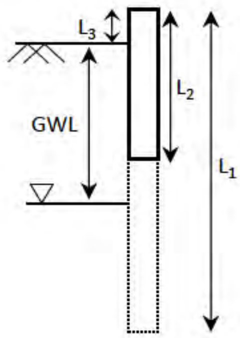
Above Gnd L_3: 0 m

Ground Conditions

GWL: 3 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$



Bottom of Test Hole: 3.00 m BGL

Hydraulic Conductivity (k)

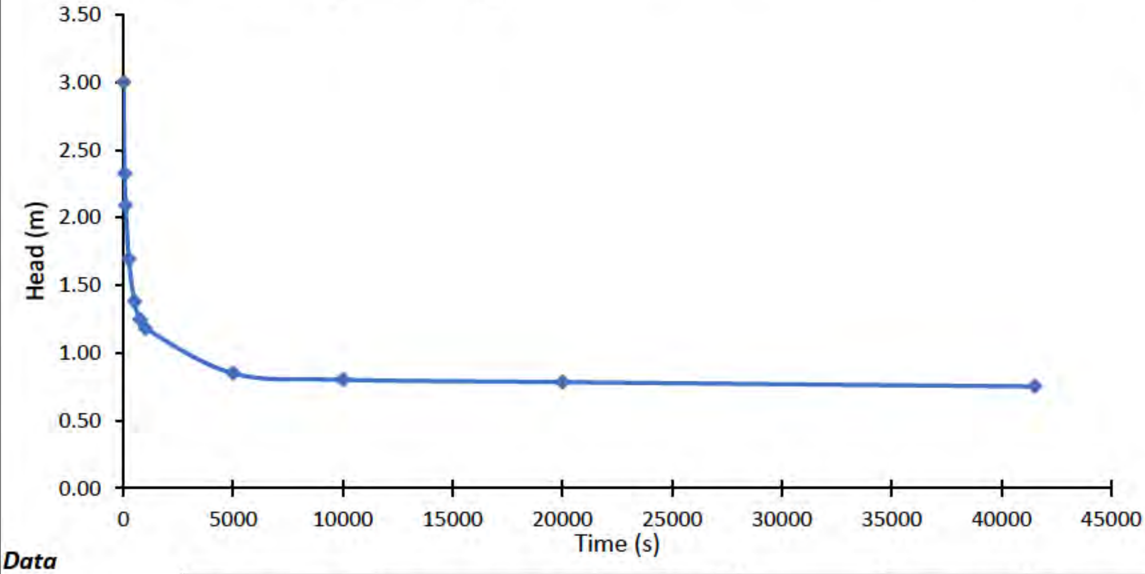
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

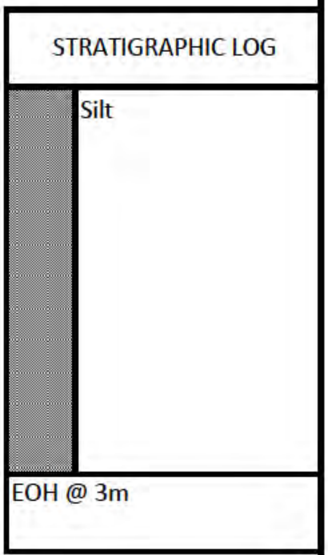
CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$ 1.96E-05 ms^{-1} = 1.69 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2 - t_1)} \ln\frac{H_1}{H_2} =$$ 1.84E-06 ms^{-1} = 0.16 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	3.000				
50	0.676	2.325	2.662		7.92E-06	9.91E-05
100	0.909	2.091	2.208		3.78E-06	4.06E-05
250	1.307	1.693	1.892		2.82E-06	2.71E-05
500	1.621	1.379	1.536		1.91E-06	1.57E-05
750	1.754	1.246	1.312		1.06E-06	7.70E-06
1000	1.819	1.181	1.213		5.84E-07	4.00E-06
5000	2.151	0.849	1.015		2.57E-07	1.57E-06
10000	2.199	0.801	0.825		4.12E-08	2.14E-07
20000	2.216	0.784	0.792		8.10E-09	4.08E-08
41530	2.249	0.751	0.768		7.32E-09	3.61E-08

CLIENT:		DESIGNER:	NK
PROJECT:	124 Station Road, Matamata	CHECKED:	DM
		REVISION:	0
TITLE:	HAS24-09 Falling Head Permeability Test	DATE:	10/06/2024
		PROJECT:	HAM2023-0124

CMW Geosciences

Specifications - Open-Ended Tube

Length L_1: 3 m

Diameter: 90 mm

Non-Perm L_2: 0 m

Above Gnd L_3: 0 m

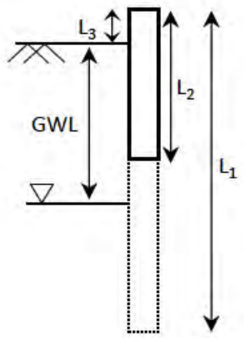
Ground Conditions

GWL: 3 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 3.00 m BGL



Hydraulic Conductivity (k)

Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

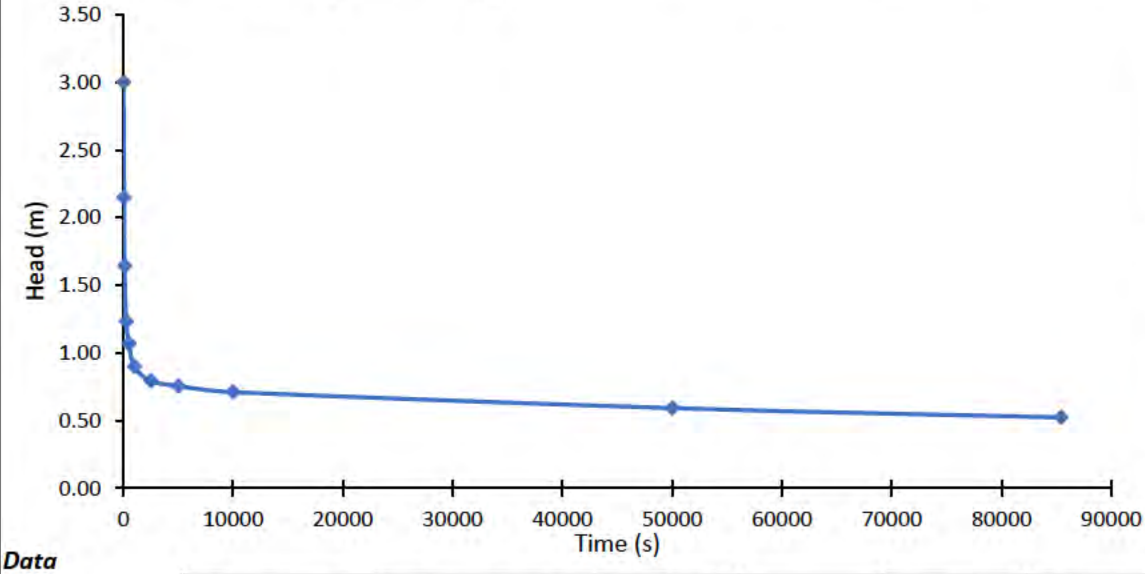
$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d} \right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} =$$

2.91E-05 ms^{-1} = 2.51 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2\, ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1} \right)}{8L(t_2 - t_1)} ln\frac{H_1}{H_2} =$$

2.92E-06 ms^{-1} = 0.25 m/day



STRATIGRAPHIC LOG
Silt
Sand
Silt
EOH @ 3m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	3.000				
50	0.853	2.147	2.573		1.07E-05	1.31E-04
100	1.357	1.644	1.895		1.07E-05	1.03E-04
250	1.767	1.233	1.438		4.68E-06	3.68E-05
500	1.934	1.066	1.149		1.66E-06	1.10E-05
1000	2.102	0.898	0.982		1.09E-06	6.43E-06
2500	2.207	0.793	0.846		2.91E-07	1.54E-06
5000	2.245	0.756	0.774		7.29E-08	3.62E-07
10000	2.290	0.710	0.733		4.80E-08	2.29E-07
50000	2.408	0.592	0.651		1.89E-08	8.35E-08
85440	2.477	0.523	0.557		1.61E-08	6.38E-08

CMW Geosciences	CLIENT:	DESIGNER:	NK
	PROJECT: **124 Station Road, Matamata**	CHECKED:	DM
		REVISION:	0
	TITLE: **HAS24-10 Falling Head Permeability Test**	DATE:	10/06/2024
		PROJECT:	HAM2023-0124

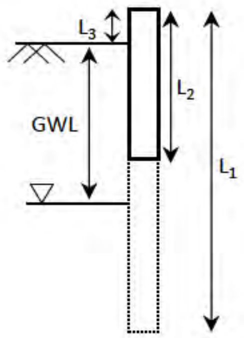
Specifications - Open-Ended Tube

Length L_1: 1.8 m
Diameter: 90 mm
Non-Perm L_2: 0 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 1.8 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h/k_v}$

Bottom of Test Hole: 1.80 m BGL



Hydraulic Conductivity (k)

Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

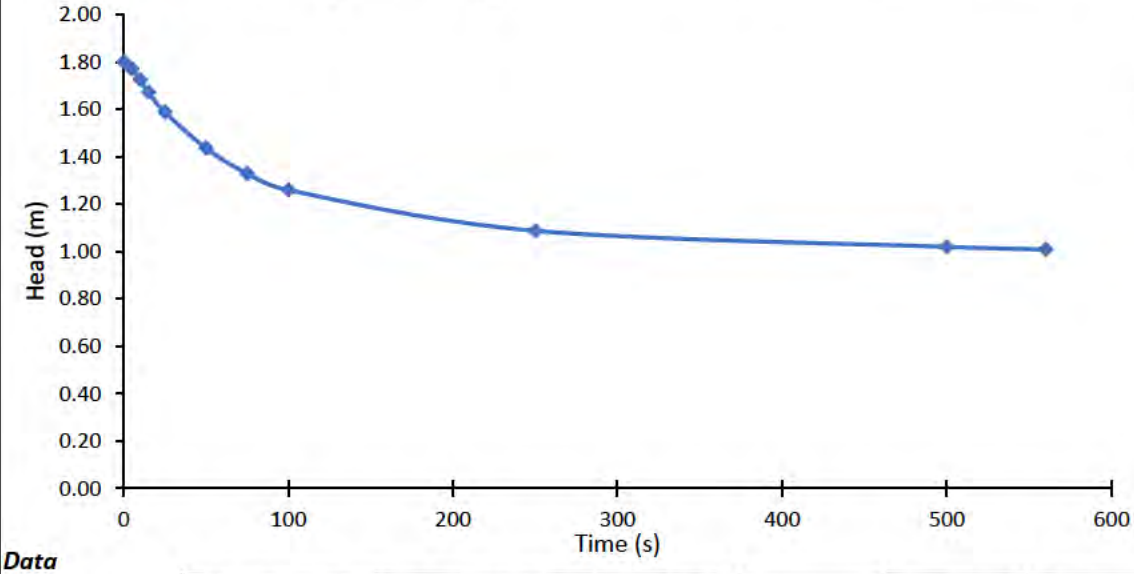
$$k = \left(\log\frac{h_1}{h_2} - \log\frac{2h_2+d}{2h_2+d}\right) \cdot \frac{(h_1+h_2)}{2(t_2-t_1)} =$$

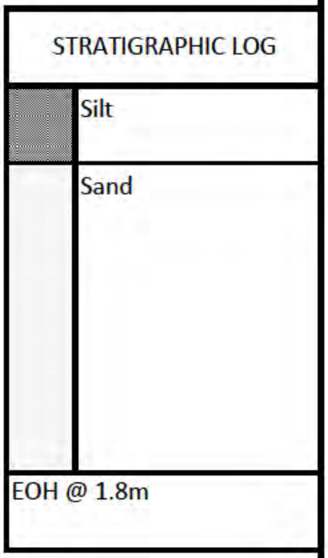
5.82E-05 ms^{-1} = 5.03 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$

7.00E-06 ms^{-1} = 0.60 m/day





Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	1.800				
5	0.031	1.769	1.785		7.19E-06	6.56E-05
10	0.077	1.723	1.746		1.12E-05	1.00E-04
15	0.127	1.673	1.698		1.30E-05	1.14E-04
25	0.213	1.587	1.630		1.17E-05	9.97E-05
50	0.364	1.436	1.511		9.45E-06	7.63E-05
75	0.472	1.328	1.382		7.81E-06	5.89E-05
100	0.541	1.259	1.293		5.67E-06	4.07E-05
250	0.713	1.087	1.173		2.75E-06	1.85E-05
500	0.781	1.019	1.053		7.83E-07	4.84E-06
560	0.792	1.008	1.013		5.74E-07	3.45E-06

CLIENT:		DESIGNER: NK
PROJECT:	124 Station Road, Matamata	CHECKED: DM
		REVISION: 0
TITLE:	HAS24-11 Falling Head Permeability Test	DATE: 10/06/2024
		PROJECT: HAM2023-0124

CMW Geosciences

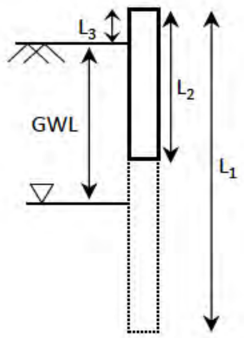
Specifications - Open-Ended Tube

Length L_1: 1.6 m
Diameter: 90 mm
Non-Perm L_2: 0 m
Above Gnd L_3: 0 m

Ground Conditions

GWL: 1.4 m BGL (Blank = Bottom of hole)
Permeability Anisotropy
m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 1.60 m BGL



Hydraulic Conductivity (k)

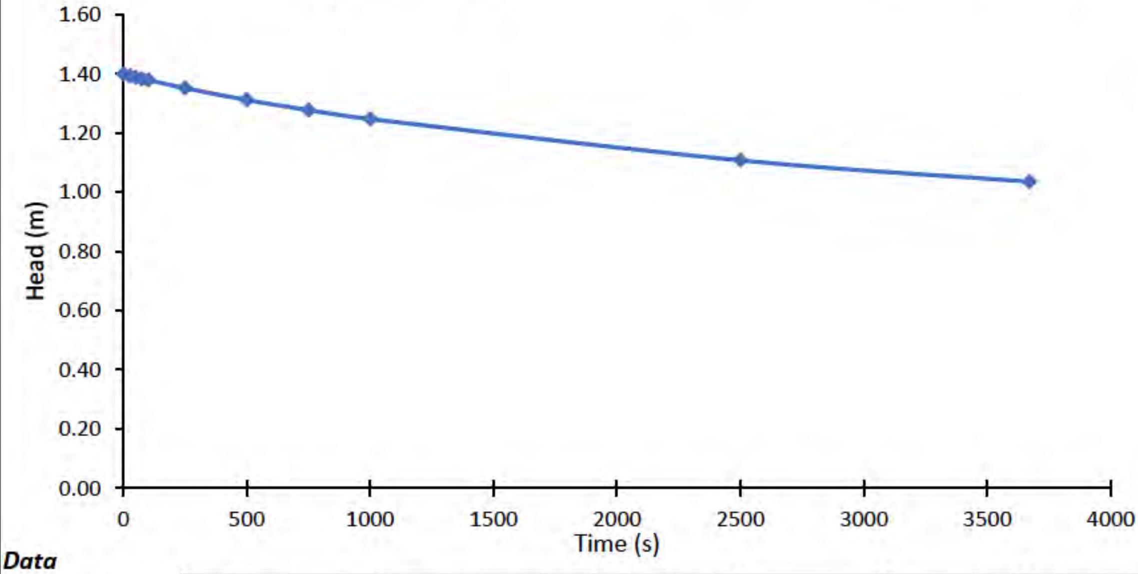
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(\log\frac{h_1}{h_2} - \log\frac{2h_1+d}{2h_2+d}\right) \cdot \frac{(h_1+h_2)}{2(t_2-t_1)} =$$ 2.27E-06 ms^{-1} = 0.20 m/day

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2-t_1)} \ln\frac{H_1}{H_2} =$$ 2.80E-07 ms^{-1} = 0.02 m/day



STRATIGRAPHIC LOG
Sand
EOH @ 1.6m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	1.400				
25	0.007	1.393	1.597		4.41E-07	3.69E-06
50	0.013	1.387	1.590		3.99E-07	3.32E-06
75	0.018	1.383	1.585		3.02E-07	2.52E-06
100	0.021	1.379	1.581		2.44E-07	2.03E-06
250	0.048	1.352	1.565		3.03E-07	2.49E-06
500	0.088	1.312	1.532		2.82E-07	2.28E-06
750	0.122	1.278	1.495		2.49E-07	1.98E-06
1000	0.153	1.247	1.462		2.32E-07	1.82E-06
2500	0.292	1.108	1.377		1.99E-07	1.49E-06
3670	0.364	1.036	1.272		1.53E-07	1.08E-06

CMW Geosciences	CLIENT:	DESIGNER: NK
	PROJECT: **124 Station Road, Matamata**	CHECKED: DM
		REVISION: 0
	TITLE: **HAS24-12 Falling Head Permeability Test**	DATE: 10/06/2024
		PROJECT: HAM2023-0124

Specifications - Open-Ended Tube

Length L_1:	3	m
Diameter:	90	mm
Non-Perm L_2:	0	m
Above Gnd L_3:	0	m

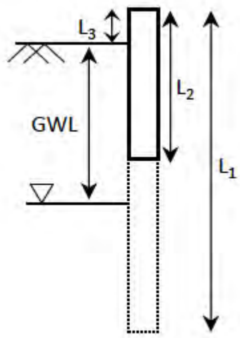
Ground Conditions

GWL: 3 m BGL (Blank = Bottom of hole)

Permeability Anisotropy

m: 1 $m = \sqrt{k_h / k_v}$

Bottom of Test Hole: 3.00 m BGL



Hydraulic Conductivity (k)

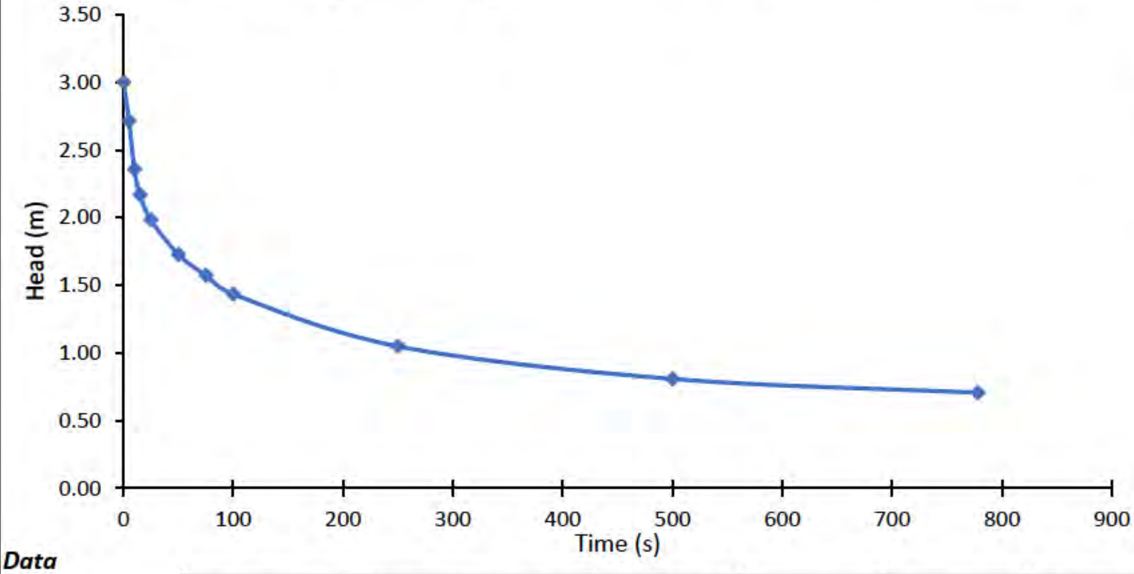
Note: CMW considers the CIRIA 113 value the most appropriate method for most purposes, but also provides the analysis method as outlined by Hvorslev if desired.

CIRIA 113: Somerville (1986), *Control of groundwater for temporary works,* CIRIA Report 113, Appendix 4

$$k = \left(log\frac{h_1}{h_2} - log\frac{2h_1 + d}{2h_2 + d}\right) \cdot \frac{(h_1 + h_2)}{2(t_2 - t_1)} = \quad 1.74E\text{-}04 \ ms^{-1} \quad = \quad 15.00 \ m/day$$

Hvorslev: Hvorslev (1951) *Time Lag and Soil Permeability in Ground-Water Observations*, Fig 18, p49

$$k = \frac{d^2 \ln\left(\frac{mL}{d} + \sqrt{\left(\frac{mL}{d}\right)^2 + 1}\right)}{8L(t_2 - t_1)} \ln\frac{H_1}{H_2} = \quad 1.60E\text{-}05 \ ms^{-1} \quad = \quad 1.38 \ m/day$$



STRATIGRAPHIC LOG
Silt
Sand
EOH @ 3m

Data

Time (s)	Tape Avg (m)	Head (m)	Perm. Length (m)		Hvorslev 'k' Case G (ms^{-1})	CIRIA 113 'k' (ms^{-1})
0	0.000	3.000				
5	0.287	2.713	2.857		2.96E-05	3.87E-04
10	0.643	2.357	2.535		4.53E-05	5.42E-04
15	0.832	2.168	2.262		2.93E-05	3.21E-04
25	1.016	1.984	2.076		1.65E-05	1.70E-04
50	1.273	1.727	1.855		1.13E-05	1.06E-04
75	1.427	1.574	1.650		8.22E-06	7.08E-05
100	1.566	1.434	1.504		8.78E-06	7.06E-05
250	1.951	1.049	1.241		5.65E-06	4.00E-05
500	2.193	0.807	0.928		3.45E-06	1.97E-05
778	2.295	0.705	0.756		1.84E-06	9.01E-06

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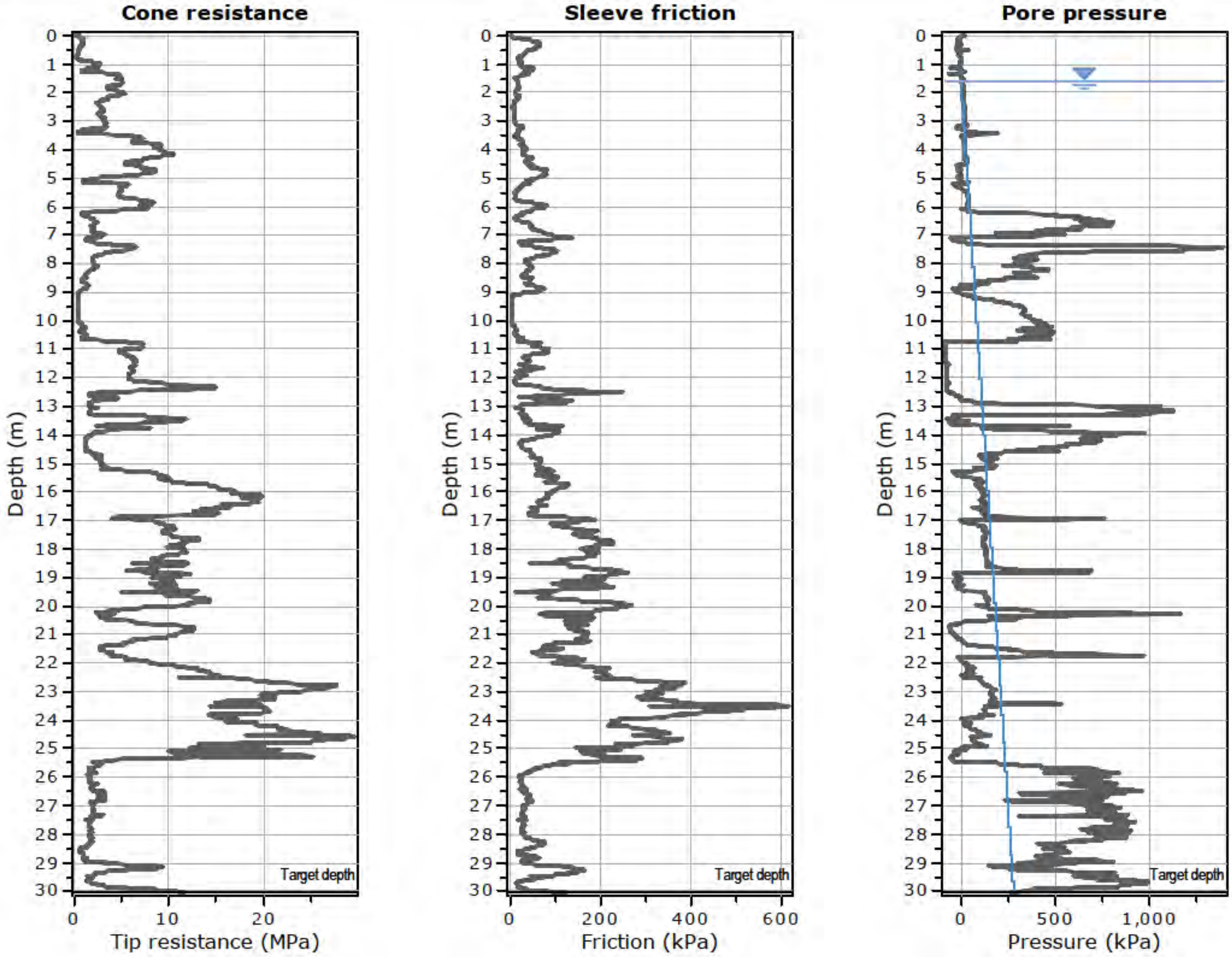
APPENDIX E: CPT INVESTIGATION RESULTS

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

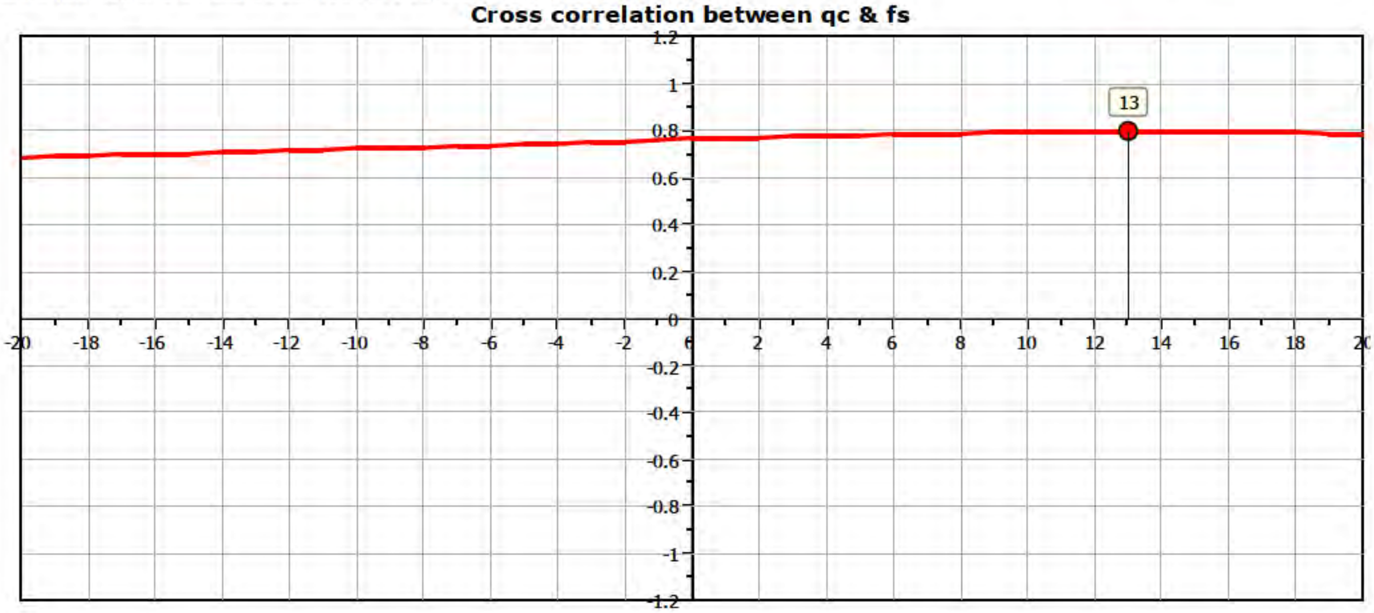
CPT: 24-04

Total depth: 30.04 m, Date: 4/06/2024
Coords: lat -37.812787° lon 175.751857°
Cone Type: DC10

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **127 Station Road, Matamata | Holes dipped onsite using Dipmeter**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

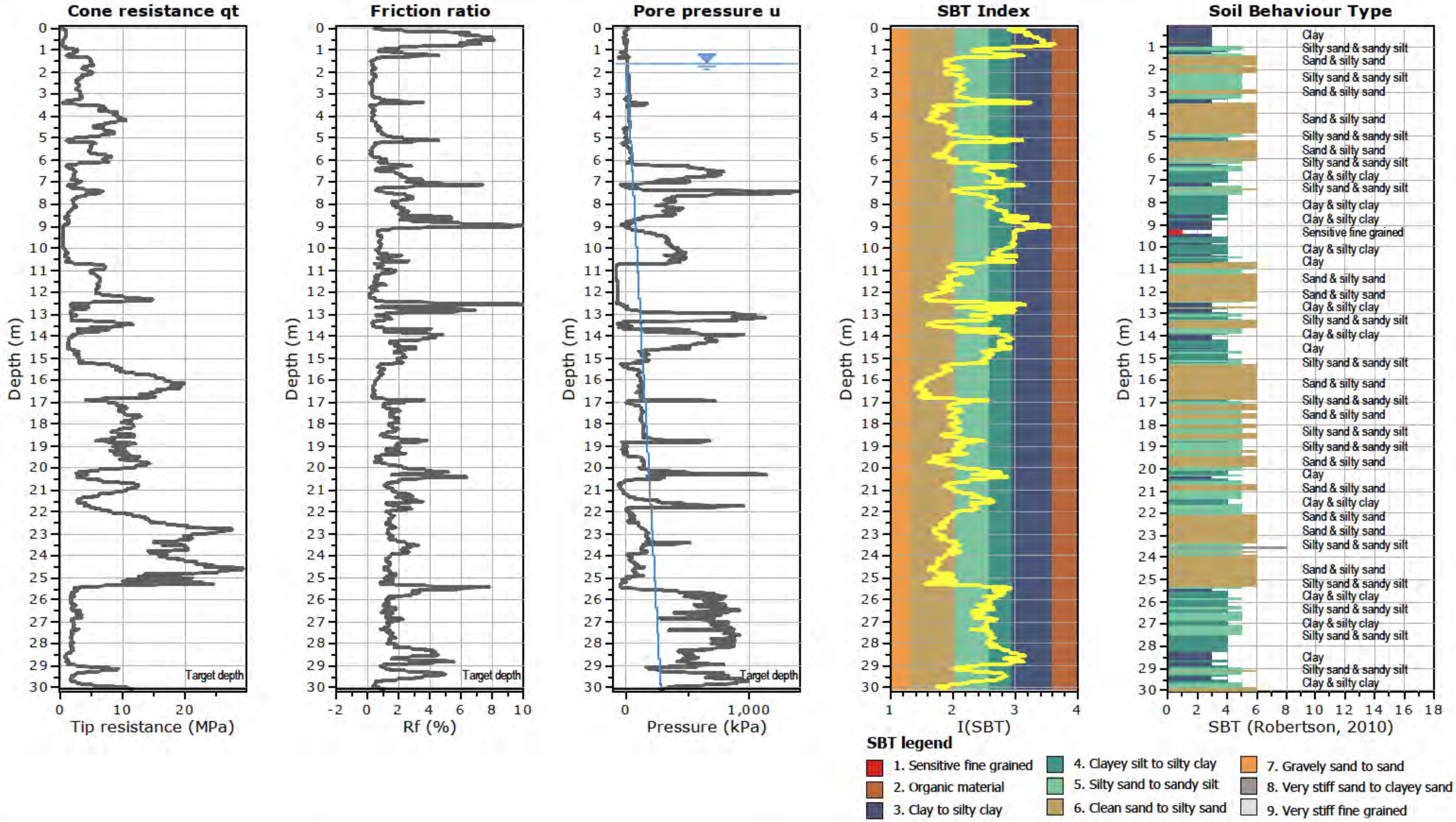


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-04

Total depth: 30.04 m, Date: 4/06/2024
Coords: lat -37.812787° lon 175.751857°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter

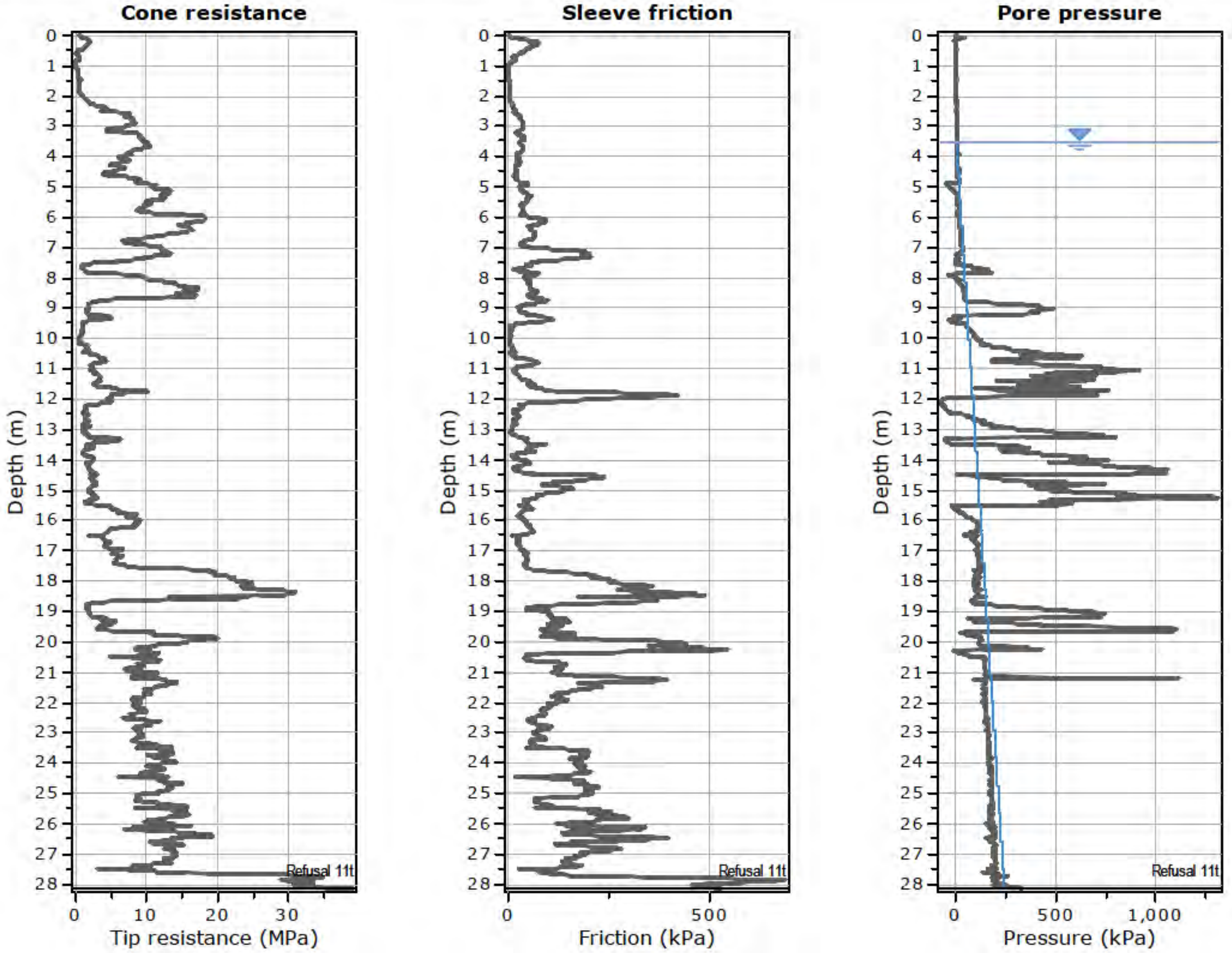


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

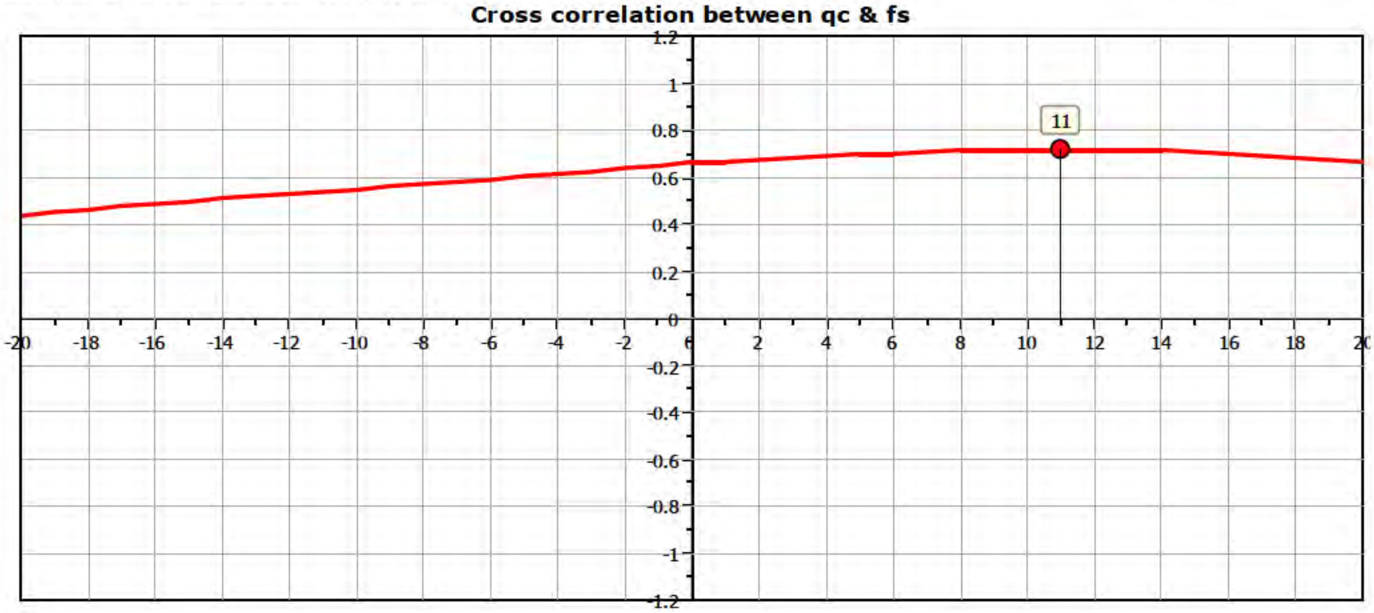
CPT: 24-05

Total depth: 28.14 m, Date: 4/06/2024
Coords: lat -37.815987° lon 175.753168°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

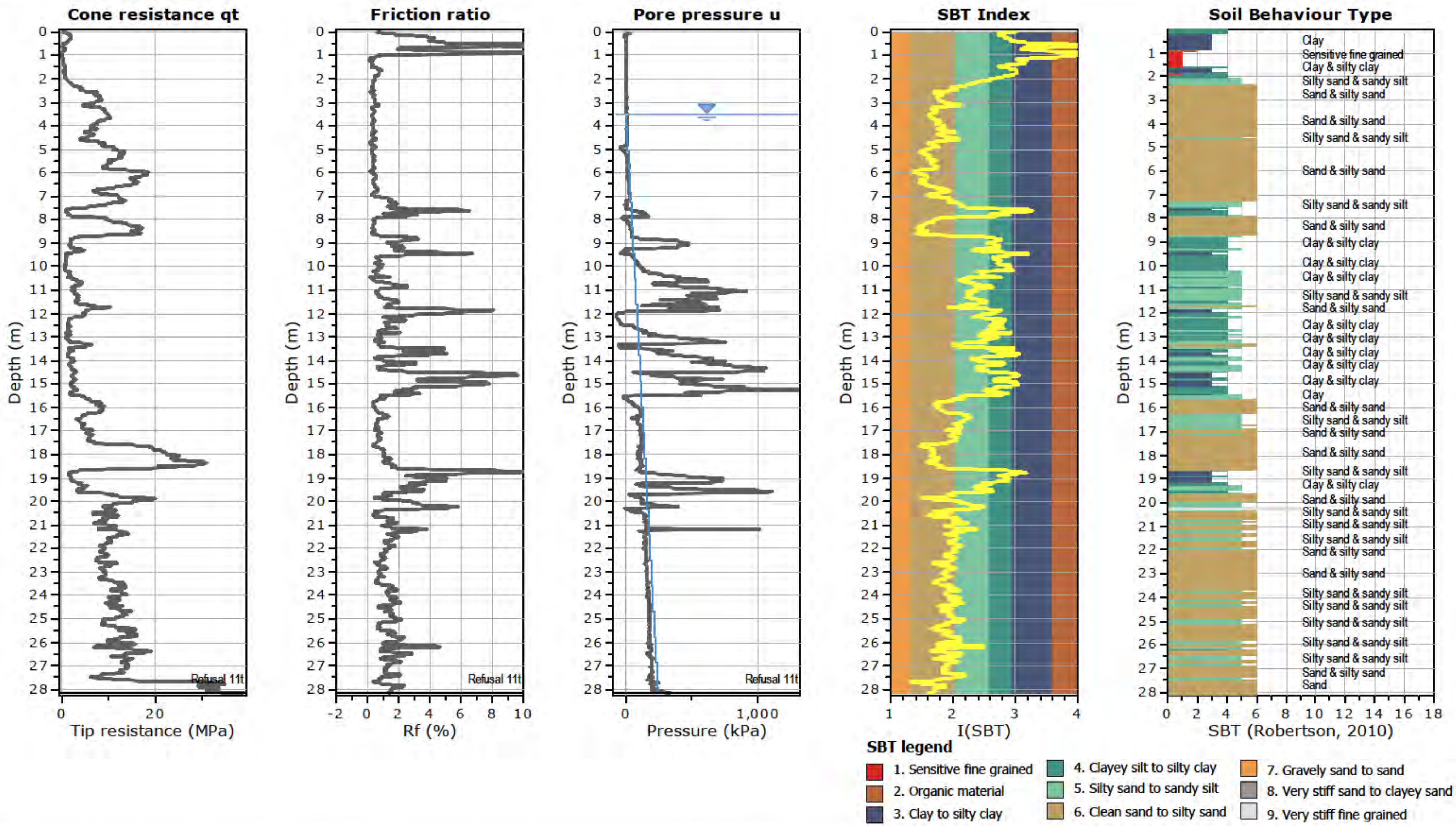


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-05

Total depth: 28.14 m, Date: 4/06/2024
Coords: lat -37.815987° lon 175.753168°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter

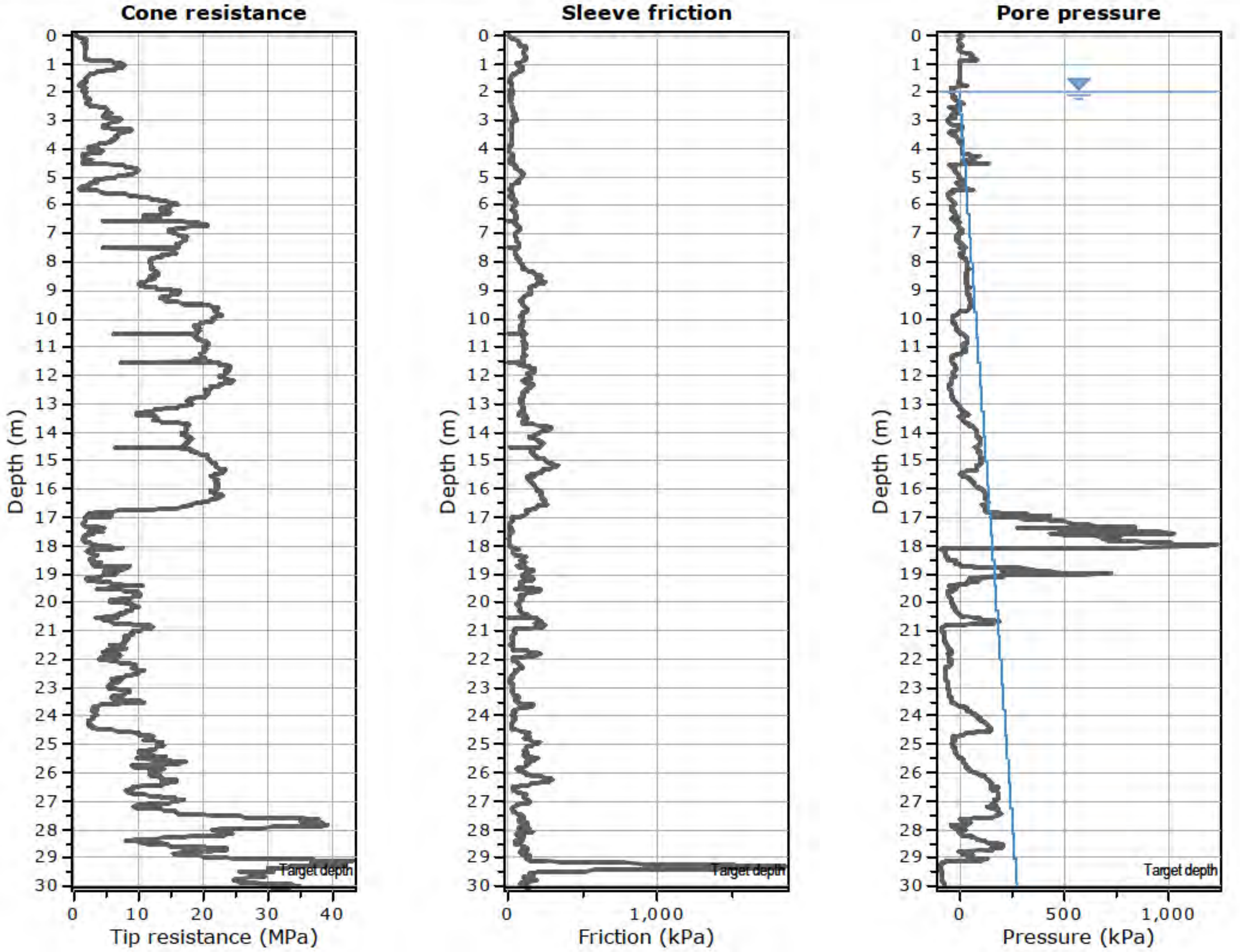


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

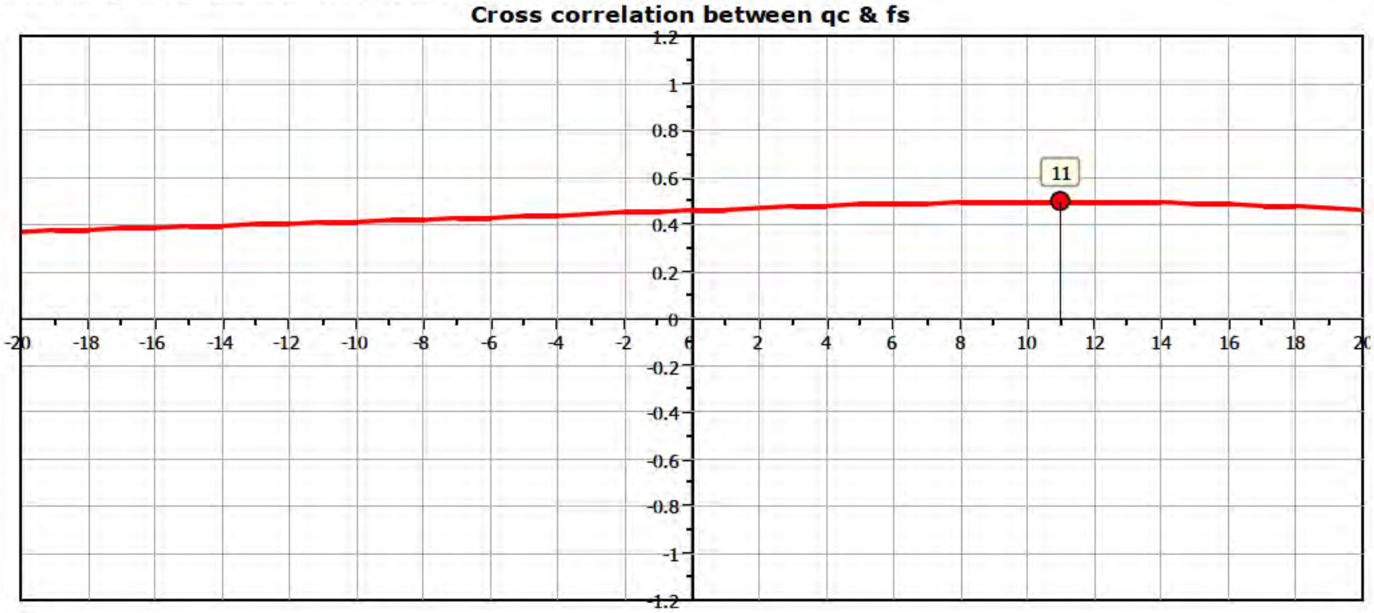
CPT: 24-06

Total depth: 30.06 m, Date: 4/06/2024
Coords: lat -37.820042° lon 175.759802°
Cone Type: DC10

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **127 Station Road, Matamata | Holes dipped onsite using Dipmeter**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



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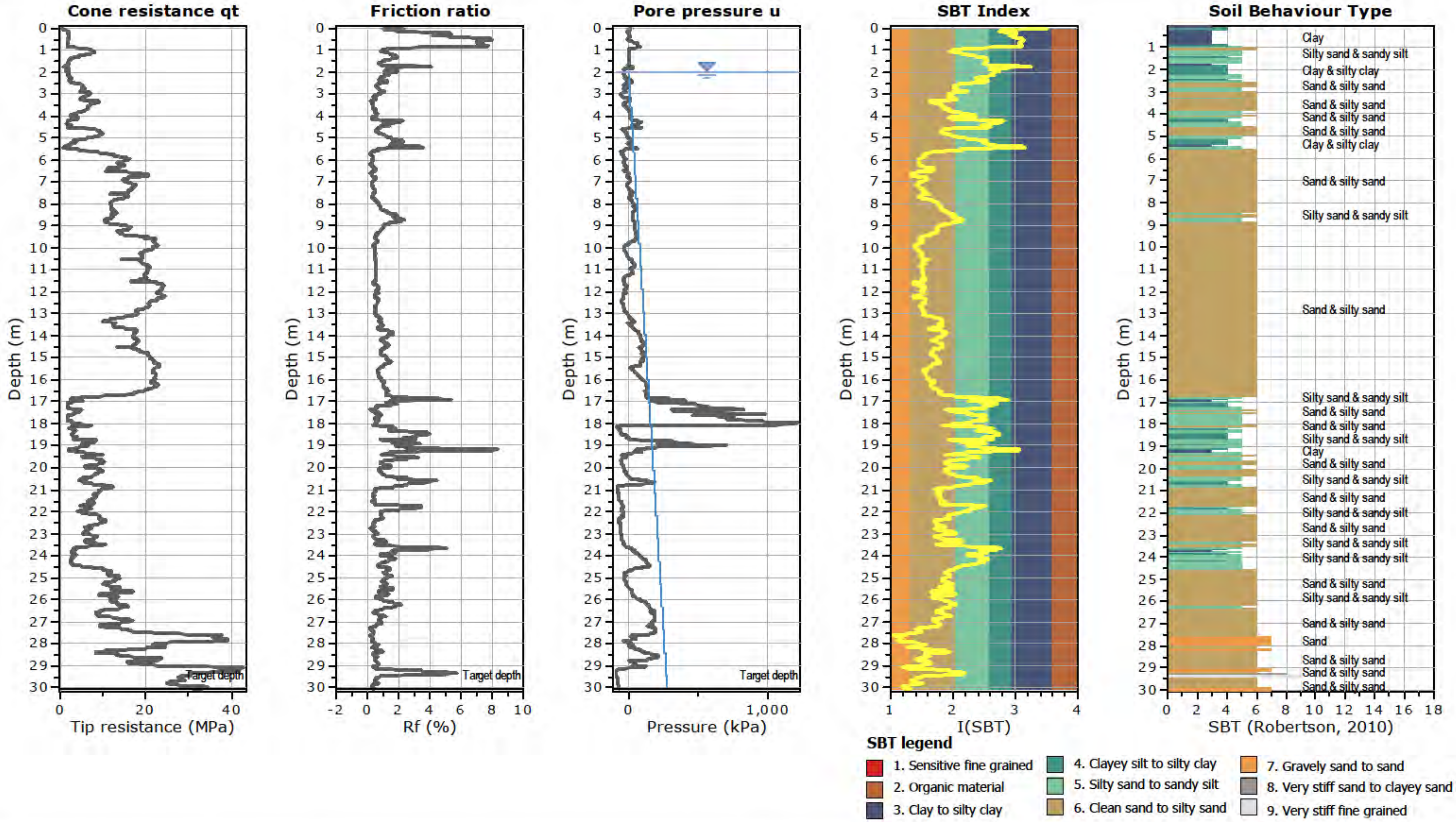
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-06
Total depth: 30.06 m, Date: 4/06/2024
Coords: lat -37.820042° lon 175.759802°
Cone Type: DC10

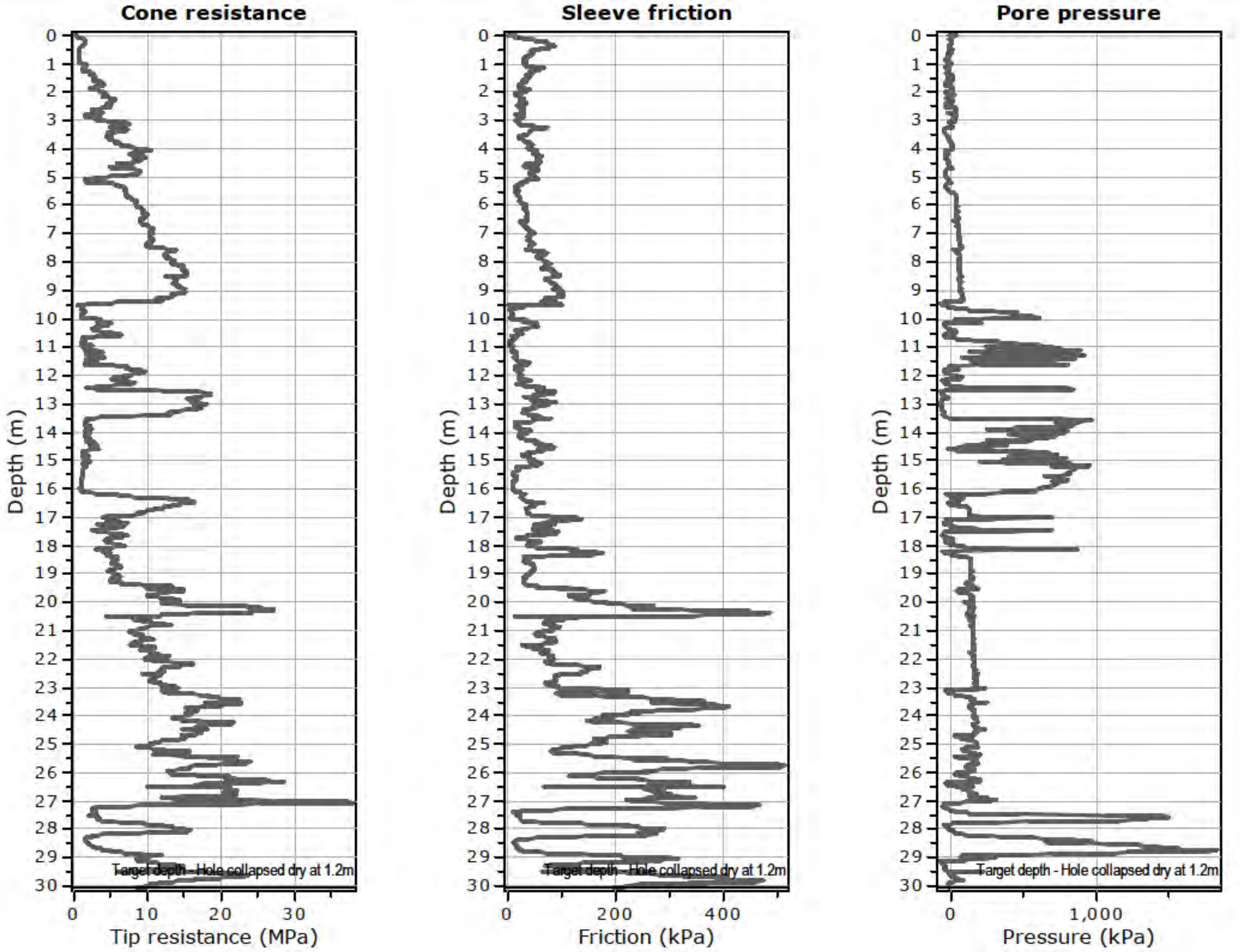
Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



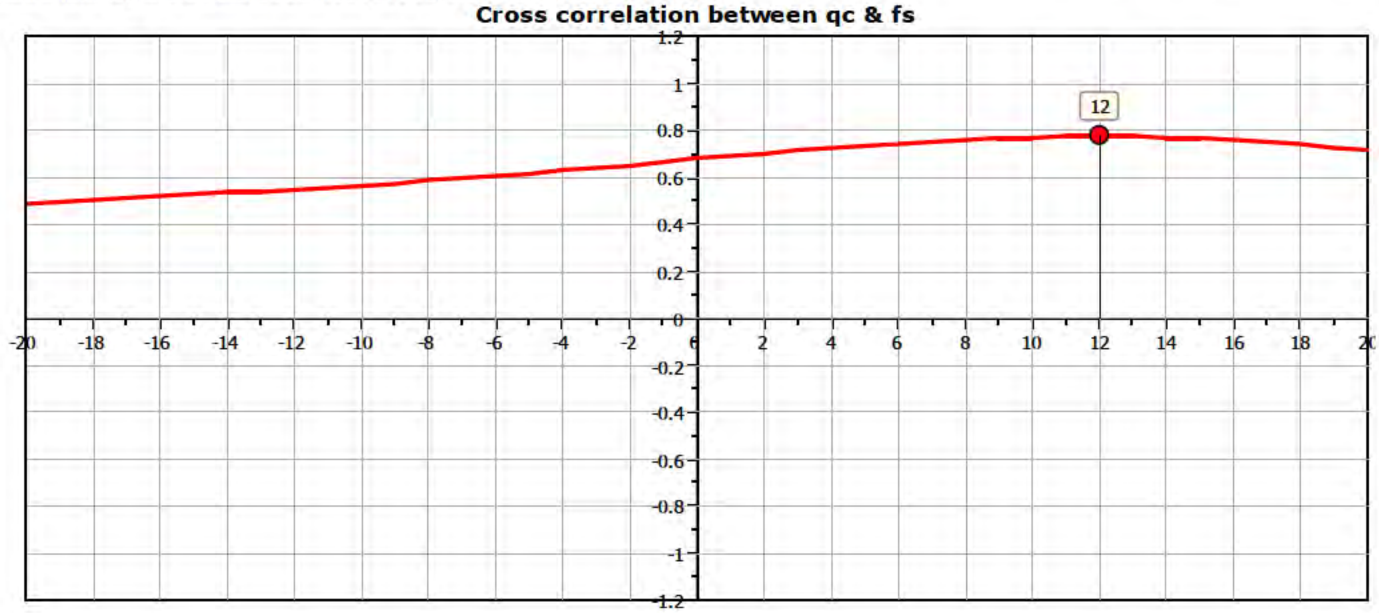
Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-07
Total depth: 30.07 m, Date: 4/06/2024
Coords: lat -37.82305° lon 175.750916°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Geo Data Solutions (GDS) NZ Ltd.
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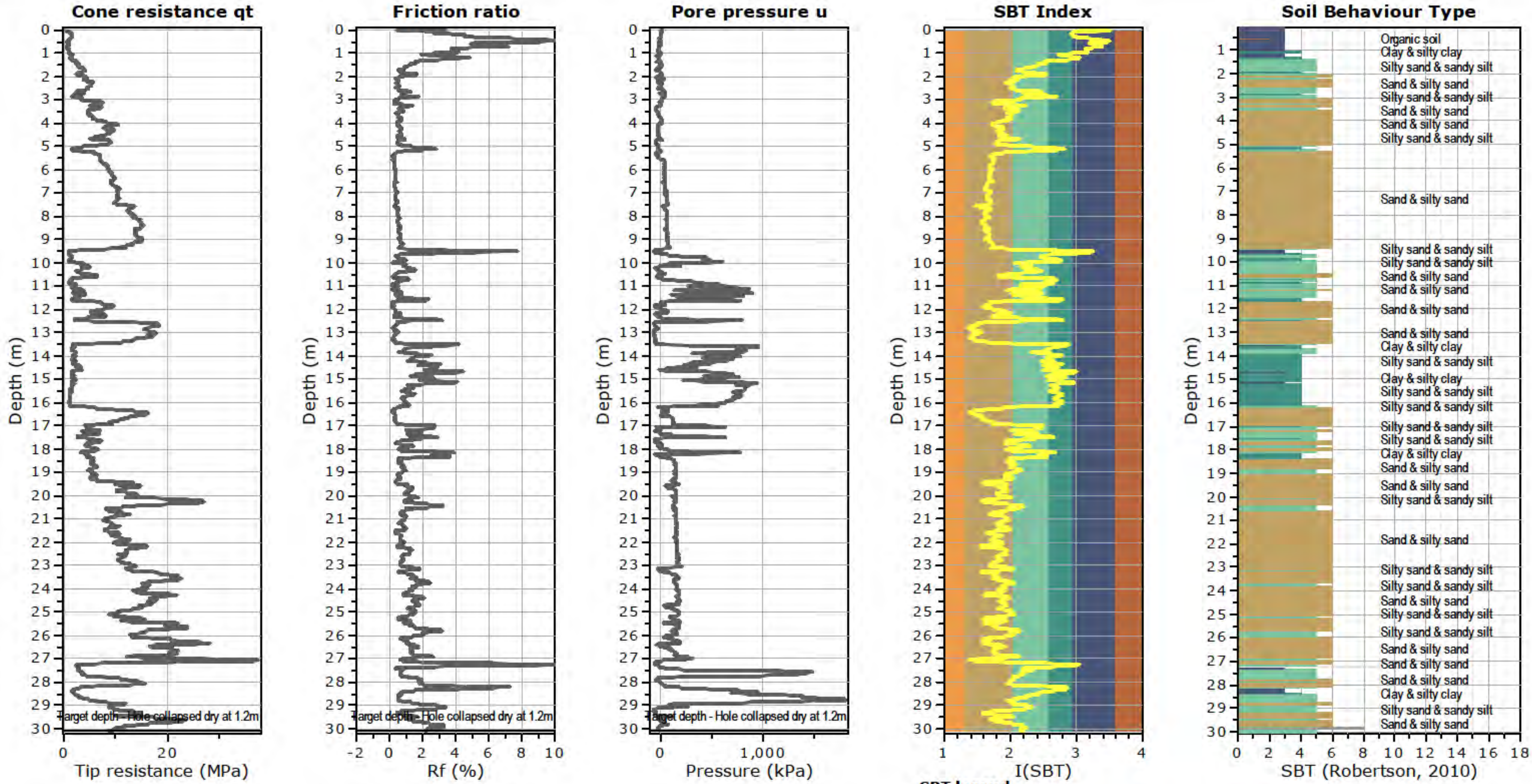
www.gdsnz.co.nz

CPT: 24-07

Total depth: 30.07 m, Date: 4/06/2024
Coords: lat -37.82305° lon 175.750916°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



SBT legend

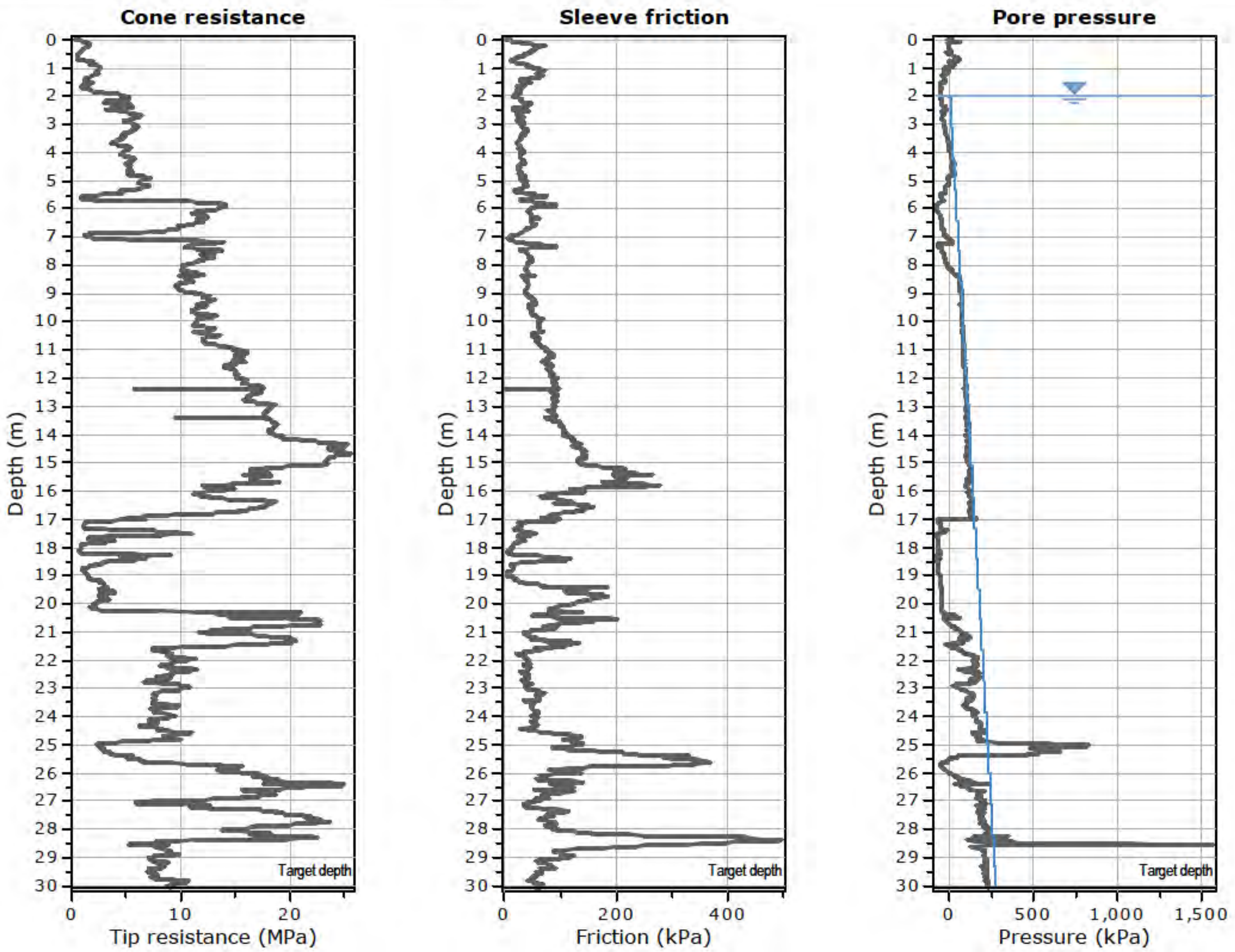
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

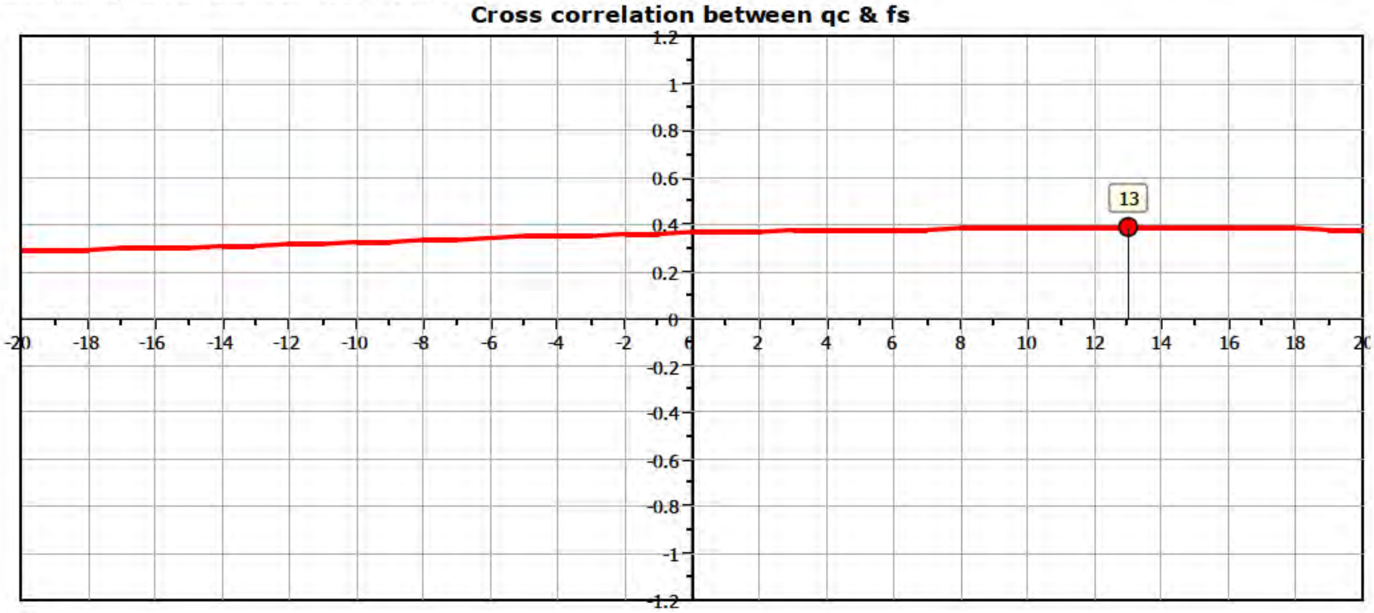
CPT: 24-08

Total depth: 30.08 m, Date: 4/06/2024
Coords: lat -37.82359° lon 175.754635°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

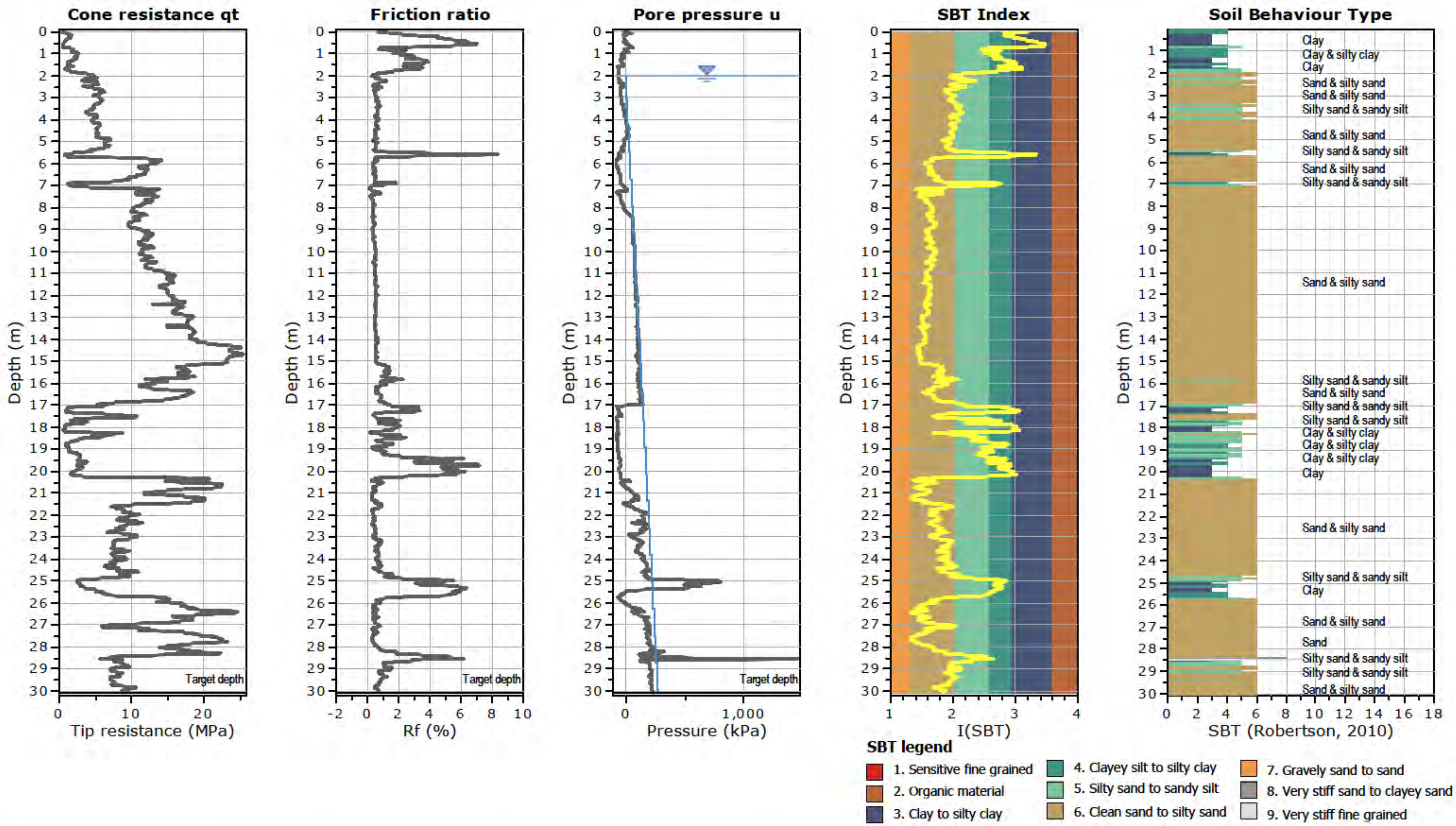


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-08

Total depth: 30.08 m, Date: 4/06/2024
Coords: lat -37.82359° lon 175.754635°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter

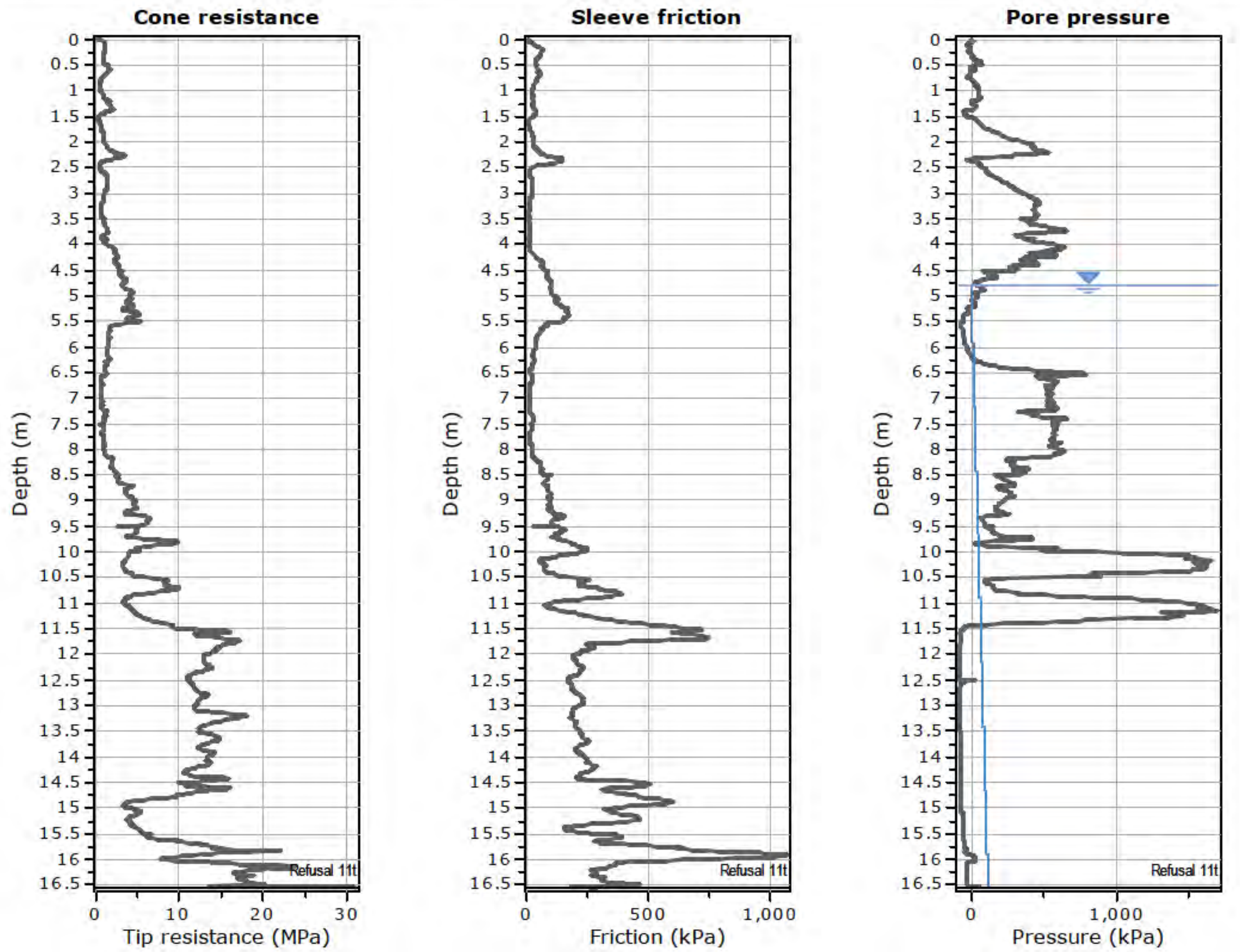


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

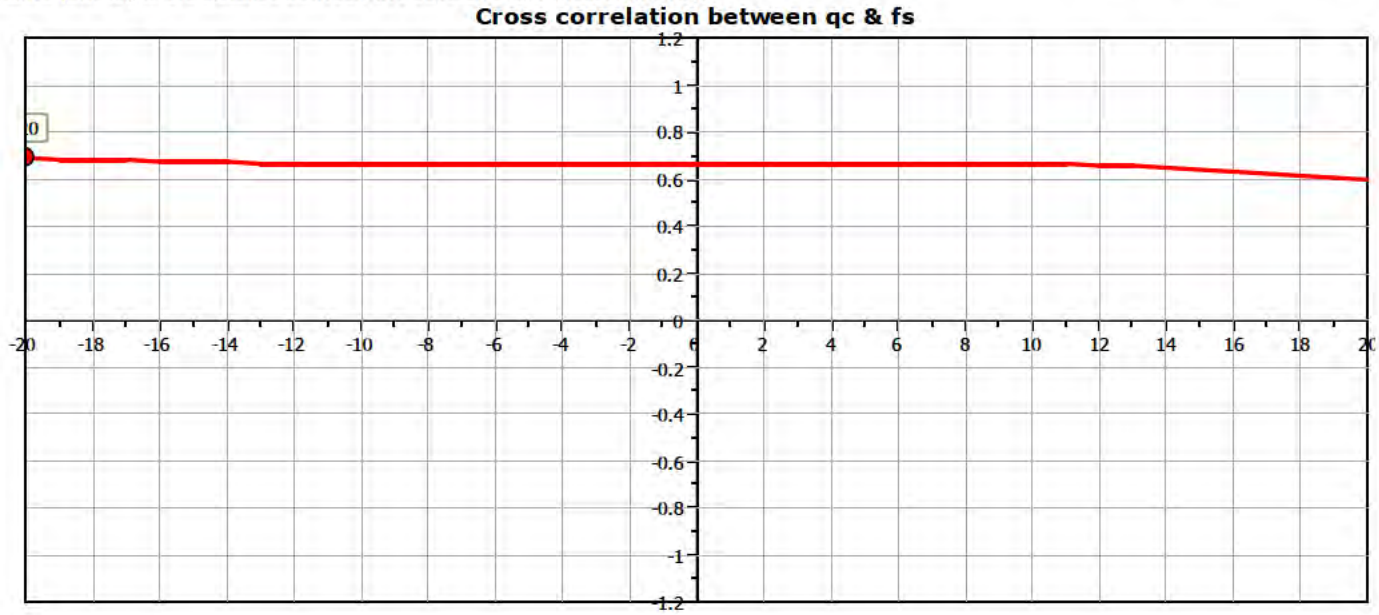
CPT: 24-09

Total depth: 16.56 m, Date: 4/06/2024
Coords: lat -37.824685° lon 175.748286°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

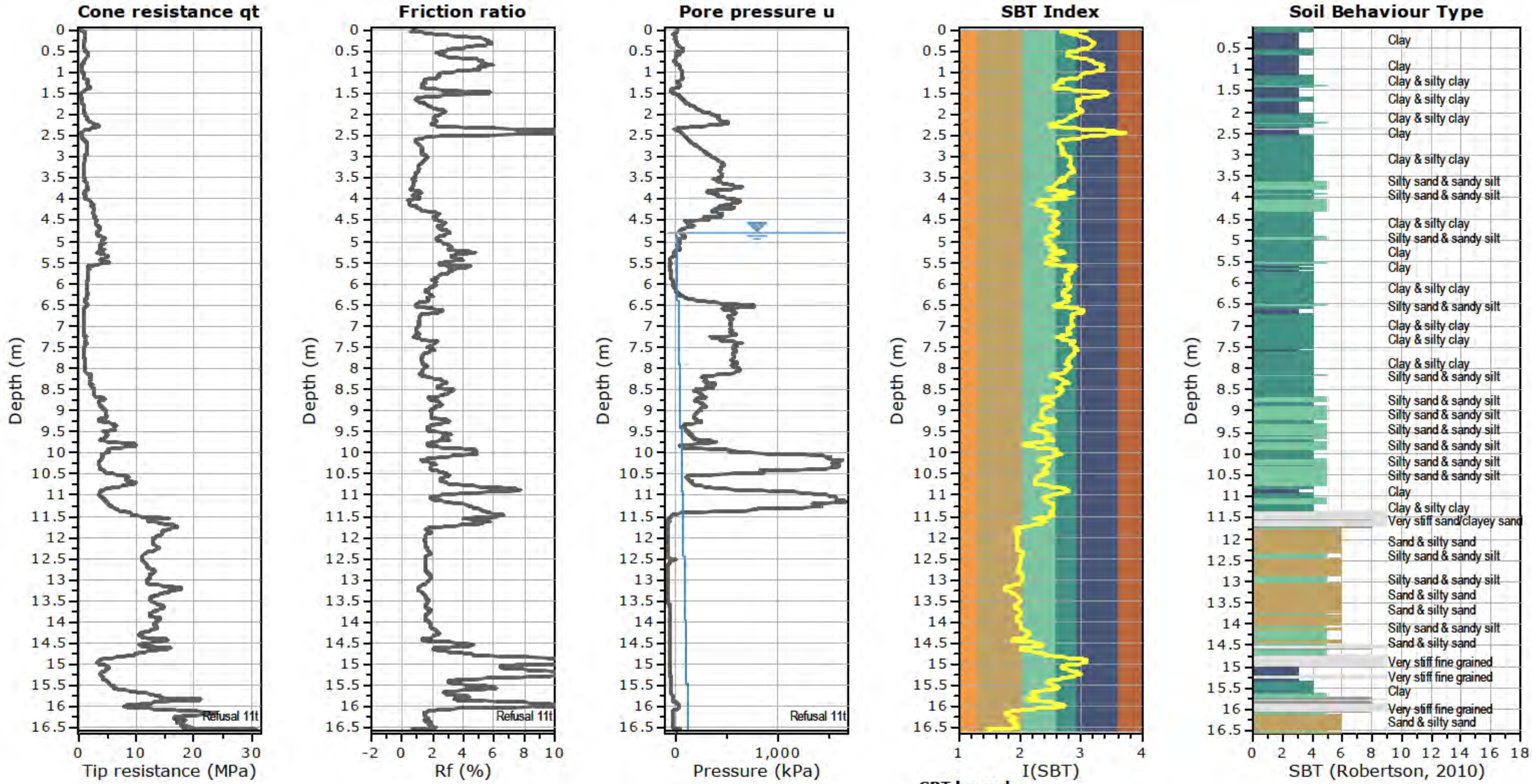


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-09

Total depth: 16.56 m, Date: 4/06/2024
Coords: lat -37.824685° lon 175.748286°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-10

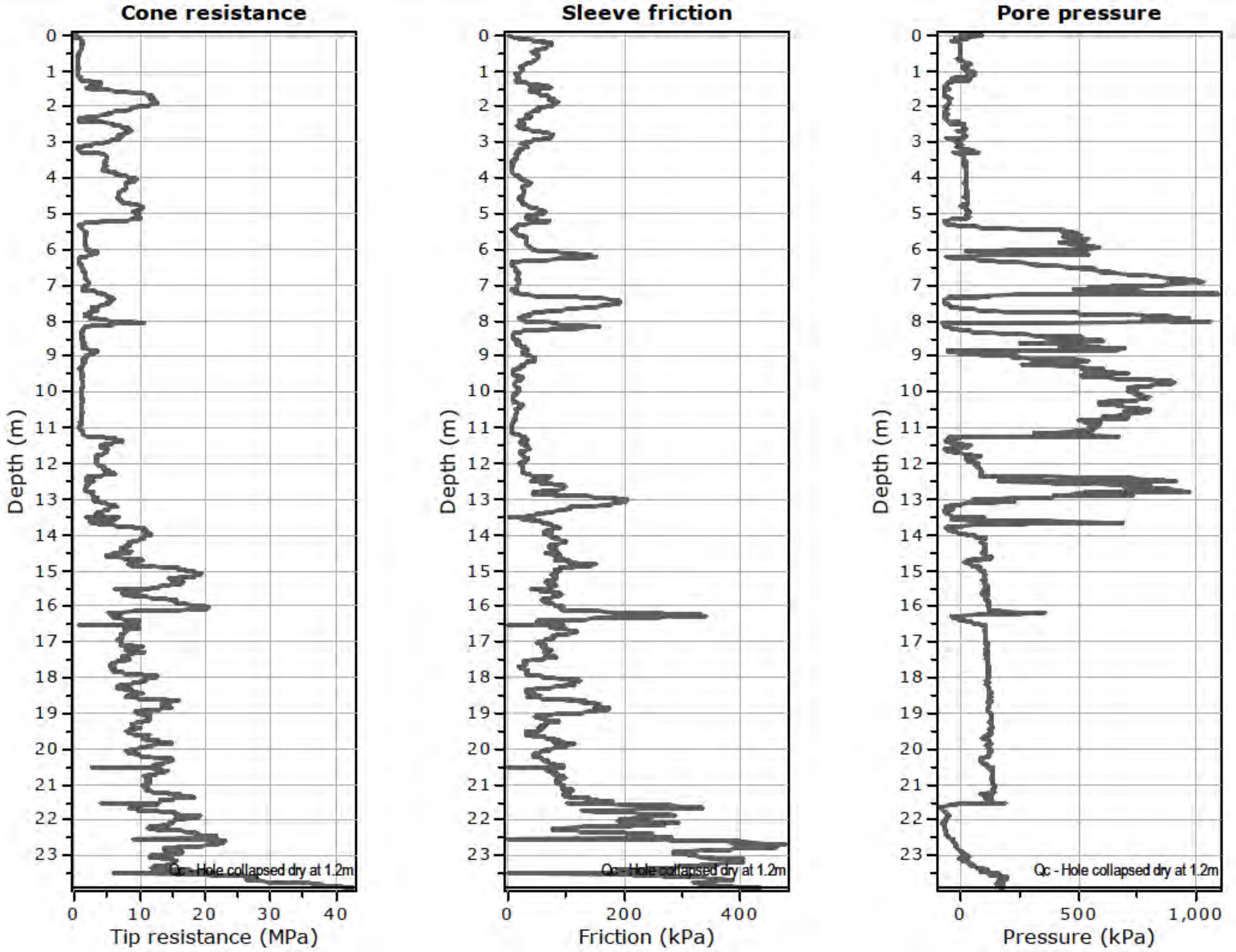
Total depth: 23.89 m, Date: 4/06/2024

Coords: lat -37.82614° lon 175.752408°

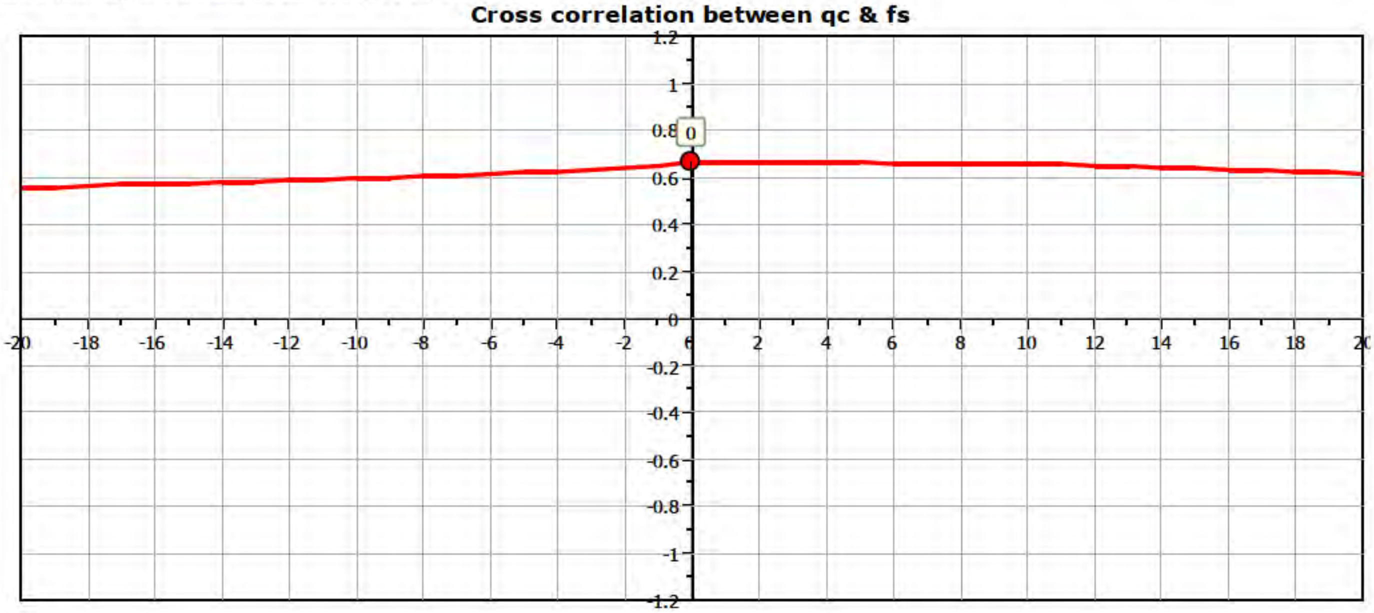
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

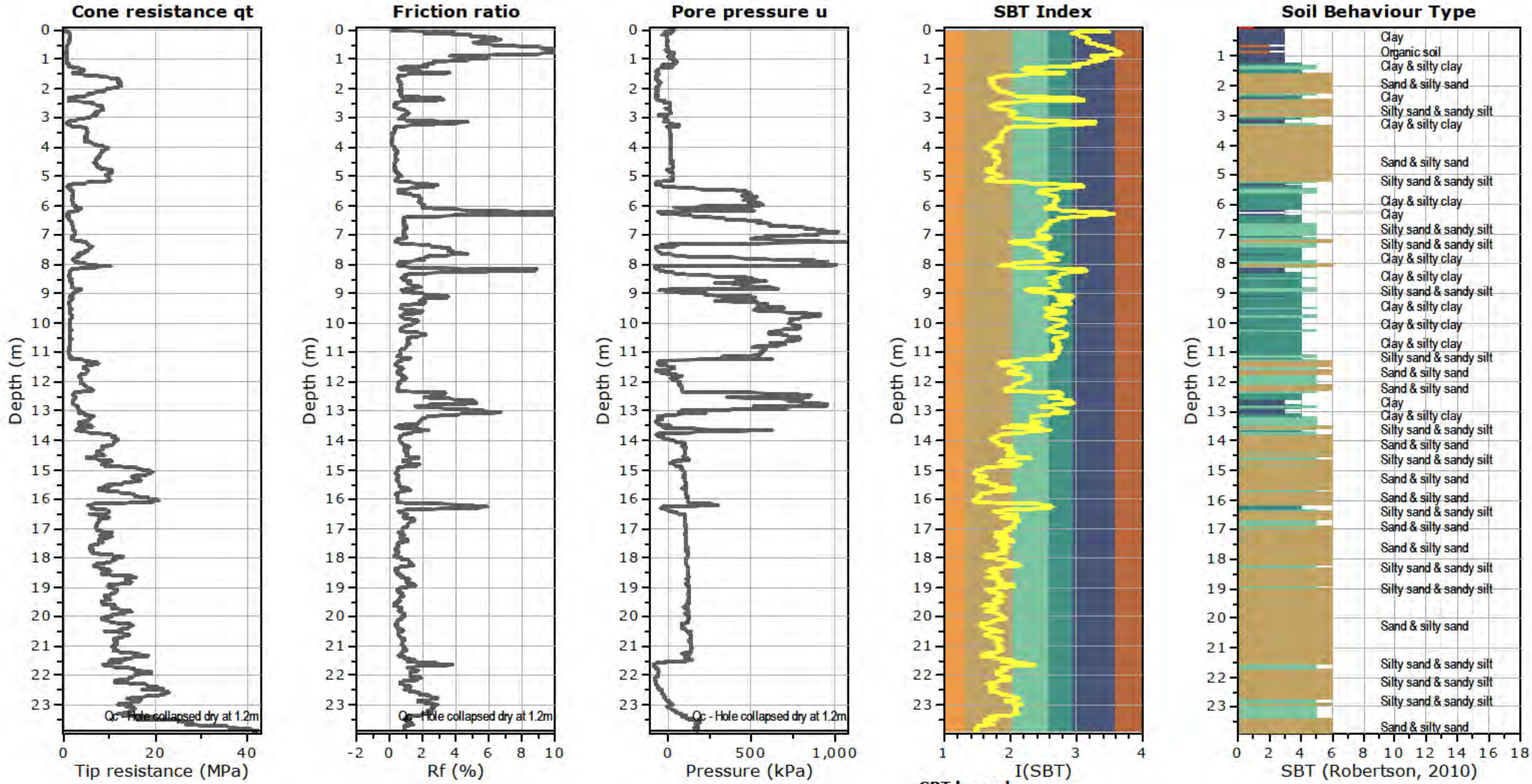


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: 24-10

Total depth: 23.89 m, Date: 4/06/2024
Coords: lat -37.82614° lon 175.752408°
Cone Type: DC10

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **127 Station Road, Matamata | Holes dipped onsite using Dipmeter**



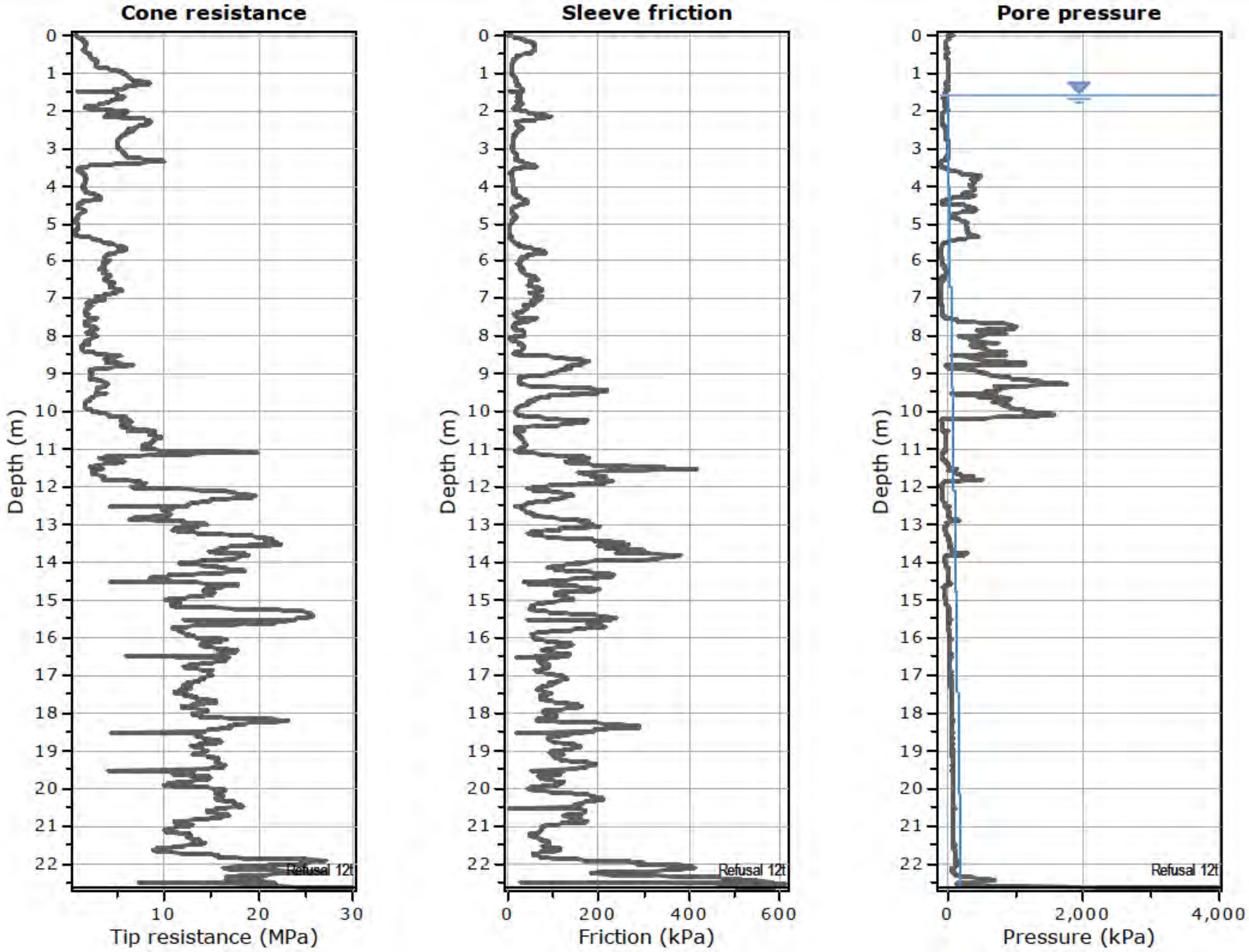
SBT legend

1. Sensitive fine grained
2. Organic material
3. Clay to silty clay
4. Clayey silt to silty clay
5. Silty sand to sandy silt
6. Clean sand to silty sand
7. Gravely sand to sand
8. Very stiff sand to clayey sand
9. Very stiff fine grained

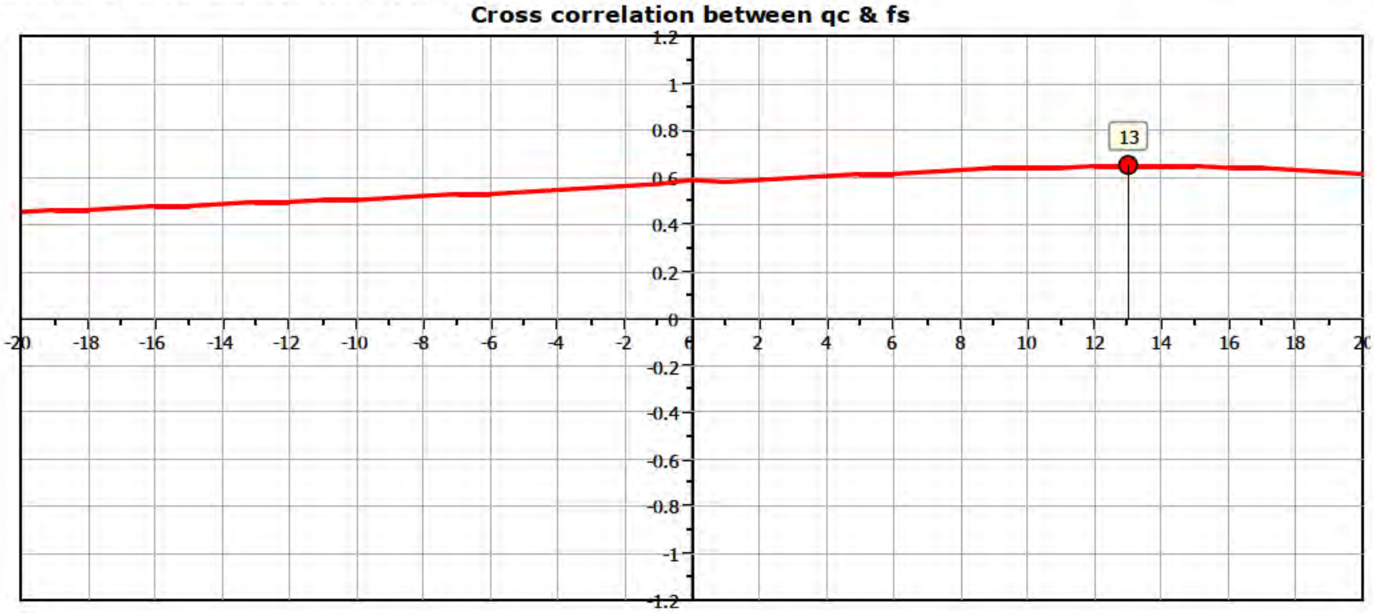
Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-01
Total depth: 22.64 m, Date: 4/06/2024
Coords: lat -37.820766° lon 175.747979°
Cone Type: DC10

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **127 Station Road, Matamata | Holes dipped onsite using Dipmeter**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-01

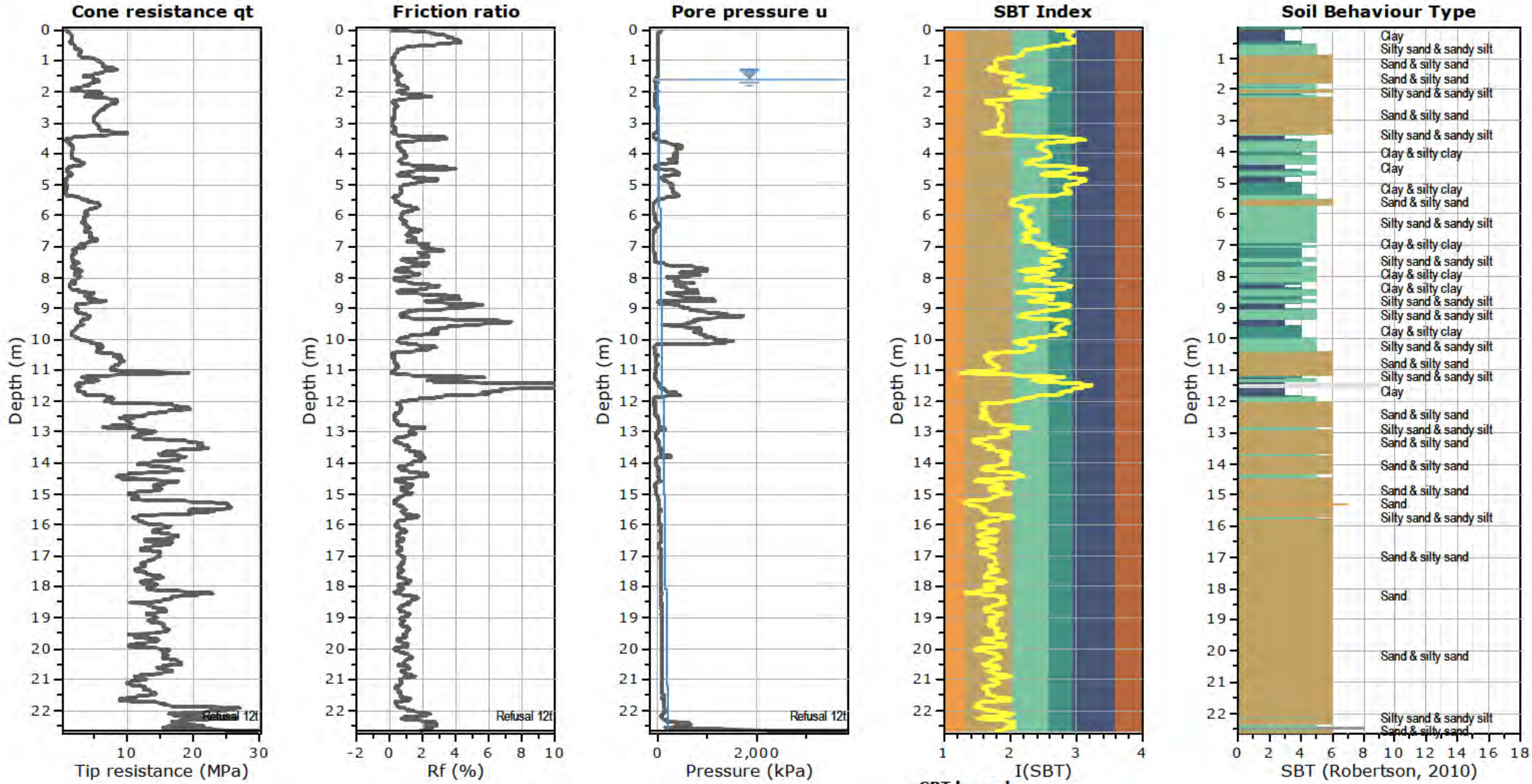
Total depth: 22.64 m, Date: 4/06/2024

Coords: lat -37.820766° lon 175.747979°

Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



SBT legend

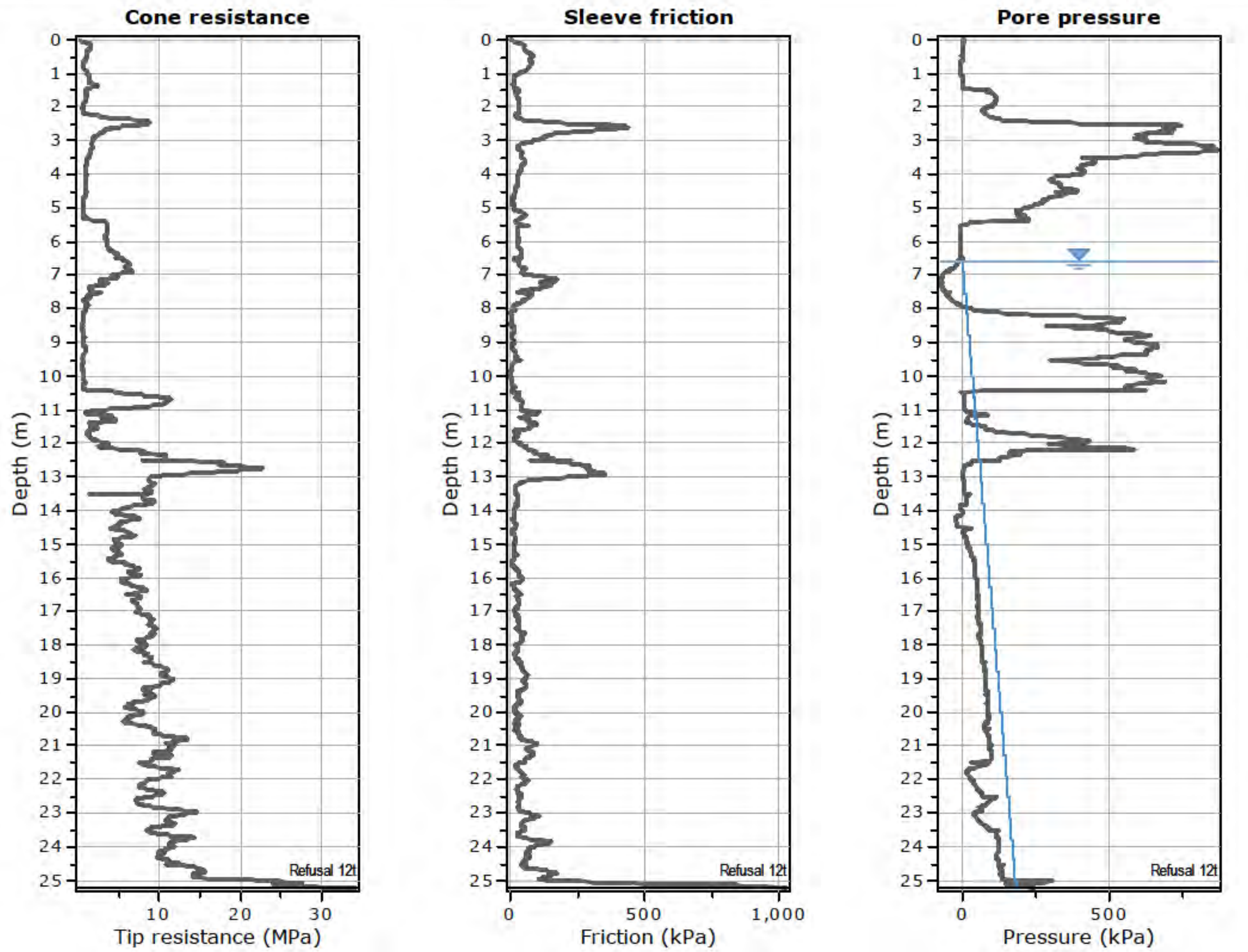
- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

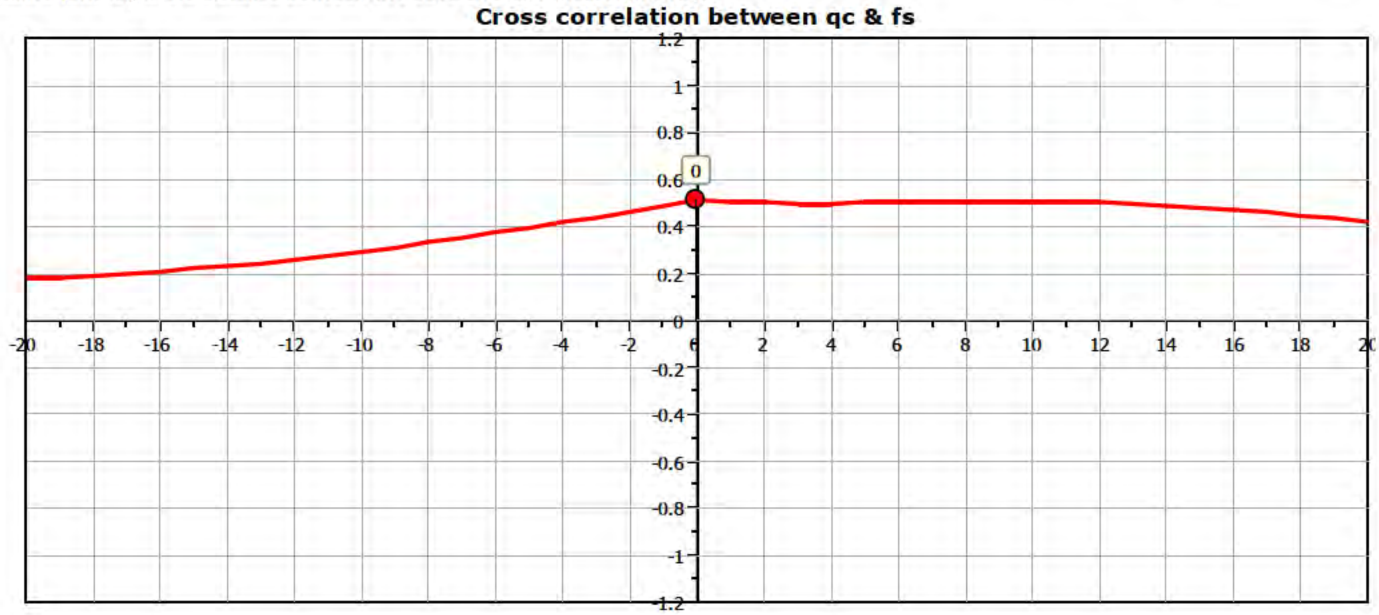
CPT: SCPT24-02

Total depth: 25.23 m, Date: 4/06/2024
Coords: lat -37.822827° lon 175.745404°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



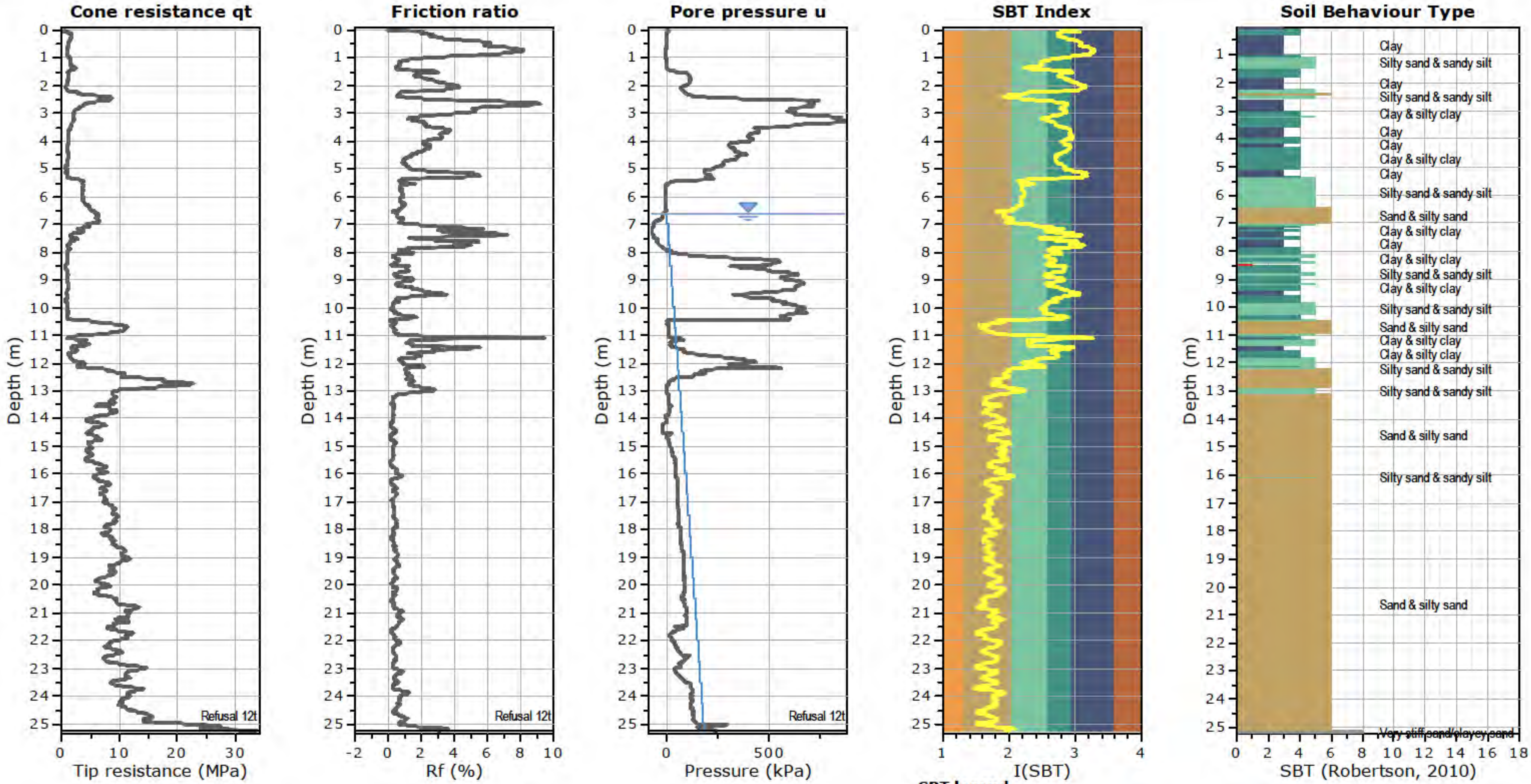
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



GDS
GEO DATA SOLUTIONS
Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-02
Total depth: 25.23 m, Date: 4/06/2024
Coords: lat -37.822827° lon 175.745404°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



SBT legend

- 1. Sensitive fine grained
- 2. Organic material
- 3. Clay to silty clay
- 4. Clayey silt to silty clay
- 5. Silty sand to sandy silt
- 6. Clean sand to silty sand
- 7. Gravely sand to sand
- 8. Very stiff sand to clayey sand
- 9. Very stiff fine grained

Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-03

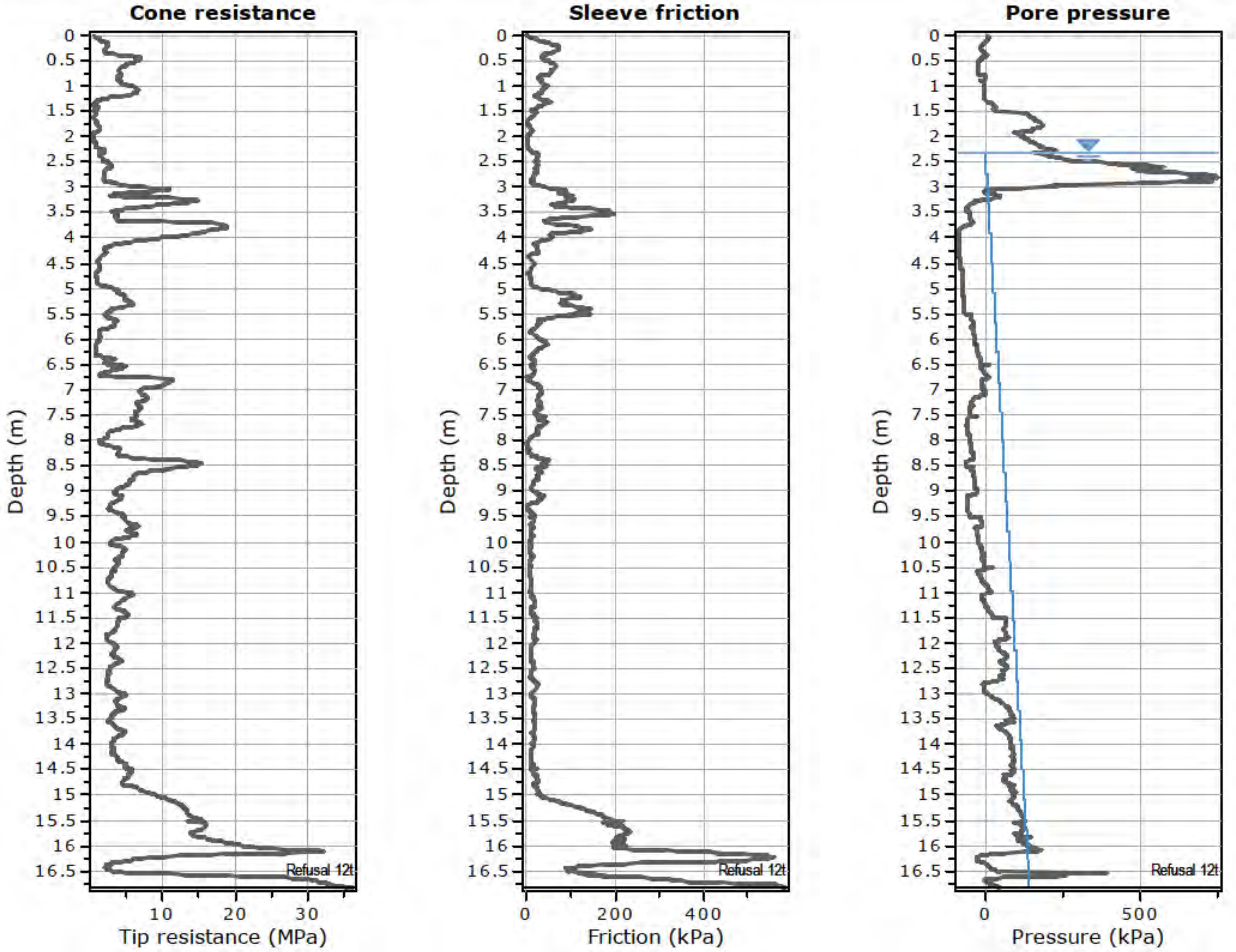
Total depth: 16.83 m, Date: 4/06/2024

Coords: lat -37.825528° lon 175.745502°

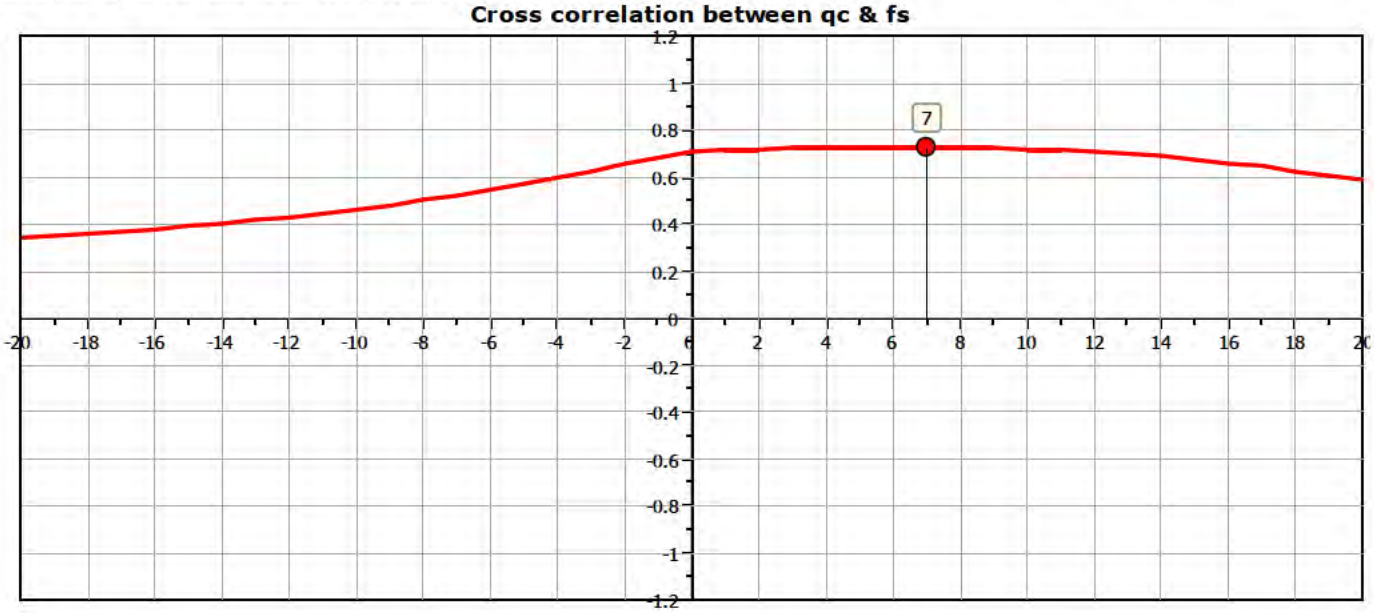
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd

Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



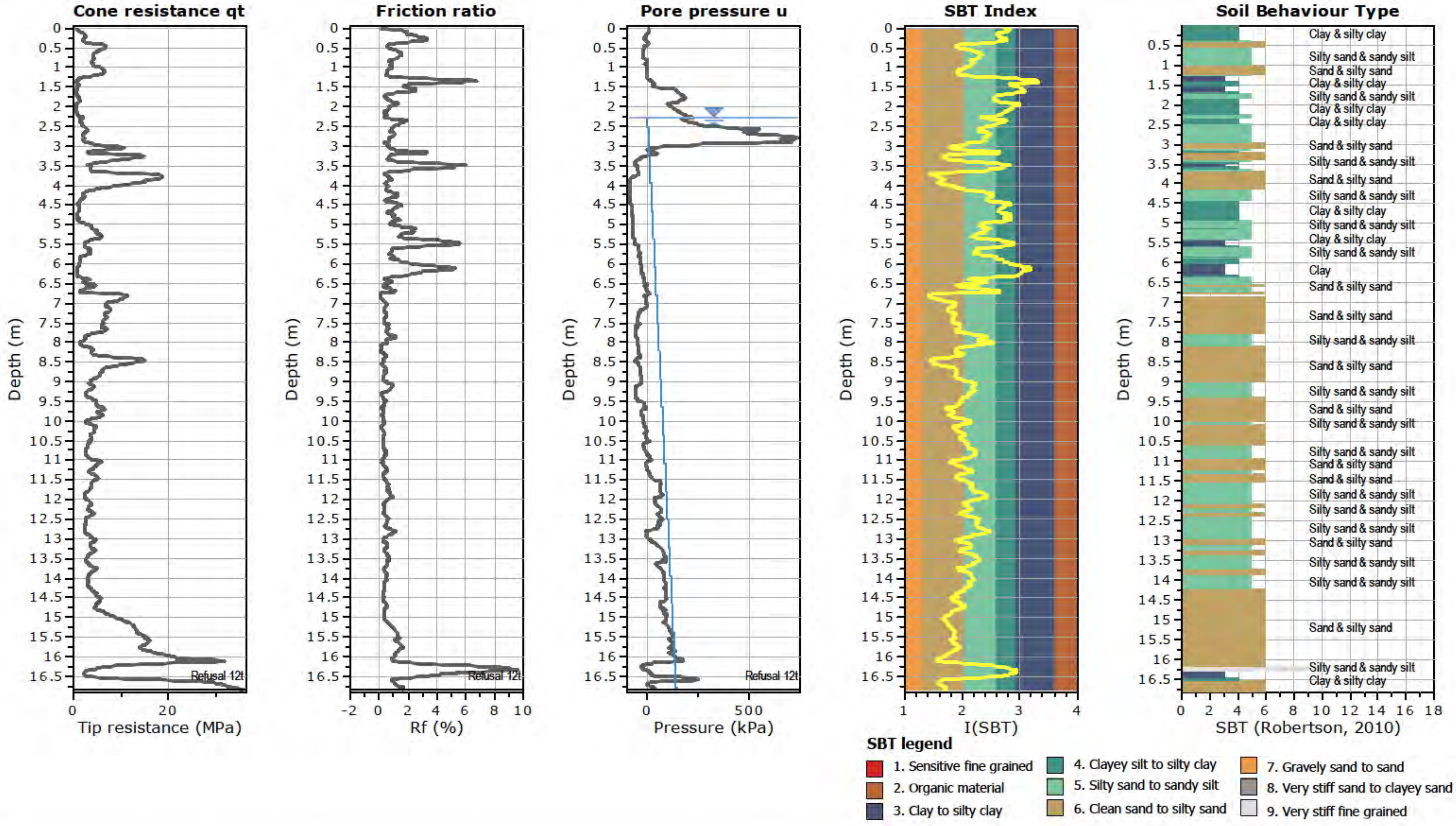
The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).



Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-03
Total depth: 16.83 m, Date: 4/06/2024
Coords: lat -37.825528° lon 175.745502°
Cone Type: DC10

Project: **CMW Geosciences | HAM2023-0124 | GDS NZ Ltd**
Location: **127 Station Road, Matamata | Holes dipped onsite using Dipmeter**

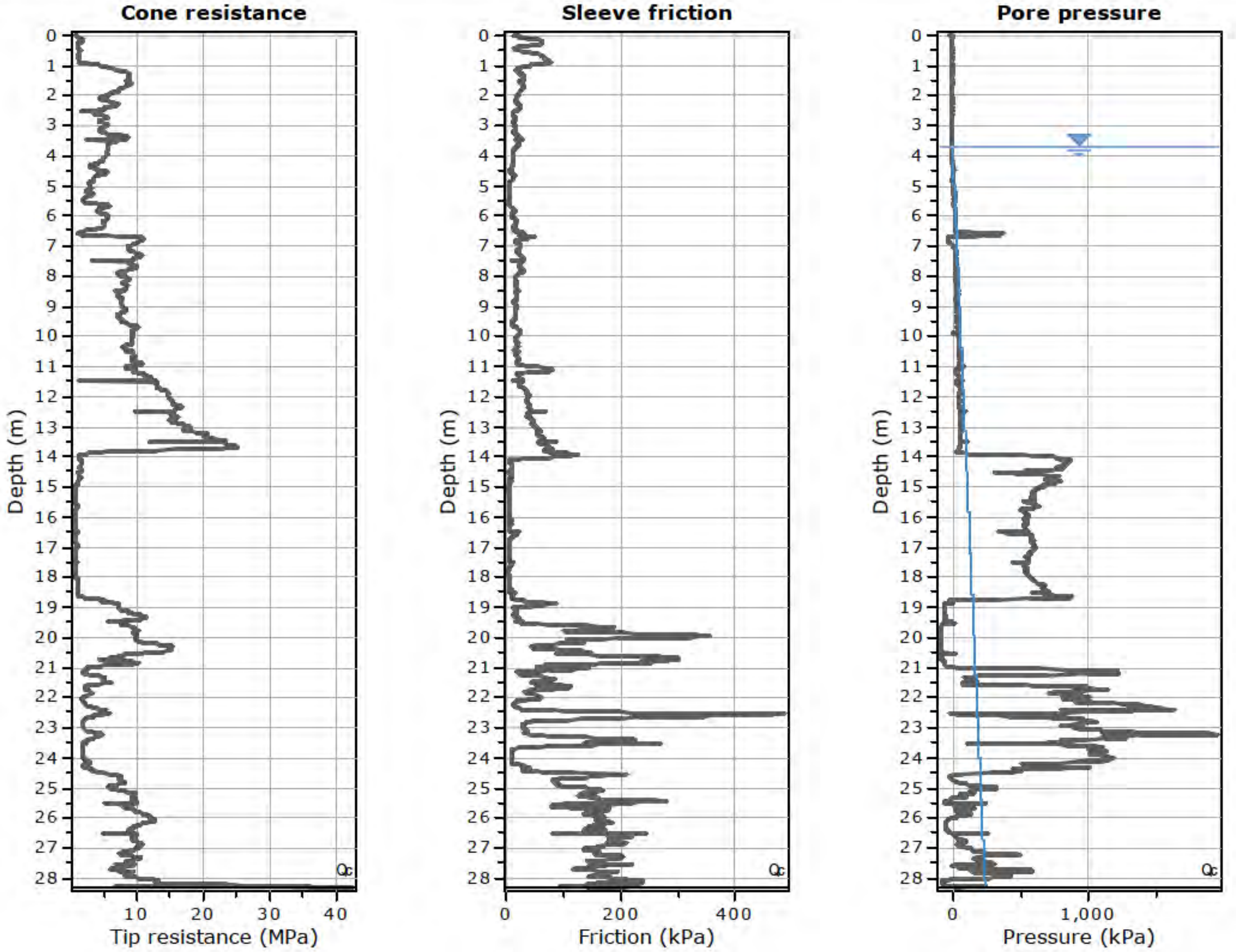


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

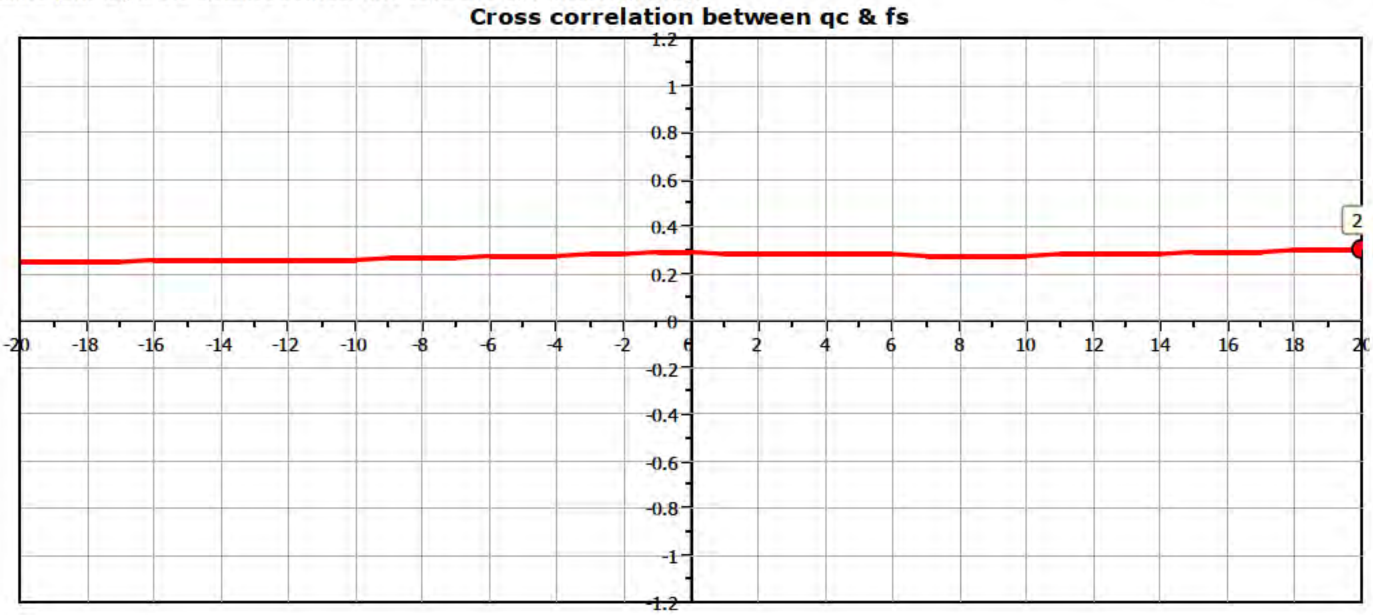
CPT: SCPT24-04

Total depth: 28.31 m, Date: 4/06/2024
Coords: lat -37.825977° lon 175.756443°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

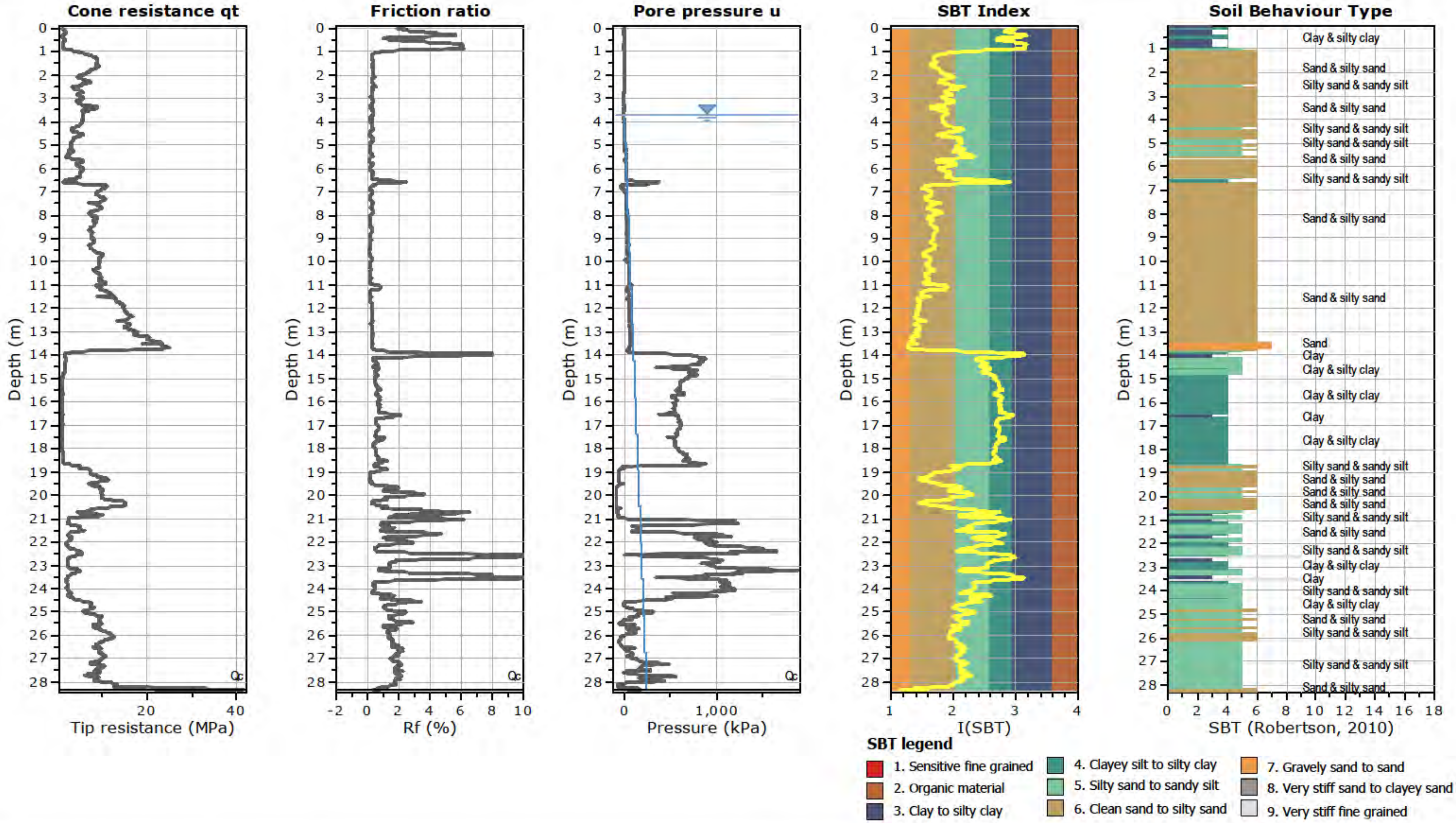


Geo Data Solutions (GDS) NZ Ltd.
Email: Josh@gdsnz.co. nz
www.gdsnz.co.nz

CPT: SCPT24-04

Total depth: 28.31 m, Date: 4/06/2024
Coords: lat -37.825977° lon 175.756443°
Cone Type: DC10

Project: CMW Geosciences | HAM2023-0124 | GDS NZ Ltd
Location: 127 Station Road, Matamata | Holes dipped onsite using Dipmeter



APPENDIX F: GEOHAZARDS ASSESSMENT TABLE

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
1	Earthquake	Seismicity	Entire Site	Site subsoil class = Class D due to less than dense/ stiff soil profile Importance Level = 2 (Residential Subdivision) Importance Level = 3 (Solar Farm)	1	5	5	None	1	5	5
		Fault Rupture	Entire Site	Nearest active fault (Kerpehi fault) is approximately 5km from the site. (Refer to section 6.2)	1	5	5	Mitigation not required	1	5	5
		Liquefaction	Whole site	Refer to section 6.3	3	4	12	TC2 or TC2-TC3 hybrid foundations required.	3	2	6
		Cyclic Softening	Entire Site	Not anticipated.	1	4	4	Mitigation not required.	1	4	4
		Lateral Spread	Swale drains, proposed greenway and riverbanks	Refer to Section 6.5	3	4	12	Lateral spreading risk should be considered in the design, further investigation and analysis will be required.	3	2	6

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
2	Volcanic Activity	Ash and Pyroclastic Falls	Entire Site	Nearest active volcano is the Rotorua Caldera. Currently at alert level 0.	1	5	5	Mitigation not required.	1	5	5
3	Slope Instability / Landslide	Global Instability	Entire site	Due to the landform being generally near level to gently sloping, slope instability is not anticipated.	1	4	4	Mitigation not required.	1	4	4
4	Problematic Soils	Expansive Soils	Entire Site	Experience in similar soils indicate that the soils on site are non-expansive.	2	3	6	Mitigation not required.	2	3	6
5	Settlement	Compressible Soils	Entire Site	No compressible soils were encountered on site.	1	4	4	Mitigation not required.	1	4	4
		Fill Induced Settlement	Entire Site	No earthwork plans are available at the time of writing report. Site is primarily underlain with dense to very dense sand and stiff to very stiff silt. It is anticipated any fill induced settlement would occur immediately and be built out during construction.	2	4	8	Mitigation not required based on current details. Will have to be assessed once cut/ fill plans are available.	1	4	4

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
6	Bearing Capacity	Bearing Capacity Failure	Building Platform	Refer to Section 7.4 of the report	1	5	5	A preliminary geotechnical ultimate bearing capacity (GUBC) of 300kPa should be available in the static case. Low ultimate bearing capacity is anticipated in the seismic case.	1	5	5
7	Construction Risks	Excavatability	Building Platform	Given the density of the soil units that will be encountered, excavation is expected to be readily achieved with normal earthworks plant. However, excavations may require temporary support due to high expected groundwater and granular soils leading to 'running sands'.	3	3	9	Consideration to be given to sensitive silts and shallow groundwater table.	3	2	6
		Sediment Retention Ponds	Building Platform	Sediment retention ponds will require geotechnical input at design stage to ensure batter stability is achievable.	2	3	6	Consideration to be given to batter stability of proposed ponds at design and construction phase.	2	2	4
		Stockpile locations	Building Platform	Stockpiles to be away from the river bank.	1	2	2	Stockpiles to be away from the river bank.	1	2	2

Appendix F - Geohazard Assessment Summary											
Item	Geotechnical Hazard	Description	Area Affected	Assessment Outcome	Existing Risk of Damage to Land / Structures			Mitigation Measure	Residual Risk of Damage to Land / Structures		
					Likelihood	Consequence	Risk Rating		Likelihood	Consequence	Risk Rating
		Subgrade Preparation	Building Platforms and Road Alignment	Topsoil and existing vegetation within the building footprints and road alignments will be cleared as part of the proposed development earthworks.	1	2	2	Mitigation not required.	1	2	2
		Service Trenches (trench collapse / long term settlement)	Building Platform and Road Alignment	Trench collapse may occur in surficial soils / if proposed service trenches extend below GW level.	3	3	9	Mitigation should be considered in the form of: - trench support - temporary dewatering, in the form of regularly spaced pumps	3	1	3

GEOHAZARD ASSESSMENT FOR LAND SUBDIVISION

Station Road, Matamata

The occurrence of natural hazards and their potential impacts on the proposed subdivision development is assessed in terms of risk significance, which is based on likelihood and consequence factors. A risk table is used to help assess the likelihood and consequence factors, the form of which used by CMW for this project is presented in Table B1.

Table B1: Natural Hazard Risk Classification

Risk Matrix		Consequence				
		Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	Almost Certain 5	Medium 5	High 10	Very high 15	Extreme 20	Extreme 25
	Likely 4	Low 4	Medium 8	High 12	Very high 16	Extreme 20
	Moderate 3	Low 3	Medium 6	Medium 9	High 12	Very high 15
	Unlikely 2	Very low 2	Low 4	Medium 6	Medium 8	High 10
	Rare 1	Very low 1	Very low 2	Low 3	Low 4	Medium 5

1.1 Likelihood

With respect to assessing the likelihood or chance of the risk occurring, the qualitative definitions used by CMW for this project are provided in Table B2 for each likelihood classification.

Table B2: Qualitative Natural Hazard Likelihood Definitions

1	Rare	The natural hazard is not expected to occur during the design life of the project
2	Unlikely	The natural hazard is unlikely, but may occur during the design life
3	Moderate	The natural hazard will probably occur at some time during the life of the project
4	Likely	The natural hazard is expected to occur during the design life of the project
5	Almost Certain	The natural hazard will almost definitely occur during the design life of the project

1.2 Consequence

In terms of determining the consequence or severity of the natural hazard occurring, the qualitative definitions used by CMW for this project are provided in Table B3 for each consequence classification.

Table B3: Qualitative Natural Hazard Consequence Definitions		
1	Insignificant	Very minor to no damage, not requiring any repair, no people at risk, no economic effect to landowners.
2	Minor	Minor damage to land only, any repairs can be considered normal property maintenance no people at risk, very minor economic effect.
3	Moderate	Some damage to land requiring repair to reinstate within few months, minor cosmetic damage to buildings being within relevant code tolerances, does not require immediate repair, no people at risk, minor economic effect.
4	Major	Significant damage to land requiring immediate repair, damage to buildings beyond serviceable limits requiring repair, no collapse of structures, perceptible effect to people, no risk to life, considerable economic effect.
5	Catastrophic	Major damage to land and buildings, possible structure collapse requiring replacement, risk to life, major economic effect, or possible site abandonment.

1.3 Risk Acceptance

It is recognised that the natural hazard risk assessment provided herein is qualitative and, due to the wide range of possible geohazards that could occur, is somewhat subjective. Other methods are available to quantitatively assess an acceptable level of geotechnical related natural hazard risk, such as defining an acceptable factor of safety with respect to slope stability or acceptable differential ground settlements with respect to recommended building code limits.

Therefore, to give this qualitative natural hazard risk assessment some relevance to more commonly adopted numerical or quantitative geotechnical assessment techniques, a residual risk rating of very low to medium (risk value = 1 to 9 inclusive) is considered an acceptable result for the proposed subdivision development.

A risk rating of high to extreme (risk value ≥ 10) is considered an unacceptable result for the proposed subdivision development.

1.4 Geohazards Assessment Summary

The table below is a summary of critical geohazards to this project and is based on information available to date.

APPENDIX G: LIQUEFACTION RESULTS

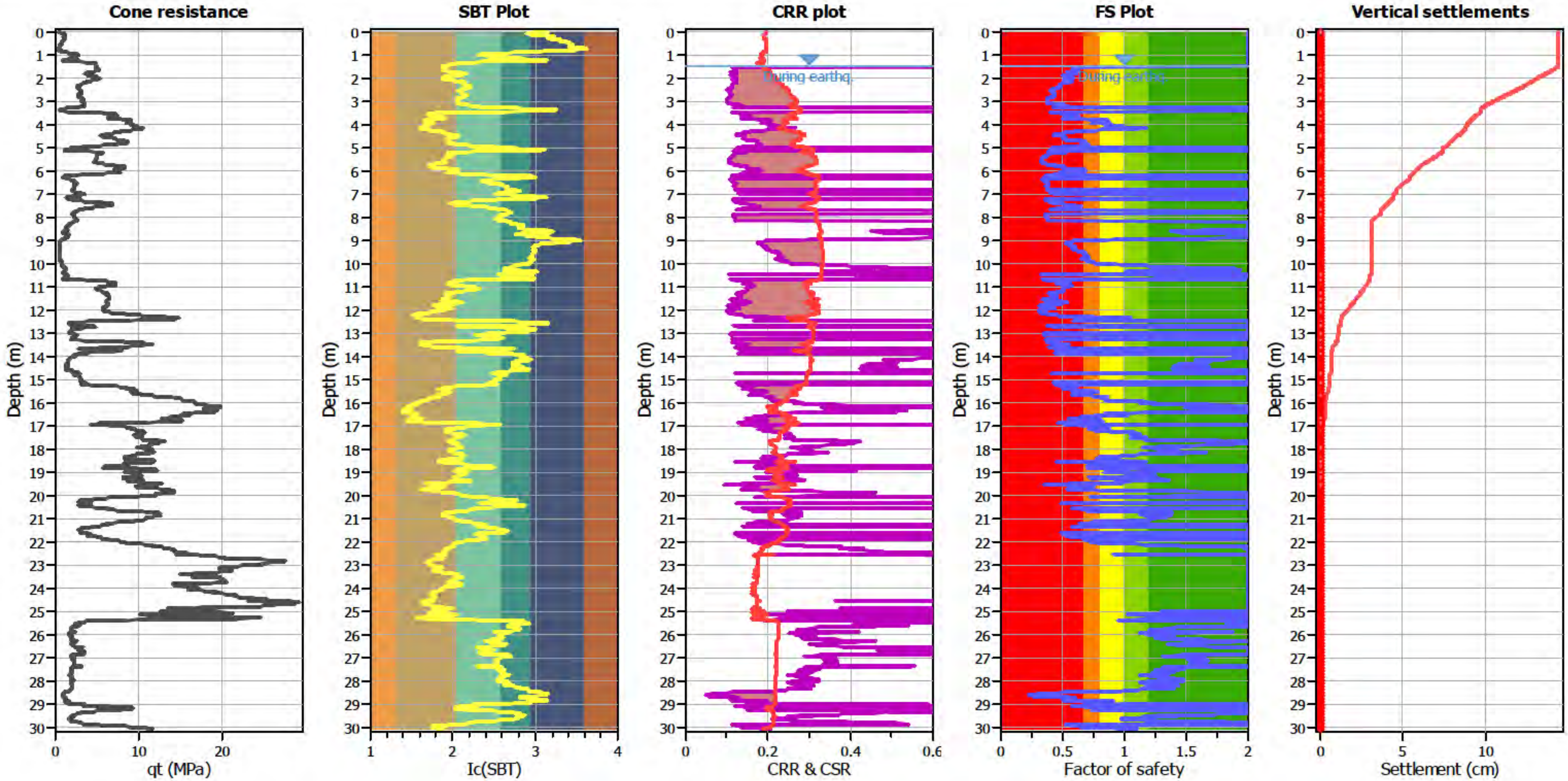
CMW Geosciences
Great People | Practical Solutions

Project: Station Road Proposed Subdivision

Location: Station Road, Matamata

CPT: CPT24-04

Total depth: 30.04 m



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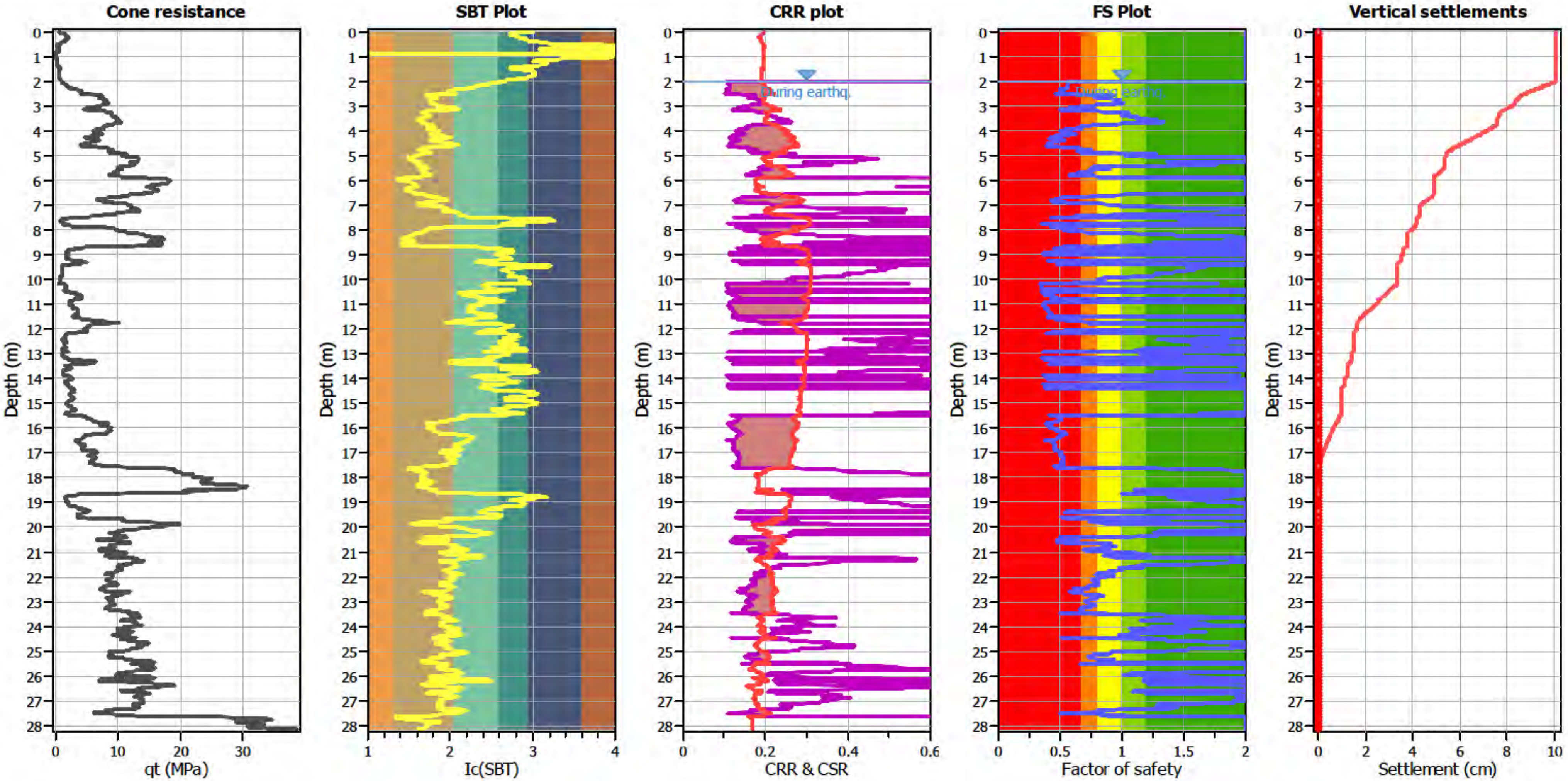
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

CPT: CPT24-05
Total depth: 28.14 m



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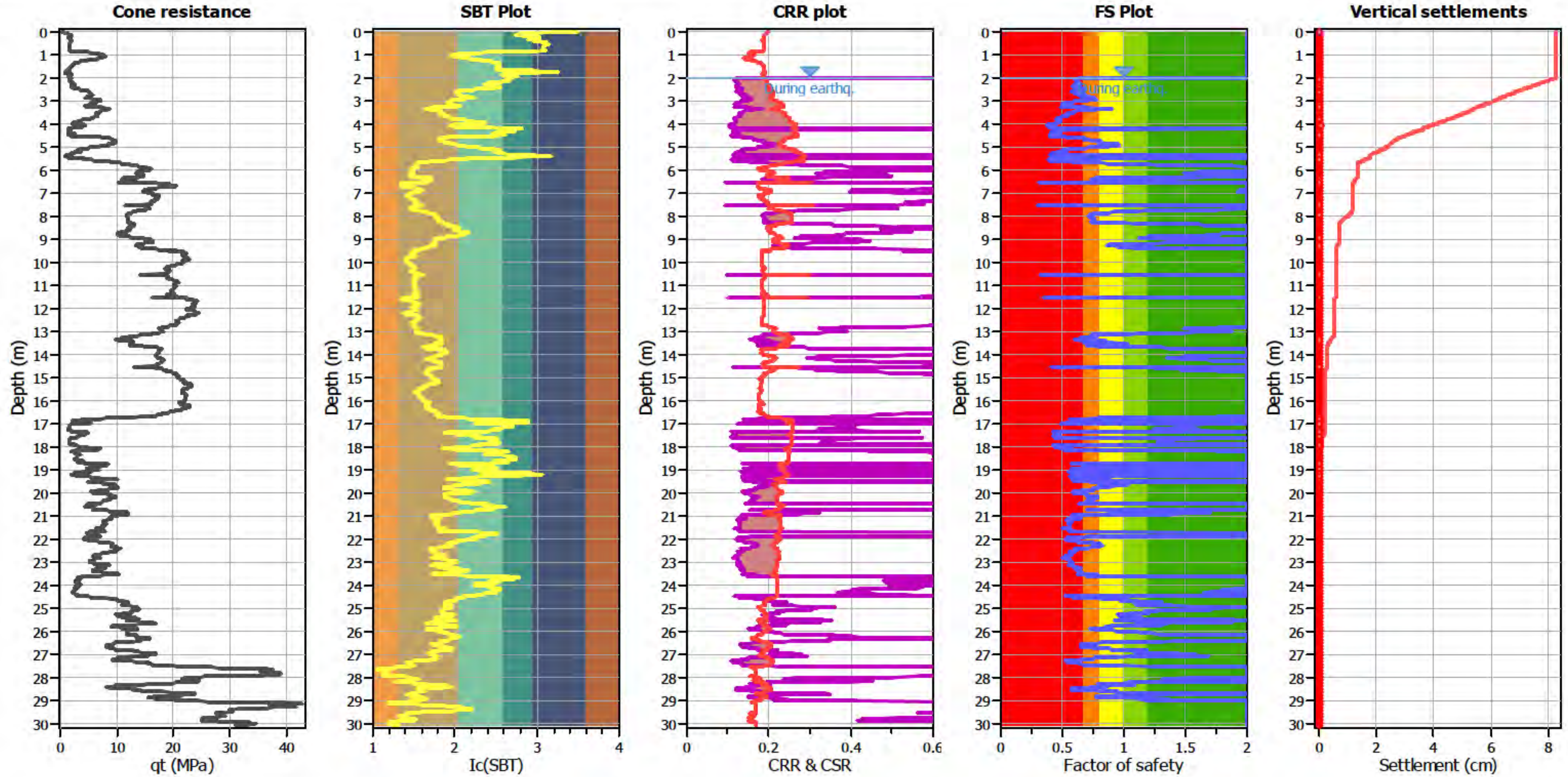
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

CPT: CPT24-06
Total depth: 30.06 m



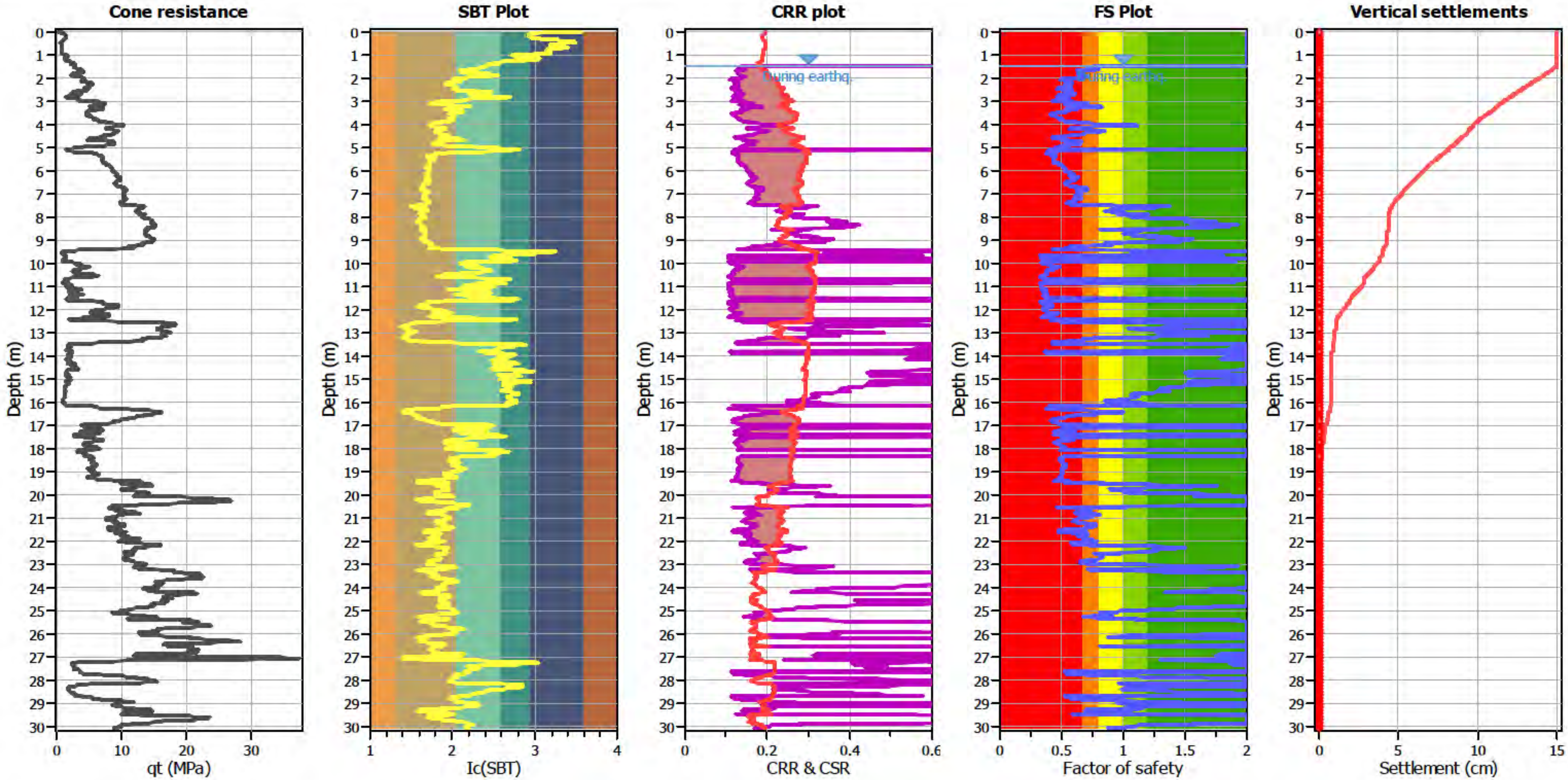
Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision

Location: Station Road, Matamata

CPT: CPT24-07

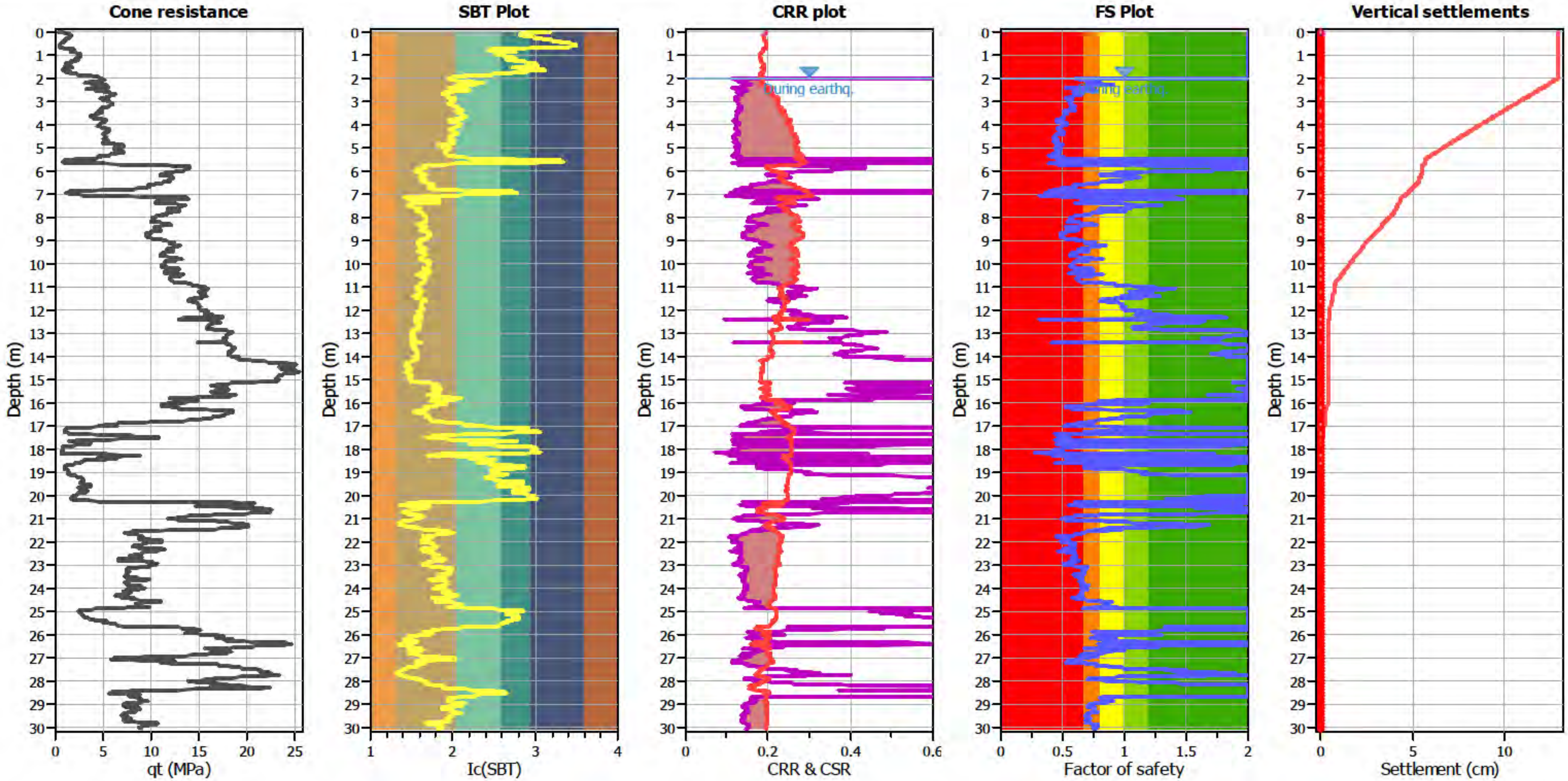
Total depth: 30.07 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **Station Road Proposed Subdivision**
Location: **Station Road, Matamata**

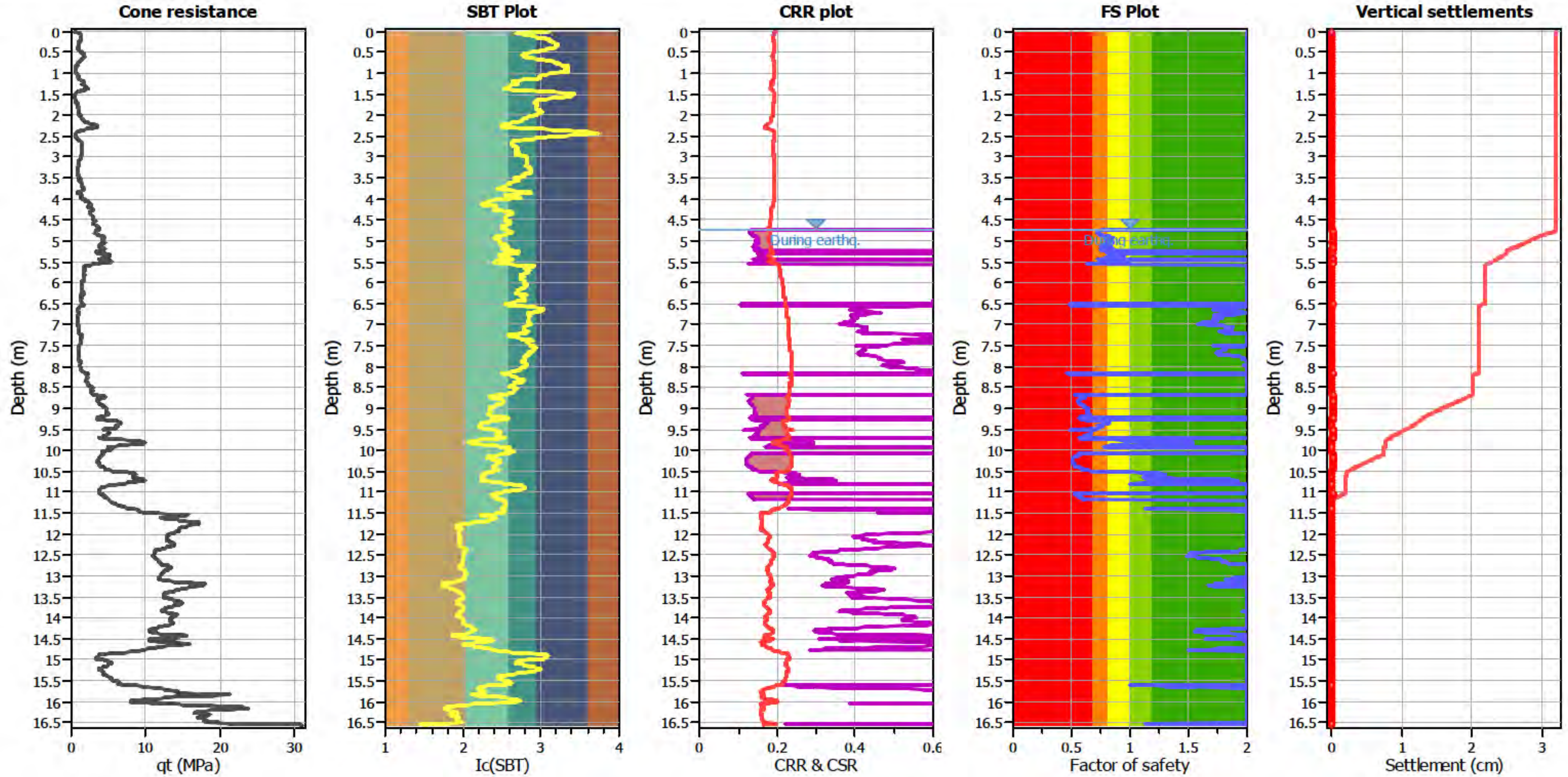
CPT: CPT24-08
Total depth: 30.08 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	2.00 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	2.00 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **Station Road Proposed Subdivision**
Location: **Station Road, Matamata**

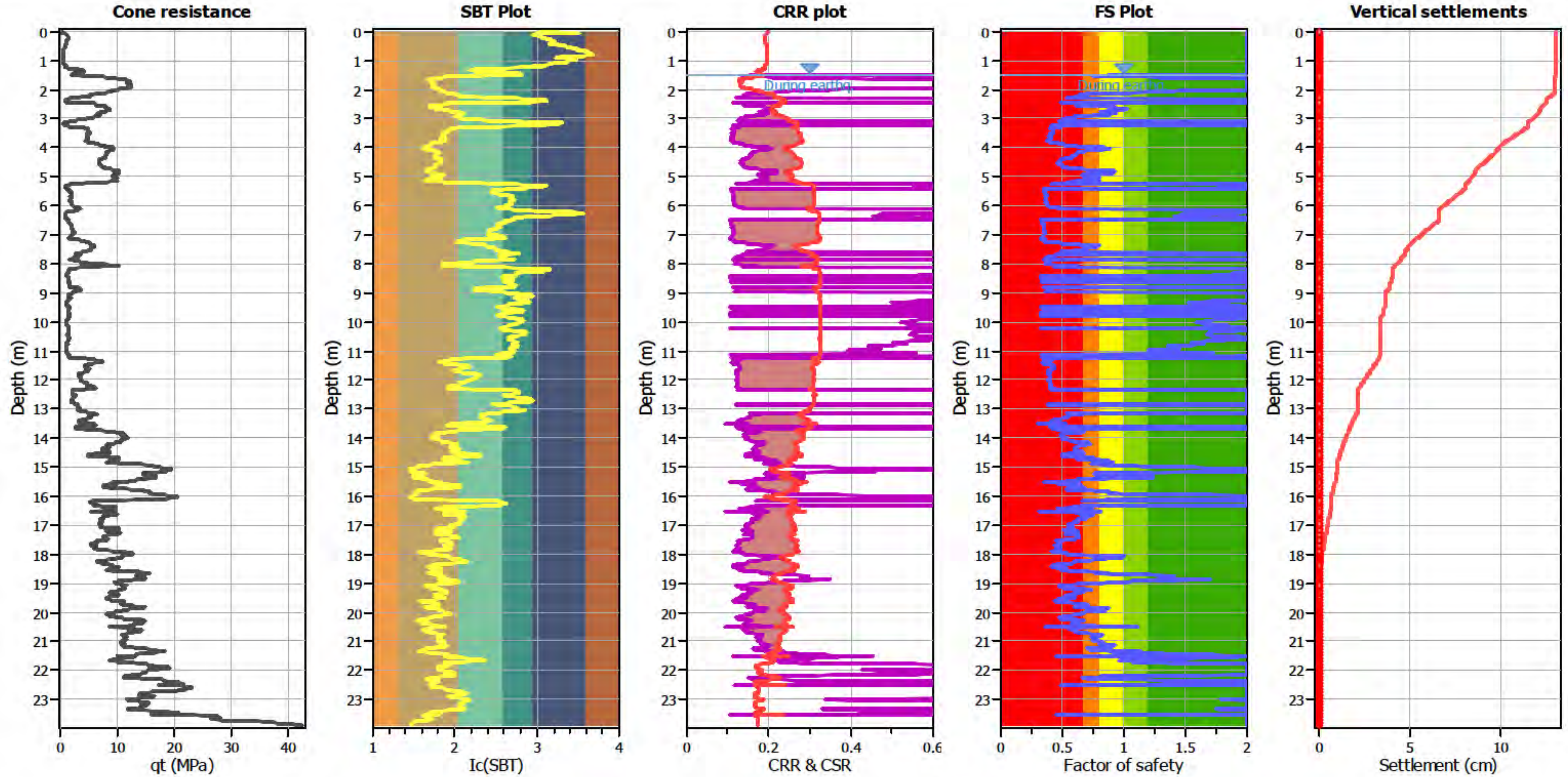
CPT: CPT24-09
Total depth: 16.56 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	4.75 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	4.75 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

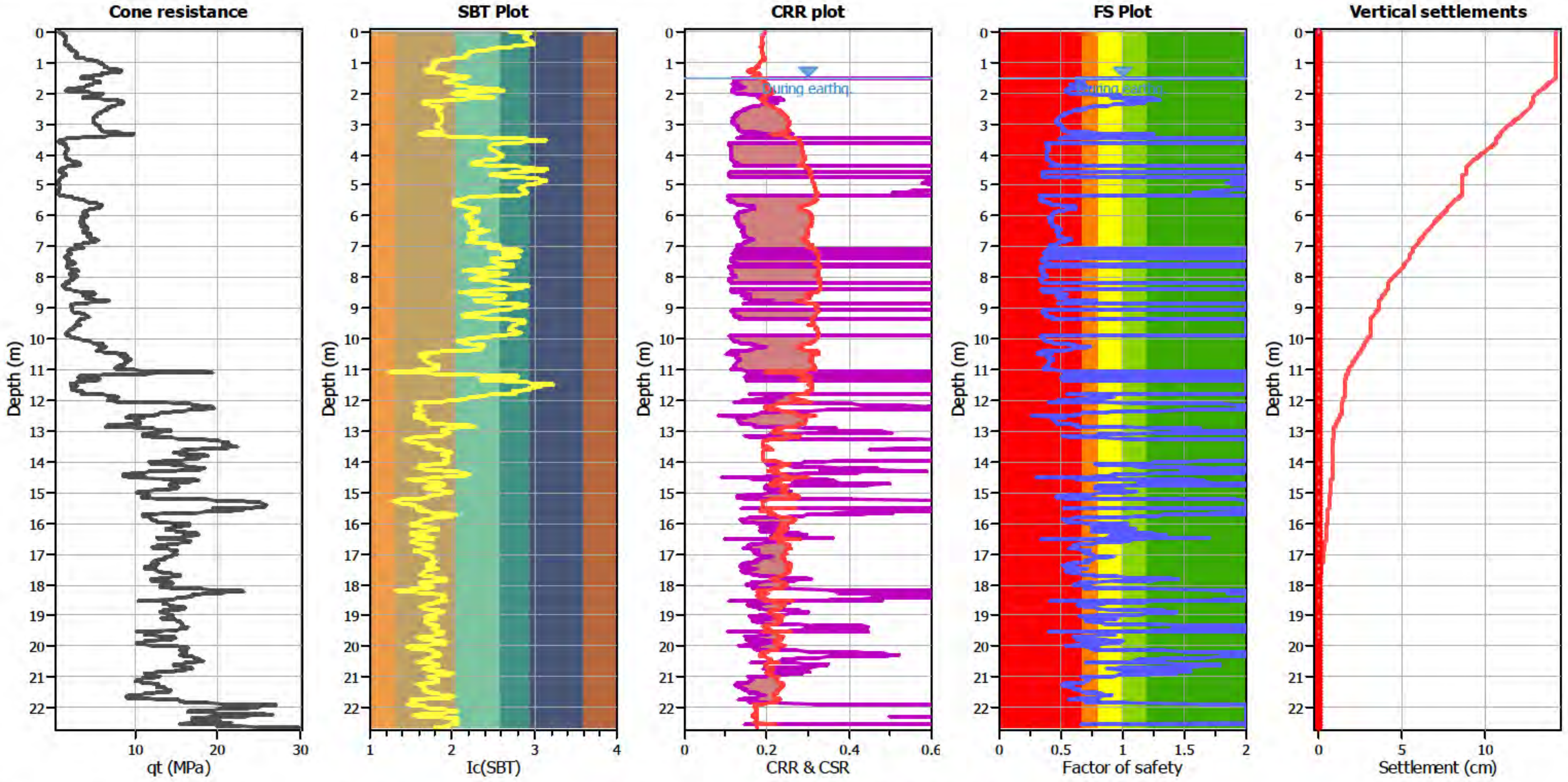
CPT: CPT24-10
Total depth: 23.89 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: **Station Road Proposed Subdivision**
Location: **Station Road, Matamata**

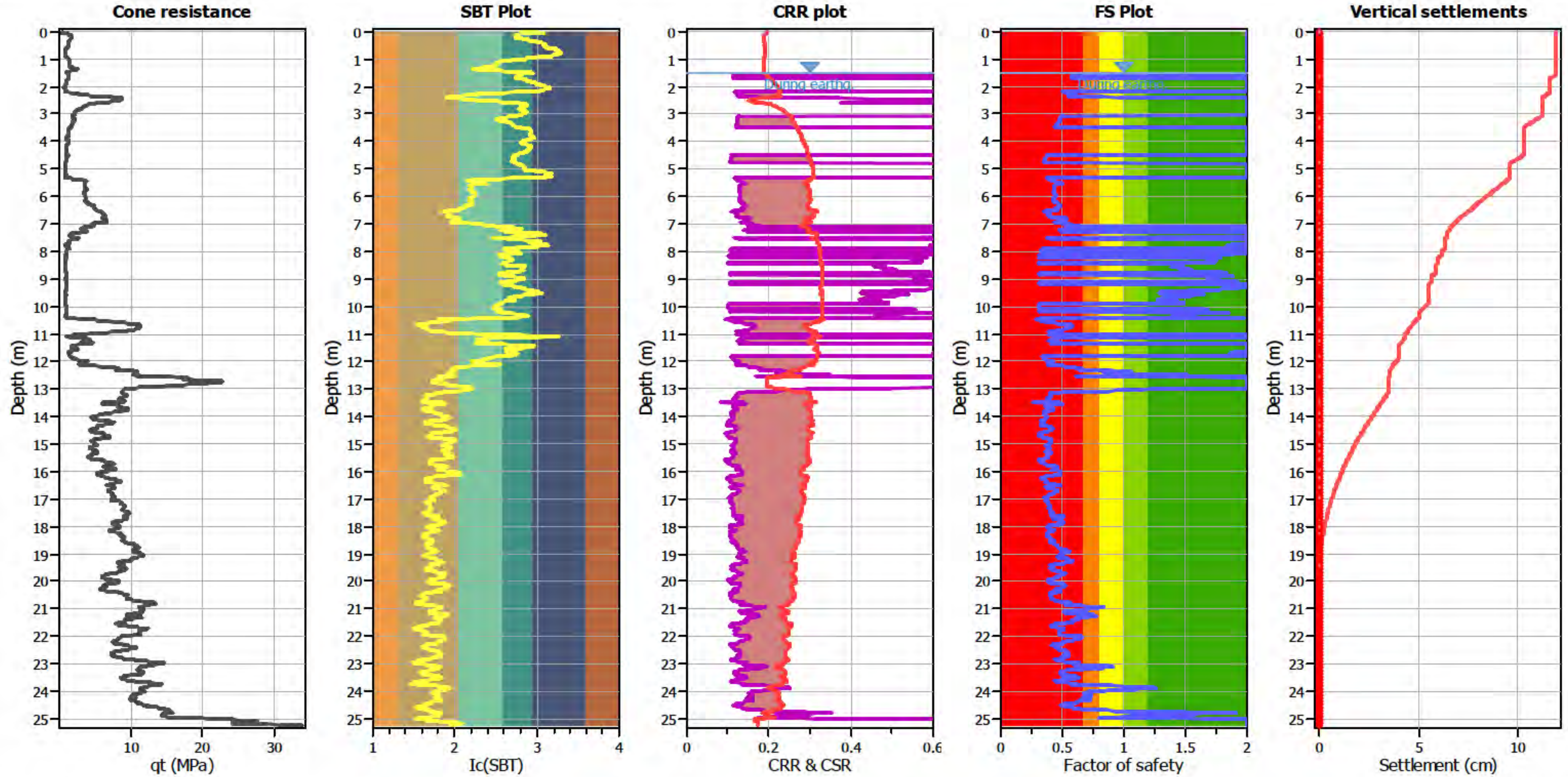
CPT: SCPT24-01
Total depth: 22.64 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

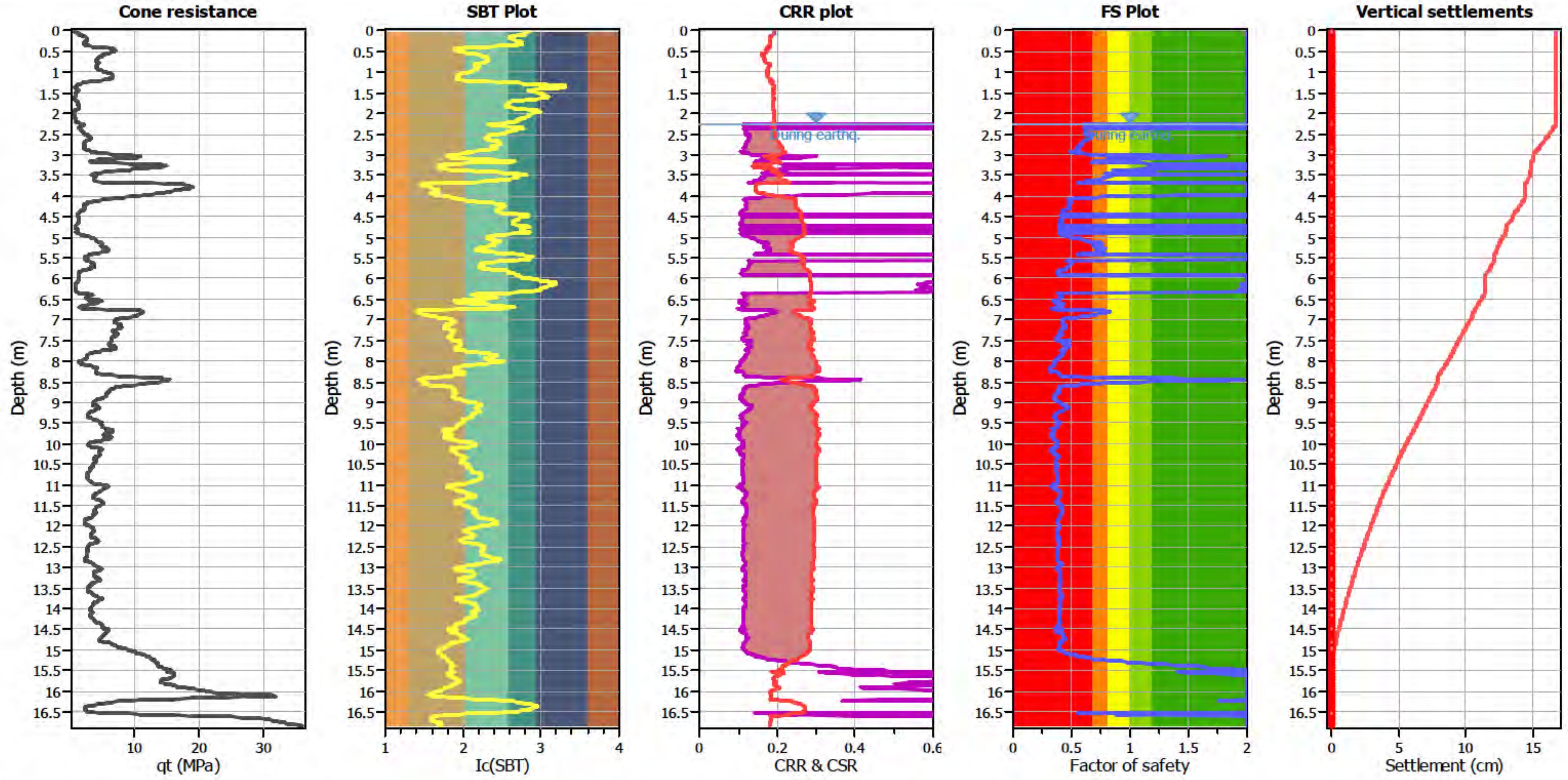
CPT: SCPT24-02
Total depth: 25.23 m



Analysis method:	B&I (2014)	G.W.T. (in-situ):	1.50 m	Use fill:	No	Clay like behavior applied:	.
Fines correction method:	B&I (2014)	G.W.T. (earthq.):	1.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

CPT: SCPT24-03
Total depth: 16.83 m



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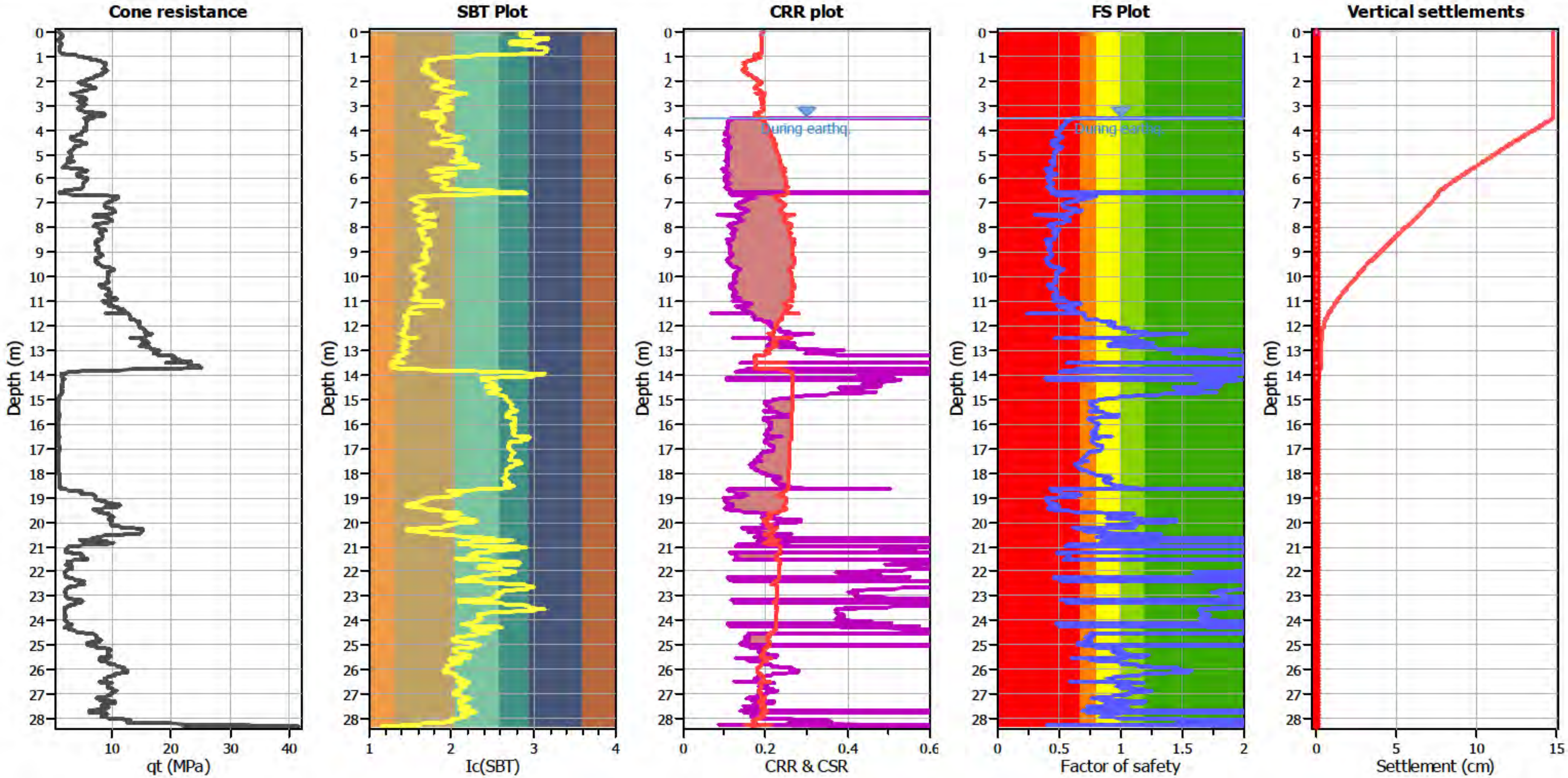
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

Project: Station Road Proposed Subdivision
Location: Station Road, Matamata

CPT: SCPT24-04
Total depth: 28.31 m



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Fines correction method:	B&I (2014)	G.W.T. (earthq.):	3.50 m	Fill height:	N/A	Limit depth applied:	No
Points to test:	Based on Ic value	Average results interval:	3	Fill weight:	N/A	Limit depth:	N/A
Earthquake magnitude M_w:	5.90	Ic cut-off value:	2.60	Trans. detect. applied:	No	MSF method:	Method based
Peak ground acceleration:	0.36	Unit weight calculation:	Based on SBT	K_σ applied:	Yes		

APPENDIX H: SAFETY IN DESIGN RISK ASSESSMENT

CMW Safety in Design Risk Assessment

HAM2023-0124 - Station Road Proposed Subdivison and Solar Farm

Design Element	Hazard	Description	Assessed Risk			Controls Incorporated in Design	Residual Risk		
			Consequence	Likelihood	Risk Rating		Consequence	Likelihood	Risk Rating
Retaining Walls (If required)	Falling from height	Injury to construction staff while constructing or public once wall is constructed.	4	3	12	Temporary barrier fence to avoid public climbing, permanent fencing to be considered to prevent falls access.	4	1	4
	Striking underground services	Injury to construction staff if live services are struck.	4	2	8	All sites cleared for services prior to construction requiring digging or boring into the ground.	4	1	4
	Moving Machinery	Lifting and swing area of machinery may cause injury to construction staff.	4	3	12	Separate moving machinery from light vehicles and person movements with fencing and/or safe distances from exposed construction staff operations.	4	1	4
	Working at edges of excavations	Injury to construction staff or public by falling into excavations.	4	3	12	Site to be made safe if excavations are to be left open and public can access, excavations to be filled or securely covered on same day of excavation, safe distances from excavations to be maintained and demarked with boundary fence.	4	1	4
	Excavation collapse	Injury to construction staff or persons able to access the excavation after hours.	4	3	12	Staged excavation to be undertaken where able, boundary fence where excavations are under construction or other means of separation for staff or public from potential collapse.	4	1	4
	Retaining wall failure	Exceed specified loading conditions, wall drainage blockage.	4	2	8	Appropriate construction and permanent loading conditions allowed for, design adequate drainage measures, assess impact of blocked drainage on design.	4	1	4
	Falling objects from above	Injury to construction staff or persons under the proposed wall.	4	3	12	Hard hats to be worn at all times as the wall is constructed and where lifting is undertaken, safe distance from any lifting or movements above when being undertaken.	4	1	4
Earthworks	Falling from height	Injury to construction staff while constructing steep temporary or permanent earthworks cut or fill faces.	4	3	12	Temporary barrier fence or other means to be used to ensure persons cannot access to the edge of steep excavations	4	1	4
	Striking underground services	Injury to construction staff if live services are struck.	4	2	8	All sites cleared for services prior to site investigations and earthworks construction	4	1	4
	Moving Machinery	Injury to construction staff.	4	3	12	Separate moving machinery from light vehicles and person movements with fencing and/or safe distances from exposed construction staff operations.	4	1	4
	Working at edges of excavations	Injury to construction staff.	4	3	12	Install safety barriers, exclusion zones, signage as necessary to warn of hazard.	4	1	4
	Trench excavation collapse	Injury to construction staff or persons due to crushing/impact injury.	4	3	12	Follow Worksafe requirements, trench shields or benching of excavations to be used. No staff to enter the trench without appropriate and approved measures already in place.	4	1	4
	Cut / fill batter collapse	Injury to construction staff during construction.	3	2	6	Safe distances and appropriate temporary slope gradients and heights to be assessed prior to construction and monitored during to confirm as appropriate, safe distances and barrier fencing to be used on site where deemed necessary.	3	1	3
	Excessive noise during construction	Damage to hearing of construction staff or persons adjacent to the site.	3	2	6	Comply with appropriate allowances for noise on site, ear protection to be worn where appropriate, setback distances from adjacent sites or notified working hours to avoid conflict with adjacent property inhabitants.	3	1	3
	Machinery rollover	Machinery trafficability over soft, wet or uneven ground.	4	2	8	Appropriate construction of temporary haul roads, implement drainage and geofabrics, appropriate driver training.	4	1	4
	Contaminated Soils	Airborne or in-ground contaminants affecting construction staff.	4	1	4	Perform an environmental assessment of the site prior to construction.	4	1	4
Plant Platform	Moving Machinery	Injury to construction staff.	4	3	12	Separate moving machinery from light vehicles and person movements with fencing and/or safe distances from exposed construction staff operations.	4	1	4
	Plant platform instability	Injury to construction staff or persons due to crushing/impact injury.	4	3	12	Design to incorporate adequate factor of safety, prepare lift management plans to ensure adequate separation between plant and persons.	4	1	4
	Excessive plant settlement	Plant / equipment damage, injury to construction staff or persons due to sudden plant / load movements.	4	3	12	Undertake trial lift with adequate separation of plant and load from persons, monitor settlements during lift.	4	1	4

NOTE: It is the Contractors responsibility to cover construction related risks in a more comprehensive manner (being the competent party in that respect).

Safety in Design Assessment Framework

Risk Matrix		Consequence				
		Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
Likelihood	Event Will Occur 5	Medium 5	High 10	High 15	Extreme 20	Extreme 25
	Event Almost Certain to Occur 4	Low 4	Medium 8	High 12	Extreme 16	Extreme 20
	Event May Occur 3	Low 3	Medium 6	High 9	High 12	High 15
	Event Not Likely to Occur 2	Low 2	Low 4	Medium 6	Medium 8	High 10
	Event Rarely Occurs 1	Low 1	Low 2	Low 3	Low 4	Medium 5