



2 March 2023

Peter & Nicky Chapman

wickedcc01@gmail.com

RE: Geotechnical Investigation for Proposed Subdivision at 576C Barrier View Road, Mangawhai

Wiley Geotechnical Limited (WGL) was requested by Peter & Nicky Chapman to provide a geotechnical investigation to support an application for a four Lot subdivision. We have received and reviewed a proposed subdivision scheme plan Stage 2 produced by Pacific Coast Surveys (Ref 3849, Rev 3 dated March 2023).

WGL visited the site on 10th February 2023 and made the following observations:

- The site is located on generally gentle to moderate sloping ground trending towards the east and south. Steep sloping ground is located in the centre eastern portion of the site and across the boundaries to the north east, east and south.
- A potentially suitable building site was identified towards the north of Lot 1 located on a gentle to moderate south facing slope. Lot 1 slopes steepen across the southern boundary.
- On Lot 2 a potentially suitable building site was identified towards the north western boundary located on a gentle south facing slope. Lot 2 slopes steepen across the southern boundary.
- Lot 3 contains a relatively flat area at the top of the spur identified as a potentially suitable building site towards the western boundary, the land then falls to the north, east and south.
- A potential building site was identified on Lot 4 on a north east facing slope towards the north western boundary of the lot. Lot 4 contains an area of steep sloping ground in the centre of the lot and the across the north east boundary.
- No obvious signs of instability were noted in Lots 1,2 & 3.
- Lot 4 shows potential for previous historic instability where slope gradients are steeper than 1v:3h. The proposed building site has been located away from this area.
- Eight hand augers were undertaken within potentially suitable building sites and potential wastewater fields to a maximum depth of 3 m below ground level.

Geology

The GNS map for the site indicates that it is underlain by sedimentary rocks of the Pakiri Formation (Waitemata Group) (PF) comprising “alternating thick-bedded, volcanic rich, graded sandstone and siltstone with volcanoclastic grit beds.”

Weathered bedrock material ranging from slightly weathered rock to residual soil overlies the Pakiri Formation on parts of the site. The soils generally comprise predominantly silts and sands with varying amounts of clay.

Landform

As seen in the contour map below the site is made up of a spur in the north west corner of the property coming off a knoll to the east. The high point of the spur is at RL54m and has slopes trending to the north east, east, south east and south down to as low as RL15m.

Slopes across the site away from the flat area on top of the spur consist of gradients ranging from 1v:5h to 1:1.5h with slopes steepening to the north east, east, south east and south near to the boundaries.

There are steep gradients within the upper middle portion of the site to the east of the spur potentially associated with deep seated historic instability where building should be avoided.

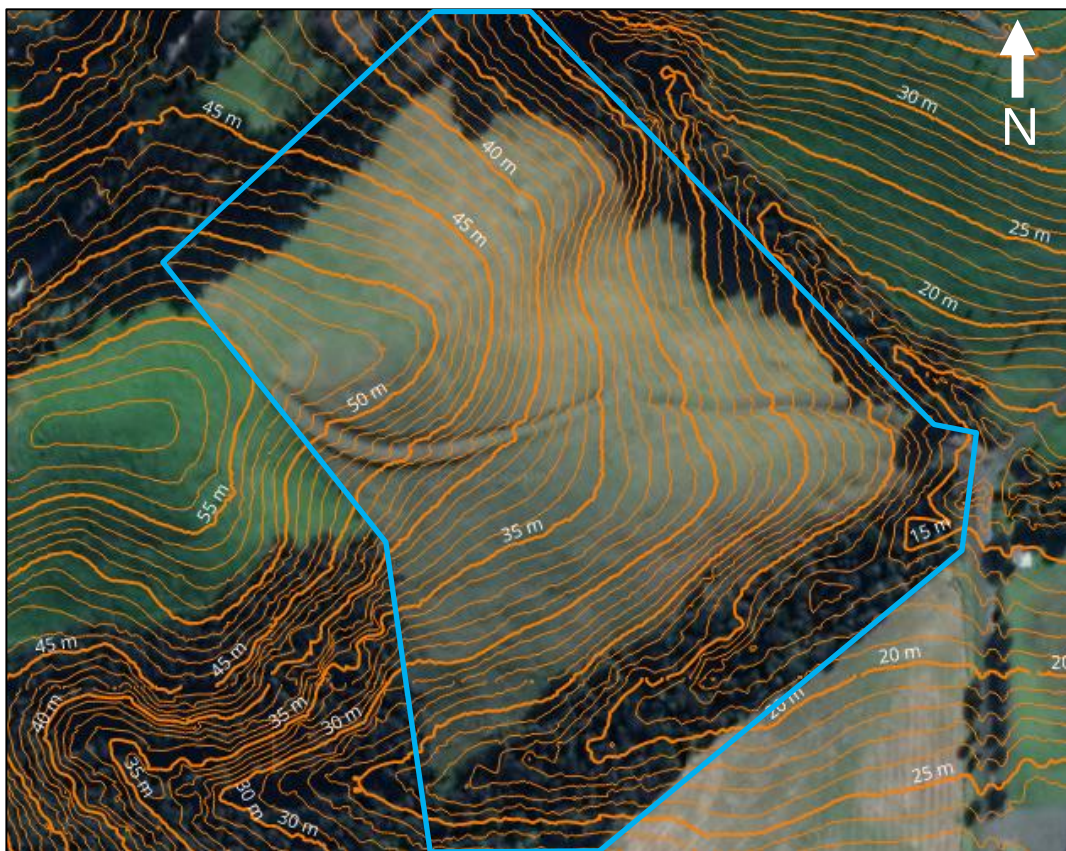


Figure 1: Contour Map (1m) sourced from NRC LIDAR with estimated development boundary

NRC GIS Hazards Map

We have reviewed the Northland Regional Council (NRC) GIS maps in relation to the subject site. There were no hazards indicated by the maps in the vicinity to the subject site.

Seismic Hazards

Since there are no known active faults crossing the property, it is our opinion that ground rupture is unlikely at the subject property. Granular soils, such as sand, are susceptible to liquefaction in the event of future earthquakes. This may result in settlement or lateral deformation. Based on the regional earthquake risk (discussed further below) and depth to groundwater, it is our opinion that there is a

relatively low risk of liquefaction induced settlement or lateral movement such that specific liquefaction design is not required.

We recommend that the future structures and improvements are designed to account for seismic shaking and ground motions. For seismic design at the site and in line with NZS 1170.5:2004 the corresponding design peak ground accelerations (PGA) for the site have been calculated from NZS 1170.5:2004 using the recommendations of the New Zealand Geotechnical Society as follows:

$$a_h = Z R C$$

In which:

Z = base PGA called "Hazard factor" and is given by Table 3.3 and Figures 3.3 and 3.4 of NZS 1170.5:2004. Z = 0.13 for areas north of Auckland.

R = "Return period factor" and is given by Table 3.5 of NZS 1170.5:2004 (R = 1.0 for 500 year return period and R = 0.25 for a 25 year return period)

C = Site response factor called "Spectral shape factor" in NZS 1170.5:2004 and is based on the seismic site classification. We consider this site to be **Class C** based on soil depth and therefore C = 1.33.

The design PGA at the site is given as:

$$\text{ULS: } a_h = 0.13 \times 1.00 \times 1.33 = 0.17 \text{ (i.e. PGA = 0.17 g)}$$

$$\text{SLS: } a_h = 0.13 \times 0.25 \times 1.33 = 0.04 \text{ (i.e. PGA = 0.04 g)}$$

Field Exploration and Subsurface Conditions

WGL carried out a shallow subsurface investigation consisting of eight hand augers with shear vane testing within the approximate areas shown on the site plan below. Hand Auger 1, 3, 5 and 7 were undertaken at the location of potential suitable building sites. Suitable wastewater disposal fields are also illustrated in blue and marked with a number for the respective Lot. Hand Augers 2, 4, 6 and 8 were undertaken within the proposed suitable wastewater disposal field area.

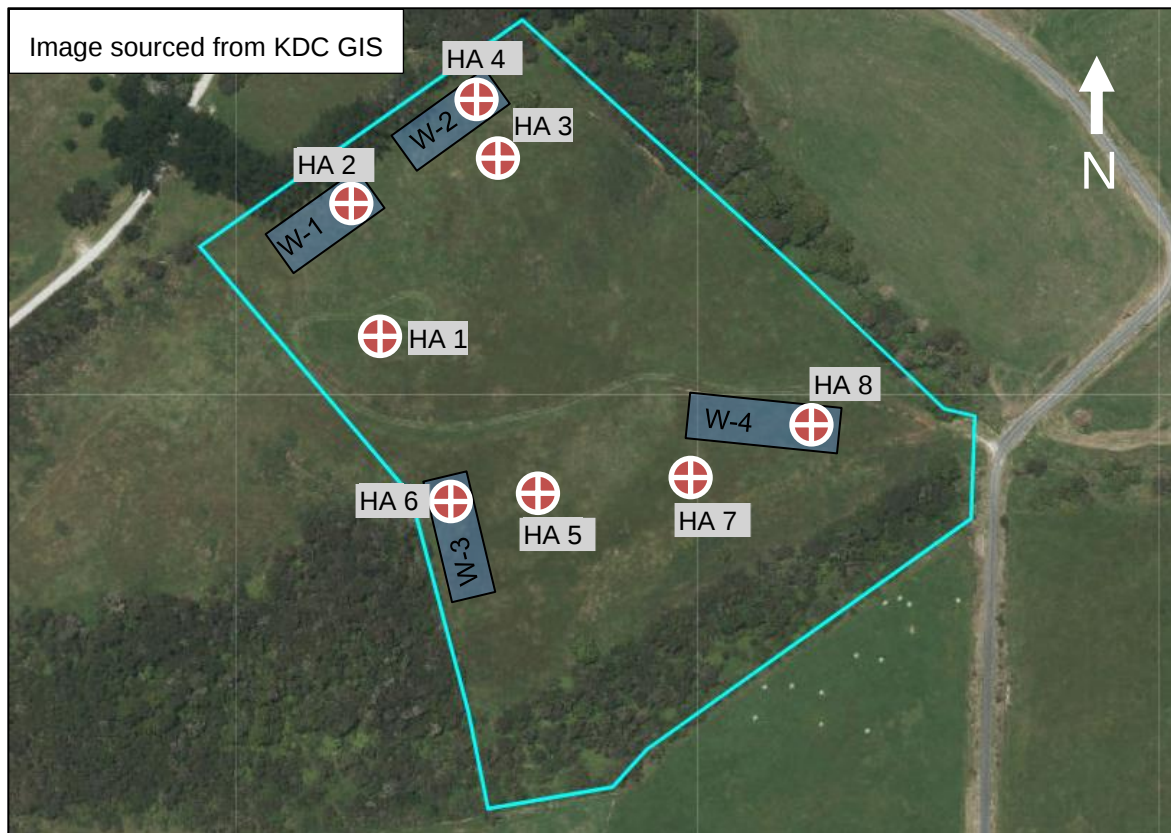


Figure 2: Approximate Subsurface Exploration Locations & Wastewater Disposal Fields

The hand augers were carried out to depths of 1.2 m and 3.0 m. The subsurface material encountered in our hand auger investigation generally consisted of topsoil underlain by slightly to moderately clayey silt with occasional sandy horizons at deeper depths. Occasional limonitic inclusions and manganese nodules were noted. Desiccation cracking was observed up to 0.6 m depth. The measured undrained shear strengths generally ranged from 72 kPa to an inferred shear strength greater than 200 kPa.

Groundwater was encountered at 2.9 m in HA5 during our testing. The groundwater level may vary from the depth measured at the time of exploration, as a result of seasonal change, recent precipitation and/or irrigation practices.

Based on this, it is our opinion that the material encountered in our subsurface investigation is broadly consistent with published geologic mapping. The bore logs are presented as an appendix to this report and are written in general accordance with the New Zealand Geotechnical Society field classification guidelines (NZGS, 2005).

Expansive Soils

Expansive clay and silt soils are common in the wider Northland region and have the tendency to shrink and swell, particularly with seasonal fluctuations of soil water content. This behavior has implications for foundation design and surface structures and should be incorporated during foundation design.

Based on our visual and field assessment of the soils encountered onsite, and our experience in the area, we consider that the Expansive Site Class for this site is "M - moderate" - in accordance with AS 2870. Accordingly, the minimum footing depth is 600 mm below cleared ground level.

Conclusions and Recommendations

It is our opinion that the proposed development is feasible from a geotechnical point of view, provided the recommendations presented in this report and standard development practices are incorporated in the design and construction of the project.

The results of the geotechnical investigation indicate a suitable bearing capacity is available for future residential development, with readings generally greater than 80 kPa.

We consider the site to be suitable for the proposed subdivision in accordance with the provision of Section 106 of the Resource Management Act 1991, and that standard earthwork and construction practises will not result significant increase or risk of erosion, subsidence, falling debris, slippage or inundation by soil or rock.

Foundations

This report is not to be used for the purposes of any building consent applications regarding the foundations of future structures. However, the following general recommendations are anticipated for the current proposed building platforms, and will be determined as part of geotechnical investigations and reporting at building consent stage of each respective lot.

We anticipate that wooden piles designed in accordance with NZS3604 (2011) would likely provide a suitable foundation for future dwellings with anchor piles embedded to a minimum depth of 0.9 m, and all other piles are embedded to a minimum depth of 0.6 m. Piles on a sloping building pad should be embedded to have a toe level extending at least 600 mm below the lowest ground surface within 2 m. Additional evaluation may be required if the building site is sloped at greater than 3:1 (H:V) and proposed construction on or near the steep sloping ground within the centre of Lot 4 should be avoided.

A concrete foundation may also be feasible. We would expect that a minimum 300 mm layer of compacted hard fill is placed prior to applying blinding sand for any reinforced concrete slab and foundation elements having a minimum embedment depth of 0.6 m.

We expect that a geotechnical ultimate bearing capacity of 300 kPa would be available; however, further geotechnical investigations and design **must** be carried out at the building consent stage.

Earthworks

We recommend that any site concept plans be discussed with WGL or suitably qualified Geotechnical Engineer familiar with the site and the contents of this report.

In addition, we suggest the following:

- All cut surfaces should be inspected by WGL (or suitably qualified Geotechnical Engineer) prior to placing any fill to ensure founding conditions are as anticipated;
- All excavated soil to be removed from site or placed in an engineered stockpile that is strategically placed such that it would not trigger slope instability. If there is any soil to be placed permanently on site, we suggest contacting WGL for further guidance;
- In areas of tree removal where planned structures or roadways are located, the full root ball should be removed;

- Any proposed earthworks and drainage plans should be approved by a suitably qualified Geotechnical Engineer familiar with both the site and the recommendations within this report for review and comment;
- Fill placement, should be placed in accordance NZS 4431 – Code of practice for Earth Fills for Residential development. Fill should be placed on a suitably stripped and prepared subgrade including the removal of any non-engineered fill;
- Additional design-level earthwork recommendations are required if cut and fills are greater than 600mm; and
- All proposed batter slopes should be restricted to gradients no steeper than 1v:3h.

Onsite Wastewater Disposal

We consider the site would be suitable for a Secondary wastewater system and depending on your requirement for the land that will be used as a disposal field the effluent field to be fenced if the land intends to be grazed.

The final onsite wastewater disposal system must meet all the relevant requirements from the Proposed Regional Plan for Northland, section C.6.1 (PRPN), Kaipara District Council as outlined in AS/NZS 1547:2012 and G13 of the NZ building code. There are a number of proprietary systems available to suit the requirements of future residential development, which are a function of the building footprint and total number of occupants.

Any treated material must be dispersed in a controlled manner across a relatively level discharge area in order to maximise the efficient infiltration of material without compromising the stability of any slopes. To this end, we recommend that the effluent disposal fields be located clear of the building locations.

In terms of AS/NZS: 1547-2012 a Soil Category of 5 (i.e. “Light Clays – poorly drained”) should be adopted. This is based on the findings of the geotechnical investigation and the assessment of the soil regarding its relevant soil category, as per the guidance document.

Considering the results of the geotechnical investigation we consider Category 5 with a DIR of 2.5 mm/day. Based on a standard 4 bedroom house with an occupancy of 6 persons with roof supply water and standard water reduction fixtures this would require $6 \times 145\text{L} = 870\text{L/day} / 2.5 = 348 \text{ m}^2$ effluent field.

We have illustrated above suitable areas for a standard wastewater disposal field with sufficient area included for 50% reserve. There are other locations upon each of the Lots which may also be suitable to utilise as a wastewater disposal field.

The Northland Regional Council rules refer to a winter ground water level and require the following;

- Primary systems - The lowest point of the disposal system is not less than 1.2 metres above winter (June, July or August) groundwater table.
- Secondary systems – The lowest point of the disposal system is not less than 0.6 metres (600 millilitres) above the winter (June, July or August) groundwater table.

WGL have assessed the summer ground water level at 2.9 m, and do not consider groundwater to exceed a depth of 0.6 m for a secondary system.

We recommend a minimum 10 metre buffer area downslope of the lowest irrigation line is included as part of the disposal area.

Stormwater

We recommend that stormwater overflow from newly developed dwelling water tanks is directed downslope via closed conduit towards the existing overland flow path. The outlet of the stormwater pipe should not be positioned above sloping ground where the risk of slope instability would be increased. We recommend the outlet pipe directs water in to rip rap erosion protection. This should consist of geotextile cloth placed upon insitu soil with clean rock of 150-300 mm in diameter. This area should be a minimum of 1 m wide and 3 m in length.

If a suitable overland flow path is not available, we recommend implementing suitable subsoil level spreader to disperse stormwater runoff from future water tank overflow pipe(s). This should consist of a 0.5 m wide by a 0.5 m deep excavation with a perforated 110 mm novacoil pipe backfilled with clean drainage rock. The base and side should be wrapped with a geotextile cloth (Bidim A29, Cirtex AS410 or similar approved product) and fold over the top of the drainage metal enclosing it. The subsoil level spreader should be designed relative to the proposed impervious area.

If the total impervious area being developed on any lot (roofs, driveways, paving etc.) is greater than 10% of the entire lot area (15% if not in any Overlay), then specific stormwater design shall have to be carried out with regards to attenuation in order to offset the increase in stormwater runoff up to the 100 year storm event.

Specific design must reach Kaipara District standards. This shall be determined at the building consent stage once final impervious areas are known.

Drainage

We recommend that a concrete lined cut off or simple v-drain is constructed upslope of the proposed house sites to help catch stormwater run-off from the upslope areas. The drain should have a minimum width of 500 mm and depth of 300 mm, and discharge downslope clear of the proposed dwelling. The outlet should have a 3 m section of rock rip rap to protect against any scour. The rip-rap apron should have a minimum width of 1 m and depth of 0.3 m, and be filled with 150-300 mm clean rock.

Flooding

We have reviewed the Northland Regional Council (NRC) GIS maps in relation to the subject site. There were no flood hazards indicated by the maps in the vicinity to the subject site.

Further Work

This report entailed an initial site investigation for the subdivision development of the site. The recommendations and considerations outlined are indicative of what is to be expected based on the initial investigations.

WGL should be provided with any revised plans to undertake a geotechnical review.

Further geotechnical review, site investigation and reporting will be required by the purchasers for each of the proposed Lots at building consent stage.

LIMITATIONS

- (i) This report has been prepared for the use of our client, Peter & Nicky Chapman and their professional advisers and the relevant Regional Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

- (ii) Assessments made in this report are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this report based on accepted normal methods of site investigations. Variations in ground conditions may exist between test locations and therefore have not been taken into account in the report. If variations are found during excavation or at foundation preparation stage WGL should be notified immediately so we can amend our recommendations.
- (iii) This Limitation should be read in conjunction with the EngNZ/ACENZ Standard Terms of Engagement.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned at richard@wileygeotechnical.co.nz or matt@wileygeotechnical.co.nz if you require any further information.



Richard Tichborne BSc, PgDip, MEngNZ

Senior Geotechnical Engineer



Matt Wiley, CPEng

Principal Engineer

Attachments:

- Bore Logs



WILEY GEOTECHNICAL LTD

BOREHOLE No. 1

SITE: 576C Barrier View Road, Mangawhai (Lot 1 - BP)

REF: 22262

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
T	TOPSOIL dark brown to 200 mm							
Pakiri Formation of the Waitemata Group	SILT slightly to moderately clayey, slightly to moderately plastic, dark brown with orange brown staining, dessication cracks to 500 mm decreased clay, decreased plasticity, light grey with orange brown staining, moist alternating layers of slightly sandy and slightly clayey SILTS		1				63 122	
							96 143	
							102 143	
							93 140	
							48 90	
							63 107	
			2				48 93	
							69 122	
							57 107	
			3				45 87	
	E.O.B: 3.0 m							
			4					
			5					

NOTES Groundwater was not encountered.
Hand auger reached target depth at 3.0 m.

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa)			SCALA PENETROMETER BLOWS / 100 mm						
							● Peak Field Vane ○ Remoulded Field vane									
							50	100	150	5	10	15				
T	TOPSOIL dark brown to 200 mm															
Waitemata Group	SILT moderately clayey, moderately plastic, dessication cracks to 450 mm, light grey with orange brown staining		1													
	E.O.B: 1.2 m		2													
			NOTES Groundwater was not encountered. Hand augre reached target depth at 1.2 m.						LOGGED BY: MD & CS DATE DRILLED: 10-Feb-23 DRILL METHOD 50 mm Hand Auger							



WILEY GEOTECHNICAL LTD

BOREHOLE No. 3

SITE: 576C Barrier View Road, Mangawhai (Lot 2 - BP)

REF: 22262

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
T	TOPSOIL dark brown to 200 mm							
Pakiri Formation of the Waitemata Group	SILT slightly clayey, slightly plastic, brown with gritty orange brown inclusions, moist							
	SILT friable, orange brown, hard							
	SILT slightly to moderately clayey, slightly to moderately plastic, slightly sandy, light grey with orange brown staining alternating layers of slightly sandy and slightly clayey SILT moist to wet		1 2 3 4 5				72 113 105 134 81 105 75 105 78 119 69 116 119 146 102 131	
	E.O.B: 3.0 m							
NOTES Groundwater was not encountered. Hand auger reached target depth at 3.0 m.							LOGGED BY: MD & CS DATE DRILLED: 10-Feb-23 DRILL METHOD 50 mm Hand Auger	

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger



WILEY GEOTECHNICAL LTD

BOREHOLE No. 5

SITE: 576C Barrier View Road, Mangawhai (Lot 3 - BP)

REF: 22262

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
T	TOPSOIL dark brown to 200 mm							
Pakiri Formation of the Waitemata Group	SILT friable, brown with orange brown mottling						45 ● 107	
							81 ○ 119	
	SILT slightly to moderately clayey, slightly to moderately plastic, light grey with orange brown staining		1				87 ○ 122	
							75 ○ 122	
	moist						57 ○ 102	
							54 ○ 87	
	alternating layers of slightly sandy and slightly clayey SILT		2				60 ○ 110	
							39 ○ 78	
	wet						45 ○ 87	
	water at 2.9 m		3			V	33 ○ 72	
	E.O.B: 3.0 m							
			4					
			5					

NOTES Groundwater was encountered at 2.9 m.
Hand auger reached target depth at 3.0 m.

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger



WILEY GEOTECHNICAL LTD

BOREHOLE No. 6

SITE: 576C Barrier View Road, Mangawhai (Lot 3 - WW)

REF: 22262

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
T	TOPSOIL dark brown to 200 mm							
Waitemata Group	SILT slightly clayey, slightly plastic, dessication cracks to 500 mm, light grey with orange brown staining		1					
	E.O.B: 1.2 m		2					
			3					
			4					
			5					

NOTES Groundwater was not encountered.
Hand augre reached target depth at 1.2 m.

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger



WILEY GEOTECHNICAL LTD

BOREHOLE No. 7

SITE: 576C Barrier View Road, Mangawhai (Lot 4 - BP)

REF: 22262

Sheet 1 of 1

REDUCED LEVEL (RL) INFERRED GEOLOGY	DESCRIPTION OF SOIL	SOIL SYMBOL	DEPTH (m)	SAMPLE TYPE	WATER CONTENT (%)	WATER LEVEL	CORRECTED VANE SHEAR STRENGTH (kPa) ● Peak Field Vane ○ Remoulded Field vane 50 100 150	SCALA PENETROMETER BLOWS / 100 mm 5 10 15
T	TOPSOIL dark brown to 100 mm							
Pakiri Formation of the Waitemata Group	SILT slightly to moderately clayey, slightly to moderately plastic, light brown with orange brown streaks, dessication cracks to 600 mm		1				75 143	
	SILT moderately clayey, moderately plastic, grey with red streaks, occasional limonitic staining		2				67 140	
	intense limonitic staining, manganese nodules						75 128	
	SILT moderately clayey, moderately plastic, light grey with orange brown streaks		3				75 137	
	E.O.B: 3.0 m		4				60 119	
			5				200	
							81 116	
							57 93	
							51 81	
							51 84	

NOTES Groundwater was not encountered.
Hand auger reached target depth at 3.0 m.

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger

LOGGED BY: MD & CS
DATE DRILLED: 10-Feb-23
DRILL METHOD 50 mm Hand Auger