REPORT

Tonkin+Taylor

Smales Farm

Geotechnical Assessment for Proposed Plan Change

Prepared for
Northcote RD1 Holdings Limited
Prepared by
Tonkin & Taylor Ltd
Date
May 2018
Job Number
1005025.v1

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Document Control

Title: Smales Farm					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
20/03/2018	V0	Draft Report	Peter Millar		
09/05/2018	V1	Final	Peter Millar		

Distribution:

Northcote RD1 Holdings Limited copies

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Table of contents

1 Introduction

Tonkin & Taylor Limited (T+T) have been engaged by Smales Farm Ltd to provide a desktop assessment of the geotechnical conditions for the future development of Smale's Farm. We understand this report is to support a proposed plan change for increased development including mixed use with multi-storey buildings.

The objective of the report is to provide an overview of geological conditions on the site based on the considerable geotechnical investigations that have been undertaken for the existing developments and to provide concept level foundation advice for any proposed new multistorey structures.

2 Background

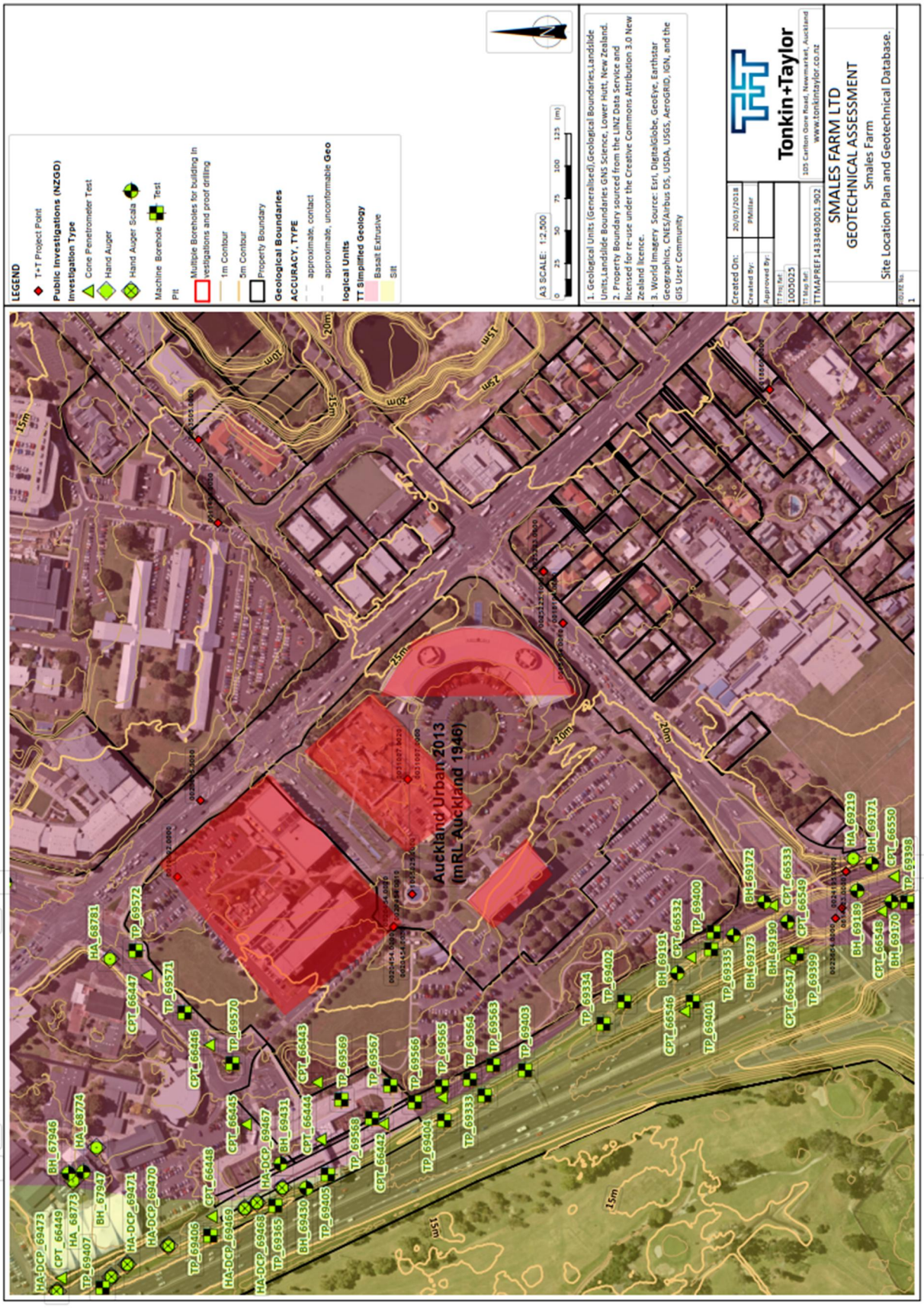
The site dips gently to the southwest of a grade of about 1 in 20, see Figure 1. A series of buildings have been constructed on the site since 1997. Prior to this it was continuously used for stock and dairy farming for over 100 years. The commercial development of the property commenced in the mid 1990's with construction of the Telstra Clear Communication Building (now Vodafone) on the corner of Taharota Rd and Northcote Rd, closely followed by the Tranzrail (now air New Zealand), Sovereign and Facilities (Q4) Buildings, B:Hive (nearing construction). The current buildings are identified in the figure included in Appendix A. Detailed investigations and testing were carried out for each of these buildings and are listed below:

1. *Clear Telstra Building. Earthworks Suitability of Materials Assessment*, (October 1997).T&T Ref 15658
2. *Geotechnical Investigation. Clear Communication Building. Smale Farm. (*January 1997*).* Connell Wagner Ltd Ref *2797A/50.*
3. *Tranzrail Building. Geotechnical Investigations Report* (August 2000).T&T Ref 18194-01
4. *Proposed Building – Smales Farm Proof Drilling Investigations. Health and fitness/ Childcare Building,* (September 2000). T&T Ref 18194-02.
5. *Northern Busway. Northcote Interchange Pile dynamic Analysis Testing*. (September 2006). T&T Ref 23684.
6. *Geotechnical Investigations. Sovereign & Facilities Building, Smales Farm, Takapuna.* (March 2006). T&T Ref 20454.001.
7. *Project S Stage 1A – Smale Farm Business Park. Dynamic Pile Testing.* Report to Hauraki Piling Ltd (March 2006). Ref 20454.002
8. Building B5. Preliminary Investigations Report. (1997). T&T Ref 20454.002
9. Buildings B5 & B6. Geotechnical Investigations Report. (August 2015). T+T Ref 31007.

The locations of these buildings are shown on Figure 1. Detailed investigations of each of these sites included series of machine boreholes, percussion holes (proof drilling of rock) and test pits.

Developments of SH1N has also involved detailed investigations along the south eastern boundary of the site. The locations of the boreholes, CPTs and test pile is also shown on Figure 1.

A sample of the typical boreholes that have been drilled on the site are included in Appendix B.


LEGEND
T+T Project Point
Public Investigations (NZGD)
Investigation Type
Cone Penetrometer Test
Hand Auger
Hand Auger Scala
Machine Borehole Test
Pit
Multiple Boreholes for building In vestigations and proof drilling
1m Contour
5m Contour
Property Boundary
Geological Boundaries
ACCURACY. TYPE
approximate, contact
approximate, unconformable Geo
logical Units
TT Simplified Geology
Basalt Extrusive
Silt
A3 SCALE: 1:2,500
0 25 50 75 100 125 (m)
1. Geological Units (Generalised),Geological Boundaries,Landslide Units,Landslide Boundaries GNS Science, Lower Hutt, New Zealand.
2. Property Boundary sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence.
3. World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Created On: 20/03/2018
Created By: PMiller
Approved By:
TT Proj. Ref: 1003025
TT Map Ref: TTMAPREF1433463001.902
Tonkin+Taylor
105 Carlton Gore Road, Newmarket, Auckland
www.tonkintaylor.co.nz
SMALES FARM LTD
GEOTECHNICAL ASSESSMENT
Smales Farm
Site Location Plan and Geotechnical Database.
DRWG No.
1
Auckland Urban 2013 (mRL Auckland 1946)

3 Geotechnical conditions

3.1 Geology

The published geology for the area, Geology of Auckland Urban Area (Scale 1:50,000) indicates the site is largely underlain by a layer of basaltic ash and lapilli. A lava flow of basalt rock is expected beneath much of the site derived from the Lake Pupuke volcanic eruptions. This partially infilled the ancient Wairau Valley that flowed to the coast at Milford Beach, forming a dam that blocked the stream gully and resulted in swamp deposits upstream. The inland edge of the basalt is close to the southwest boundary of the site where the basalt lava is expected to feather out against the shoulder of the buried valley.

3.2 Geotechnical model

The site has been intensively drilled at the locations of buildings that have been constructed on the site. This includes investigations boreholes and proof drilling of pile or shallow pad foundation positions to ensure the basalt rock was of adequate thickness and quality to support the building loadings, see references in Section 2 above.

In addition drilling and test pile for SH1N motorway widening and busway has included a series of machine boreholes, Cone Penetrometer Tests (CPT's) and test pits along the southwestern boundary of the site.

This information has been collected to develop geological sections and the following preliminary site model for the assessment of foundation conditions.

A layer of about 2.4 m of volcanic ash covers the site. This comprises stiff silts with some clay that are generally slightly to moderately plastic and very stiff. On the north eastern half of the site this ash is underlain by about 2.2 m of tuff which include welded ash with zones of loose scoreaceous gravels. Underlying these materials at a depth of 2 – 7 m (increasing to the southwest) basalt lava from the Lake Pupuke lave flows is present.

The surface of the lava is variable as is the quality of the upper flow comprising moderately weathered, highly fractured rock with zones of silts and volcanic debris. The basalt is likely to have been formed by at least 2 lava flows and the quality of the rock improves with depth. The deeper flows comprise fresh strong fine dark grey grained rock with some vesicular zones. The competent rock has generally been proven to over 3 m thickness and is typically at least 5 m thick under the existing buildings on the site. However, at the south western boundary it is likely to thin and may not be continuous or sufficiently thick to provide a suitable founding layer for multistorey structures (see comments below).

Beneath the basalt is Tauranga Group Alluvium (Pleistocene Age sediments). This comprises clayey and sandy silts which are generally slightly plastic and stiff to very stiff. The boreholes along the busway record some zones of peat and organises within the upper Tauranga Group materials. Below about 10 m – 12 m the Northern Busway logs show a sand layer within the Tauranga Group. These sands are slightly cemented and dense. The extent that these sands are present over the remainder of the site is unknown.

East Coast Bay Formation is the basement rock in the Auckland region. It comprises interbedded siltsones and sandstones and is a very weak rock. It is recorded in deep boreholes at about 20 – 25 m on the southwest boundary. It is unproven by the boreholes over the remainder of the site but is expected to be deeper to the north and northeast (as the ground surface rises to the northeast). The depth to rock is estimated to be 30 – 35 m below the Taharota Road Boundary.

Recent sedimentary deposits are present on sites to the south of the site. These soils are variable but typically comprise soft to firm, highly to moderately compressible clayey silts with some high organic and peat zones. These were deposited post the Pupuke activity but do not extend onto the Smale Farm site.

The groundwater is generally encountered at about 4 -5 m depth on the north eastern side of the site i.e. within the tuff and above the basalt rock, and is within the ash at about 2 m depth on the south eastern boundary.

3.3 Seismic Design and Site Subsoil Classification

The New Zealand Standard for Structural Design Actions NZS 1170.5: 2004 provides guidance on the levels of ground shaking that should be considered for design at the site. On the basis of our knowledge of the site and experience in similar ground condition, we classify the site as Class C (shallow soil).

Based on the return periods in NZS1170.5, and an Importance Level 2 structure with a 50 year design life, the following peak ground accelerations (PGA) are calculated:

i. Serviceability Limit State (SLS) = 0.04 g

ii. Ultimate Limit State (ULS) = 0.17 g

These PGA values are for geotechnical analysis only. The client and structural engineer should confirm the above importance level is applicable for the proposed structure.

We do not expect the foundation soils will be subject to liquefaction or lateral spread under a design earthquake seismic event. The ash and Tauranga Group soils are generally not susceptible to liquefaction. The medium dense to dense sands which are present at about 10m depth on the southwest boundary are described in logs as being lightly cemented and hence are unlikely to be liquefiable but may undergo some pore pressure response under an ULS seismic event. Further assessment of this layer should be undertaken to confirm this conclusion.

3.4 Foundation options

The buildings on the site are generally up to 6 levels with up to 1 level of basement and most have generally been founded on driven steel piles embedded in the basalt rock. The rock in the building footprints has been confirmed by proof drilling and piles have been tested using pile dynamic analysis testing (PDA). The most recent building (B:Hive) is a 5 level structure with a single level compensating basement that has been founded on shallow pads in the ash/ tuff soils.

These methods of founding are expected to be suitable and economic for future medium rise buildings on other parts of the site. However, this needs to be confirmed for structures close to the southwestern boundary. Driven steel piles may be used subject to proof drilling and confirming the competency and thickness of the basalt rock. Provided the thickness of the basalt rock is greater than 3 m, the following design capacities may be assumed for preliminary design.

Table 3.1: Driven Steel Pile Capacities

Pile Size	Basalt Rock		ECBF	
	Geotechnical Ultimate Capacity	ULS Capacity	Geotechnical Ultimate Capacity (kN)	ULS Capacity (kN)
150UC30	540	375	720	500
200UC60	1080	750	1440	1000
250UC90	1620	1125	2160	1500

310UC97	1750	1200	2330	1600
31UC137	2470	1725	3290	2300

Note: 1. The ULS capacities are based on PDA testing of 10% of piles. The capacities of piles on Basalt are affected by high stresses resulting from reflection at toe.

2. larger steel sections may be used but are not available ex stock in N.Z. Equipment is presently available to drive sections up to a maximum of 202 kg/m.

For structures exceeding about 6 levels and founded on driven piles we expect pile groups will to be required to provide capacity and the thickness of competent basalt would need to be proven to be at least 5m thick.

For sites near the southwestern boundary, or where the competent basalt rock is expected to be less than 5 m in thickness, we expect multistorey buildings will require founding on piles embedded in the unweathered ECBF rock. This will range in depth from at about 20 – 25 m depth below ground level in the southwest half of the site and increase up to about 35m in the northeast. Bored piles should be embedded at least 3 diameters into the rock and may require sleeving where the piles extend through the basalt. The following ultimate limit states capacities may be assumed for the bored piles.

End Bearing in ECBF (ULS) 3 MPa

Side Friction (ULS)

- Tauranga Group > -10m 40 kPa
- ECBF 100 kPa

Side Friction in the upper Tauranga Group, basalt and ash above 10 m should be ignored.

Alternatively driven steel piles may be considered. Preliminary bearing capacities for driven steel piles in the ECBF are given in Table 3.1 above.

A layer of dense lightly cemented sand was identified within the Tauranga group sediments in some boreholes on the southwest boundary. If this is proven to be continuous over the site there is potential for medium to high rise buildings to be founded on driven piles embedded into the dense sand layer below about 10 – 12 m depth. The capacity of driven steel piles would need to be confirmed by test but for preliminary design we expect an ULS friction of 80kPa may be assumed.

For lateral capacity of piles we expect a horizontal subgrade reaction of 40-50kPa/mm may be assumed in the ash soils while effective fixity may be expected for piles sections bored through basalt rock where it exceeds 3m thickness.

For structures with single level basements we expect these will be constructed within the stiff ash soils. We generally expect drained basements (with an underdrainage collector system) should be feasible but depth to groundwater will need to be confirmed to assess whether a resource consent is required under the Auckland Unitary Plan (OIP) Rules E7.6.1.10. The following parameters may be assumed for preliminary design of retention for single level basement structures

$K_a = 0.3$

$K_o = 0.5$

$K_p = 4.5$

$\gamma = 18\ kN/m^3$

For deeper basements, the potential presence of fill and basalt rock will need to be determined.

4 Conclusions

The site conditions at Smales Farm generally comprise a layer of stiff volcanic ash and fill of 3 – 7 m depth (increasing to the north east) overlaying basalt. The basalt is derived from basalt lava flows derived from the Lake Pupuke eruption and has been proved to be over 3 m thick over much of the site. It thins towards the southwest boundary. The basalt is underlain by Tauranga Group sediments. These are clayey silts with some organics which become increasingly sandy with depth and become dense lightly cemented sands below about 10 m. The basement ECBF is expected at 20 – 35 m depth, increasing to the northeast.

Foundation options for medium rise structures (up to 6-8 stories) include founding on piles embedded in the basalt rock where this is proven to be continuous and of adequate thickness. For multi-storey buildings exceeding 6-8 levels options for founding include driven grouped piles founded in competent basalt confirmed to exceed 5m thickness (as expected in the northern half of the site) or bored or driven piles extending into the ECBF rock.

Where buildings include basements, the potential effects on groundwater will need to be assessed. For single level basements these will generally be constructed above the groundwater level and may be permanently drained but deeper basements will require a resource consent for groundwater take and divert.

5 Applicability

This report has been prepared for the exclusive use of our client Northcote RD1 Holdings Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement

Tonkin & Taylor Ltd

Report prepared by:

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Peter Millar

Project Director

PJM
p:\1005025\workingmaterial\09052019.pjm.rep geotechnical assessment.v1 draft.docx

Appendix A: Existing Buildings

Appendix B: Sample Borehole Logs

- Building 5a – Borehole BH4P
- Borehole 69172 – Busway. Northcote Intersection (Opus)
- Borehole 69431 – Busway. Bus station (Connell Wagner)

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH4P
Hole Location: Refer site plan.

SHEET 1 OF 2

PROJECT: Smales Farm B5-B6	LOCATION: Smales Farm, Takapuna, Auckland	JOB No: 31007
CO-ORDINATES:	DRILL TYPE:	HOLE STARTED: 15/7/15
	DRILL METHOD: PERCUSSION	HOLE FINISHED: 15/7/15
R.L.: 22.50 m		DRILLED BY: Niederer Drilling
DATUM:	DRILL FLUID:	LOGGED BY: CEM CHECKED: CEM

GEOLOGICAL	ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
ASH			0	ROTARY PERCUSSION				22	0								FILL and ASH.
								21	1								
								20	2								
								19	3								
								18	4								
								17	5								
BASALT								16	6								Scoria, ash, fractured rock, water.
								15	7								BASALT ROCK, competent.
								14	8								Fractured rock/scoria. Solid.
								13	9								
									10								

T+T DATATEMPLATE.GDT jlb

Log Scale 1:50

BORELOG 31007.GPJ 11-Aug-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH4P
Hole Location: Refer site plan.

SHEET 2 OF 2

PROJECT: Smales Farm B5-B6	LOCATION: Smales Farm, Takapuna, Auckland	JOB No: 31007
CO-ORDINATES:	DRILL TYPE:	HOLE STARTED: 15/7/15
	DRILL METHOD: PERCUSSION	HOLE FINISHED: 15/7/15
R.L.: 22.50 m		DRILLED BY: Niederer Drilling
DATUM:	DRILL FLUID:	LOGGED BY: CEM CHECKED: CEM

GEOLOGICAL									ENGINEERING DESCRIPTION							
GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m) / DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
BASALT			0	ROTARY PERCUSSION				12 / 11								BASALT, solid.
								11 / 12								Fractured rock with silt, water.
								10 / 13								Solid.
								9 / 14								
								8 / 15								
ALLUVIUM								7 / 16								SILT, stiff.
								6 / 17								
								5 / 18								
								4 / 19								
								3 / 20								**END OF BOREHOLE AT 20m.** Description of soil/rock based on observation of cuttings.

T+T DATATEMPLATE.GDT jlb

Log Scale 1:50

BORELOG 31007.GPJ 11-Aug-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:BH5P
Hole Location: Refer site plan.

SHEET 1 OF 2

PROJECT: Smales Farm B5-B6	LOCATION: Smales Farm, Takapuna, Auckland	JOB No: 31007
CO-ORDINATES:	DRILL TYPE:	HOLE STARTED: 15/7/15
	DRILL METHOD: PERCUSSION	HOLE FINISHED: 15/7/15
R.L.: 22.25 m		DRILLED BY: Niederer Drilling
DATUM:	DRILL FLUID:	LOGGED BY: CEM CHECKED: CEM

GEOLOGICAL	ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	METHOD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MOISTURE CONDITION / WEATHERING	STRENGTH/DENSITY CLASSIFICATION	SHEAR STRENGTH (kPa) 10 25 50 100 200	COMPRESSIVE STRENGTH (MPa) 1 5 20 50 100 250	DEFECT SPACING (mm) 50 250 1000 2000	SOIL DESCRIPTION: Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION: Substance: Rock type, particle size, colour, minor components. Defects: Type, inclination, thickness, roughness, filling.
ASH			0	ROTARY PERCUSSION				22	0								FILL and ASH.
								21	1								
								20	2								
								19	3								
								18	4								
BASALT								17	5								Fractured rock, ash, scoria?
								16	6								BASALT ROCK, competent.
								15	7								Cavity.
								14	8								Hard rock.
								13	9								
									10								ASH

T+T DATATEMPLATE.GDT jlb

Log Scale 1:50

BORELOG 31007.GPJ 11-Aug-2015

AE02429_BHX016

Borehole No: BH12110R15 **Project No:** A083.50.CC
Project: North Shore Busway Project - Northern Sector
Location: Westlake Girls High School
Client: Transit New Zealand
Driller: Drillwell Exploration **Shear Vane No:** DR4940
Drill Type: Top Head Drive **Vane Factor:** 1.392

Sheet: 1 of 2
Northing: 710416.51
Easting: 298782.12
Elevation: 17.27
Inclination: 90°
Commenced: 7th May 2003

Connell Wagner

Grid Datum: Mt Eden Circuit 1949
Level Datum: MSL Auckland 1946
Bearing: -
Completed: 7th May 2003

Elevation (m)	Method	Casing / Support	Sample Type	Core Recovery (%)	SPT Blows	SPT "N"	Vane Shear Strength* (Peak / Remoulded kPa)	Groundwater	Depth	Graphic Log	Material; Colour; Plasticity Or Particle Characteristics; Minor Constituents	USCS Class	Consistency / Relative Density	Moisture Condition	Other Test Results, Stratigraphy, etc
17											**SILT** Dark brown, moderately plastic, with some clay.				- 0.0m to 8.0m Auckland Volcanic Field Deposits.
16				80					1		Becoming orange				
15	HQ Coring	Unsupported	S	100			45 / 174	As at 13th June 2003	2			ML	VSt	M	
14				87					3		Becoming dark reddish orange.				
13				76	2/14/35 over 95m		14 / 50		4		**Basalt** Grey, fine grained, vesicular, moderately weathered, highly fractured, very strong.			D	
12			S	19							**SILT** Dark reddish orange, moderately plastic with some clay.	ML	VSt	M	
11				28					5		**Basalt** Grey, speckled white and black,massive, moderately weathered, highly fractured.				- 5.0m Point Load Testing Is50 (MPa) 0.22/0.2
10				75					6		Alternating basalt layers with light grey, slightly plastic silty clay.			D	
9				100					7						- 7.0m Point Load Testing Is50 (MPa) 8.02/6.76
8				6	2/5/6				8		**Clayey SILT** Light grey, highly plastic with minor fine sand.				- 8.0m to 10.95m Puketoka Formation Alluvium.
				100					9		**Fine sandy SILT** Light grey, slightly plastic, with minor clay.				
				100	1/3/4				10			ML	VSt	M	
				100											

* Vane readings taken in end of drill core while still inside the core barrel or sample end within a thin wall sampling tube.

Consistency
VS-Very Soft **S**-Soft **F**-Firm **St**-Stiff **VSt**-Very Stiff **H**-Hard **Fb**-Friable

Moisture
D-Dry **M**-Moist **W**-Wet

Relative Density
VL-Very Loose **L**-Loose **MD**-Medium Dense **D**-Dense

USCS
Unified Soil Classification System

Logged By: KRJ
Verified: MJL
Approved: GCA

AE02429_BHX016

Borehole No: BH12110R15 **Project No:** A083.50.CC **Sheet:** 2 of 2

Project: North Shore Busway Project - Northern Sector **Northing:** 710416.51

Location: Westlake Girls High School **Easting:** 298782.12 **Grid Datum:** Mt Eden Circuit 1949

Client: Transit New Zealand **Elevation:** 17.27 **Level Datum:** MSL Auckland 1946

Driller: Drillwell Exploration **Shear Vane No:** DR4940 **Inclination:** 90° **Bearing:** -

Drill Type: Top Head Drive **Vane Factor:** 1.392 **Commenced:** 7th May 2003 **Completed:** 7th May 2003

Connell Wagner

Drilling Information					In-Situ Testing			Well	Soil Description						Remarks
					SPT		Vane Shear Strength*								
Elevation (m)	Method	Casing / Support	Sample Type	Core Recovery (%)	SPT Blows	SPT "N" 10 30	Peak • kPa • 50 150 / Remoulded × kPa × 50 150	Groundwater	Depth	Graphic Log	Material; Colour; Plasticity Or Particle Characteristics; Minor Constituents	USCS Class	Consistency / Relative Density	Moisture Condition	Other Test Results, Stratigraphy, etc
7									10						
				100	0/2/3						**SILT** Light grey, moderately plastic with minor clay.				
6									11		End of Borehole				
5									12						
4									13						
3									14						
2									15						
1									16						
0									17						
-1									18						
-2									19						
									20						

* Vane readings taken in end of drill core while still inside the core barrel or sample end within a thin wall sampling tube.

Consistency
VS-Very Soft **S**-Soft **F**-Firm **St**-Stiff **VSt**-Very Stiff **H**-Hard **Fb**-Friable

Moisture
D-Dry **M**-Moist **W**-Wet

Relative Density
VL-Very Loose **L**-Loose **MD**-Medium Dense **D**-Dense

USCS
Unified Soil Classification System

Logged By: KRJ

Verified: MJL

Approved: GCA

Opus International Consultants - DRILLHOL ANP2028 BHX025

Date Drilled : 7/6/02
Logged by : Debbie Head
G.W. Table (m) : As shown
Total Depth (m) : 37.5

Location : Northcote - Stn. 11695 CL
Elevation : 23.5m
Co-ord : E: 298991 N:710047
Drilling Method : HQ Wireline

Project No. : 1-81001.03
Project : Northshore Busway
Client : Transit New Zealand

Geological Unit	Symbols	SOIL / ROCK DESCRIPTION	Depth/Elevation	Piezometers	SPT Blows	Field Tests SPT blows/0.3m 10 30	RQD	Recovery	Method
Topsoil / Fill		***SILT with trace clay*** Soft, wet, slightly plastic, dark brown SILT with trace clay. ***Silty CLAY*** Stiff, moist, highly plastic, orange brown/cream/brown mottled silty CLAY. Rare gravels up to 0.5cm diameter. Rootlets, organics.	-1.00	Concrete	6				HQ SPT
			-2.00						HQ
			-3.00		7				SPT
			-4.00						HQ
		Gravelly SILT with trace clay Firm, moist, non- plastic, dark grey gravelly SILT with trace clay. Gravels up to 3cm diameter (scoreaceous and SILTSTONE). ***Silty CLAY*** Firm, moist, moderately-highly plastic, greyish brown silty CLAY.	-5.00		9				SPT HQ
			-6.00		11				SPT
		Clayey SILT Firm, moist, moderately-highly plastic greyish brown clayey SILT.	-7.00						HQ
		Silty CLAY Stiff, moist, highly plastic, orange brown silty CLAY. Dark brown/grey mottles from 8m.	-8.00		3				SPT
		Slightly gravelly silty SAND Weakly cemented, dark grey slightly gravelly silty SAND. Gravels up to 0.5cm diameter.							HQ
Volcanic Tuff		***Gravelly TUFF*** Weak, moderately cemented/welded, dark brown gravelly TUFF. Almost black at 8.7m, with some greenish grains. Cream silty CLAY infill between grains from 10.5-12.2m.	-9.00		42				SPT
			-10.00						HQ

Note: The information shown in this log is accurate at the test position only; variations in soil type may exist across the site.

Note: SPT blow count with '*' symbol indicates that the seating drive(s) are included in the value given.

Opus International Consultants Ltd
PO Box 5848
Auckland, New Zealand

Geological Unit	Symbols	SOIL / ROCK DESCRIPTION	Depth/Elevation	Piezometers	SPT Blows	Field Tests SPT blows/0.3m 10 30	RQD	Recovery	Method
Pleistocene Alluvium			-11.00		7				SPT
									HQ
			-12.00		7				SPT
		Silty CLAY/clayey SILT Firm-stiff, moist, moderately plastic, greyish brown silty CLAY/clayey SILT. Dark brown at 12.6m (organic rich), firm. Gradually becoming lighter with depth, light brown at 13.5m. Rare organics throughout. Clear/orange/yellow crystallised material (calcite?) at 13m, 2cm max. diameter.	-13.00						HQ
		SILT with some clay Firm-stiff, moist, moderately plastic, light brown SILT with some clay. Rare organics (wood etc.). Trace very fine sand at 14.1-14.2m.	-14.00		6				SPT
		CLAY with trace silt Firm, moist, highly plastic, brown CLAY with trace silt. Light brown from 14.5-14.9m. Very dark brown at 14.9m (organic rich). Some organics throughout. Stiff at 16.3m.	-15.00						HQ
			-16.00						HQ
					11				SPT
		SILT Firm, moist, non-plastic, light brownish grey SILT. Some black/brown organics.	-17.00						HQ
		Clayey SILT/silty CLAY Firm-stiff, moist, moderately-highly plastic, light brownish grey clayey SILT. Rare organics.	-18.00		22				SPT
		SAND with trace clay Moderately dense (very weakly cemented), moist, non-plastic, brownish grey SAND with trace clay (<1%).							HQ
		CLAY with trace silt Stiff, moist, highly plastic, brownish grey CLAY with trace silt. Slightly sandy and very dark brown at 18m.	-19.00		10				SPT
		SAND with trace clay As per 17.5-17.7m.	-20.00						

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Note: SPT blow count with '*' symbol indicates that the seating drive(s) are included in the value given.

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Geological Unit	Symbols	SOIL / ROCK DESCRIPTION	Depth/Elevation	Piezometers	SPT Blows	Field Tests: SPT blows/0.3m (10 30)	RQD	Recovery	Method
Pleistocene Alluvium		***Sandy CLAY*** Stiff, moist, highly plastic, very dark brown sandy CLAY. Trace organic brown flecks throughout. Becomes very sandy (sandy CLAY) at 19.8m. Becomes lighter brown with depth.							HQ
		CLAY with trace sand Firm, moist, highly plastic, light brownish grey CLAY with trace sand and silt.	-21.00		12				SPT
		Sandy CLAY Stiff, moist, moderately plastic, light brownish grey sandy CLAY.							HQ
		Clayey SAND with trace silt Moderately dense, moist, slightly-moderately plastic clayey SAND with trace silt. Black organics at 21.4m. From 21.5m - Alternating medium-coarse clayey SAND (80%), and slightly clayey fine SAND (20%). Moderately dense (moderately cemented), moist, slightly plastic. Some black/brown organics.	-22.00		10				SPT
		CLAY with trace sand/CLAY/sandy CLAY Alternating grey sandy CLAY/CLAY/CLAY with trace sand (fine-coarse). Stiff, moist, slightly-highly plastic. Black/brown organics at 22.9m. Dark brown from 22.95m (organic rich), some partially decayed black/brown organics throughout (up to 30%).	-23.00						HQ
			-24.00		9				SPT
			-25.00						HQ
					6				SPT
		Clayey SAND/sandy CLAY Moderately dense (moderately-well cemented) / very stiff, moist, slightly-moderately plastic, grey clayey SAND, with slightly clayey SAND layers (20%). Trace organics.	-26.00						HQ
		SAND with trace clay Loose (very weakly cemented), grey SAND (medium-coarse) with trace clay. Slightly DILATANT, rare organics. Moderately dense (well cemented) from 27.6m. Gravels up to 1cm diameter, includes SILTSTONE, jasper (<1%), organics.	-27.00		24				SPT
			-28.00						HQ
Waitemata Group		***Sandy/silty CLAY/clayey SAND*** Stiff, moist, slightly-highly plastic, grey sandy CLAY/CLAY with trace sand (fine). 1cm thick black organic layer at 29m. Hard at 29.05m, very hard-extremely weak at 29.1m. Occasional very stiff soil and very weak 'rock' beds <5cm thick. RQD = 0 (soil).	-29.00		46				SPT
									HQ
			-30.00						

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Geological Unit	Symbols	SOIL / ROCK DESCRIPTION	Depth/Elevation	Piezometers	SPT Blows	Field Tests SPT blows/0.3m 10 30	RQD	Recovery	Method
Waitemata Group		*Sandy/silty CLAY/clayey SAND* As previous.	-31.00		50 235mm				SPT
									HQ
			-32.00		50				SPT
									HQ
			-33.00		50 245mm				SPT
			-34.00						HQ
			-35.00		50 160mm				SPT
									HQ
			-36.00		50 160mm				SPT
			-37.00						HQ
		End of Hole	-38.00						
			-39.00						
			-40.00						

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