REPORT

Northern Interceptor - Phase 1

Ground contamination assessment

Prepared for:

Watercare Services Limited

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Tonkin & Taylor

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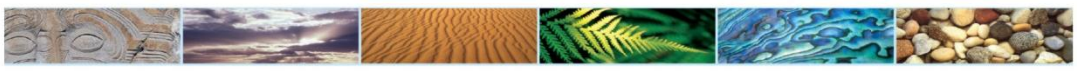

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Table of contents

Table of terms and abbreviations

Abbreviation	Definition
AC	Auckland Council
ACM	Asbestos containing material
AEE	Assessment of Effects on the Environment
ALW Plan	Auckland Council Regional Plan: Air, Land and Water
B(a)P eq.	Benzo(a)pyrene equivalent
DSI	Detailed Site Investigation
ECBF	East Coast Bays Formation
GIS	Geographic Information System
HAIL	Hazardous Activities and Industries List
HDD	Horizontal directional drilling
HDPE	High Density Polyethylene
MfE	Ministry for the Environment
NES Soil	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health
OCP	Organochlorine pesticides
ONOP	Organonitrogen and organophosphorus pesticides
PA	Permitted activity
PAH	Polycyclic Aromatic Hydrocarbon
PAUP	Proposed Auckland Unitary Plan
PE	Polyethelene
Phase 1	To be completed in 2020, Phase 1 transfers the existing Hobsonville Pump Station flows to Rosedale WWTP through a 600mm ID rising main crossing the Upper Harbour, and through Greenhithe, The North Shore Memorial Park, the North Shore Golf Club and Rosedale Industrial areas. The majority of the construction will be open trenched.
PSI	Preliminary Site Investigation
RMA	Resource Management Act 1991
SMP	Site Management Plan / Remedial Action Plan
TPH	Total Petroleum Hydrocarbon
T&T	Tonkin & Taylor Ltd
WWTP	Wastewater Treatment Plant
UCL	Upper confidence limit

1 Introduction

Watercare Services Limited ("Watercare") is proposing to build new wastewater pipelines and associated infrastructure to convey wastewater from north-western parts of Auckland to the Rosedale Wastewater Treatment Plant ("WWTP") in Albany. This project is known as the "Northern Interceptor". Construction of the Northern Interceptor is intended to be staged, with the timing of various stages depending on the rate of population growth.

Tonkin & Taylor (T&T) has been commissioned by Watercare to assess the potential ground contamination effects related to the construction of the proposed Northern Interceptor Phase 1 project.

The proposed work requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input relating to ground contamination for the Northern Interceptor Phase 1 – Assessment of Effects on the Environment report ("the main AEE") prepared by MWH New Zealand Limited, which supports the resource consent application.

This report has been prepared in general accordance with the requirements for a DSI (Detailed Site Investigation) referred to in the National Environmental Standard for Assessing and Managing Contaminants in Soil to protect Human Health (NES Soil regulations), and as outlined in the Ministry for the Environment (MfE) Contaminated Land Management Guidelines[1].

The persons undertaking, managing reviewing and certifying this investigation are suitably qualified and experienced practitioners as defined in the NES Soil.

1.1 Description of proposed works

The proposed Northern Interceptor Phase 1 (refer Figure 1) will transfer existing flows from the Hobsonville Pump Station to the Rosedale WWTP. The proposed route is from the existing Hobsonville Pump Station, under the State Highway 18 motorway, along the northern side of the motorway causeway, and then under the Upper Waitemata Harbour, through Greenhithe and then the commercial area of Rosedale.

Key elements of the project include:

- Upgrading of the existing Hobsonville Pump Station;
- Micro-tunnelling under the State Highway 18 Motorway at Hobsonville;
- Installation of dual pipelines across the Upper Waitemata Harbour to Greenhithe via marine trenching or horizontal directional drilling ("HDD");
- Installation of pipelines under Lucas Creek via HDD;
- Construction of a pipe bridge between Witton Place and North Shore Golf Course, and across streams at Wainoni Park;
- Trench construction for pipeline installation in roads, open space and other land; and
- Associated infrastructure including chambers, air valves and scour valves, connections to existing infrastructure and air treatment facilities.

With the exception noted below, the proposed works are described in detail in the main AEE. Key drawings showing the proposed works and construction methodology are copied in Appendix A of this report. The works described in the main AEE and shown on the appended drawings are assessed in this report.

[1] Ministry for the Environment, updated 2011, Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.

Watercare is proposing some widening along the existing State Highway 18 motorway causeway near Hobsonville to provide for proposed water and wastewater infrastructure, including a section of the Northern Interceptor Phase 1 pipeline. That work forms part of Watercare's proposed Greenhithe Bridge Watermain Duplication and Causeway project. That project is part of a separate resource consent package, and is described in a report titled Greenhithe Bridge Watermain Duplication and Causeway – Assessment of Effects on the Environment, prepared by Aecom New Zealand.

1.2 Objective and scope of work

T&T has undertaken this investigation to assess whether potentially contaminating activities as described by MfE Hazardous Activities Industrial List (HAIL) have occurred along the proposed alignment and implications for the proposed works.

The scope of work for this investigation comprised:

- Review of a "Site Contamination Enquiry" and Council records of pollution incidents;
- Review of historical aerial photographs from the Auckland Council GIS and selected photographs held in the T&T library;
- A site drive-by inspection;
- Soil sampling and testing to establish ground contamination conditions at identified HAIL areas;
- Assessing the analytical results against relevant criteria;
- Review of ground contamination related environmental regulations and planning documents to identify relevant resource consent requirements; and
- Preparation of this report to support the resource consent applications.

2 Location and description

2.1 Location

The alignment extends from the Hobsonville Pump Station to the Rosedale WWTP located on the western and northern sides of the Auckland Isthmus respectively, as shown on Figures 1 and 2 in Appendix A.

The alignment generally takes a path within road reserves, with a number of relatively large sections through parkland. The following summarises significant sections of the alignment that are not within road reserves:

- Crosses the harbour between Hobsonville and Greenhithe;
- Within Wainoni Park;
- Crosses Te Wharau Creek between Wainoni Park and Memorial Park;
- Within Memorial and Rosedale Parks; and
- Within the North Shore Golf Club.
- Private land between Albany Highway and William Pickering Drive

2.2 Surrounding land use

The land use surrounding the alignment is variable, a summary provided below:

- Hobsonville section (refer Figure 3) – the land use adjacent to the alignment is the Upper-Harbour Motorway to the south and a lifestyle farm to the north.
- Greenhithe (refer Figures 4-5) – Surrounding land use is largely low density residential with the exception of Wainoni Park.
- Schnapper Rock (refer Figure 6) – The alignment passes through the Memorial Park, the North Shore Golf Club and minor low density residential development.
- Rosedale (refer Figures 7-8) – Land use consists the North Shore Golf Course and commercial/industrial use associated with the Rosedale industrial area.

2.3 Drive by inspection

An environmental scientist completed an alignment drive-by inspection on 25 November 2014. Relevant observations made at the time of the inspection from the western to northern ends of the Phase 1 project are summarised below. Key features are shown on Figures 3-8 (refer Appendix A).

- The works will occur at the edge of a stream gully adjacent to the Hobsonville Pump Station.
- A Summerset rest home is being developed on the north side of the Squadron Drive on ramp; earthworks, construction, and production-bore drilling were occurring at the time of the drive-by.
- A Watercare wastewater pump station (no. 72) is located near the harbours edge on Rahui Road. A scout hall is located beside the pump station.
- A small domestic orchard, containing plum and citrus trees, is located in the southern portion of Wainoni Park. The alignment passes through largely grassed/unpaved areas of the orchard, and through the pony club grounds to the north. No chemical storage facilities were observed in the immediate vicinity of the orchard and pony club grounds.

- The alignment skirts around the Memorial Park Cemetery and the south-eastern corner of the crematorium. The alignment will be up gradient of the Memorial Park crematorium, and at least 200 m west and level/up gradient of the North Harbour chapel and crematorium.
- It crosses the western end of the North Shore Golf Club driving range and through the carpark. The driving range grass is well maintained. No underground storage or chemical storage facilities were observed immediately adjacent to the proposed alignment. Two double-garage sized sheds are located on the south eastern corner of the golf club car park; there was no evidence to indicate bulk chemical storage within the sheds, and no evidence of any chemical leaks or staining.
- A range of commercial retail and light industrial properties are located along John Glenn and Piermark Drive. The properties visible appear to be well maintained and the operations are well separated from the road reserve.
- On the east side of Bush Road, the alignment runs down an access way between a Budget Rentals depot, located at 169 Bush Road and a Vector substation located at 179 Bush Road. The Budget Rentals depot includes a campervan wastewater dump point. The Vector substation comprises a gravelled switchyard, with two sets of transformers and circuit breakers, and an equipment shed. All equipment appeared in good repair, and there was no evidence of oils spills or staining.
- There is a concrete recycling yard (Atlas Concrete) and a Fulton Hogan yard located at 8 Paul Matthews Road, Rosedale, to the south of the alignment, before it crosses Alexandra Stream.
- The alignment passes through Rosedale Park, located to the west of the Rosedale wastewater treatment plant (WWTP).
- Small pad-mounted transformers are located on the road verge in the following locations:
  - Outside 35 Greenhithe Road, near the western corner of Greenhithe School (refer Figure 4);
  - On the south side of the North Shore Golf Club driveway at 27 Appleby Road, Schnapper Rock (refer Figure 7);
  - Outside Albany Junior High school, near the corner of Appleby Road and Albany Highway (refer Figure 7);
  - At the entrance to the property at 24 Unity Drive North (refer Figure 7); and
  - Several along Piermark Drive on both sides of the road (refer Figures 7 and 8).
- No service stations or drycleaners were noted directly adjacent to the proposed alignment.

2.4 Geology

A summary of available geological information for the alignment is presented in this Section of the report.

2.4.1 Published geology

The published geology beneath the alignment is described by Edbrooke (2001) as generally consisting Puketoka Formation and East Coast Bays Formation (ECBF). The Rosedale and Hobsonville sections of the alignment are indicated to be underlain by Puketoka Formation, while the Waitemata Harbour crossing is indicated to be underlain by ECBF. The alignment overlain on a map of the published geology is provided as Figure 2 in Appendix A.

Puketoka Formation is described by Edbrooke (2001) as consisting pumiceous mud, sand and gravel with muddy peat and lignite; rhyolite pumice, including non-welded ignimbrite, tephra and alluvial pumice deposits.

East Coast Bays Formation is described as consisting alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grit beds.

2.4.2 Site geological information

The soil profile and hydrogeological information obtained from the geotechnical investigation conducted concurrently with this ground contamination investigation show the following:

- Fill material was generally encountered underlying topsoil to a depth of up to 2 m in many of the hand auger and machine boreholes on the alignment. This material typically comprised re-worked soft to stiff, clay/silt mixtures derived from natural Tauranga Group or ECBF soils. The fill material is often underlain by a thin layer of buried topsoil at the contact with natural underlying material.
- Locally around the Hobsonville Pump Station (BH01), fill was encountered to depths of up to 3 m and comprises a mixture of construction debris (concrete, steel, timber) and silt/clay soils.
- Natural Tauranga group or East Cost Bays Formation (ECBF) soils were encountered below topsoil or fill material.

Table 2.1 below summarises the geology encountered during geotechnical investigations along the alignment.

Table 2.1: Summary of site geological information

Depth below ground level to top of layer (m)	Unit thickness (m)	Geological unit	Description
0	0.2m	Topsoil	Dark brown organic silt
0.2m	0 - 1.6m	Fill	Re-worked soft to stiff, clay/silt mixtures derived from natural Tauranga Group or ECBF soils
Were present – directly underlying fill material	0 - 0.2m	Buried topsoil	Dark brown organic silt
0.2 – 1.8	> 2m	Natural soil (ECBF or Tauranga Group)	Silts and sands

2.5 Hydrogeology and hydrology

Groundwater depth within the alignment tends to be generally within a few metres of the ground surface in the alluvial sediments. Groundwater flow direction generally follows the surface topography and discharges to the nearest surface water body.

The alignment is located in various surface water catchments that generally discharge into the Upper Waitemata Harbour.

3 Site history

Historical information relating to the alignment was collected from a variety of sources. The information presented documents on-site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information that has been reviewed is summarised in this section. Detailed information documented during the review is presented in Appendix B.

3.1 Summary of historical review

The land surrounding the alignment is generally low density residential land use, with the exception of Rosedale, where land adjacent to the alignment is generally commercial. The commercial properties are generally retail and office type operations. However

The following activities/former land uses were identified on land surround the alignment:

- Horticultural operations from the early 1960s until the late 1980s across a number of locations along the alignment, including much of Rosedale;
- The North Shore Golf Course, established in the early 1970s;
- The Memorial Park Cemetery, established in the early 1980s with associated fuel storage relating to a crematorium;
- A former sludge disposal bed was present within the current Watercare Hobsonville pump station, remediated in 2008, but minor contamination (arsenic and ammonia nitrogen above background) is indicated to remain in soils down gradient (east) of the former sludge bed;
- A former air strip near Hobsonville;
- Sports field within Wainoni Park;
- Electrical transformers and substations at a number of locations along the alignment;
- A dye spill incident at Unity Drive North, Rosedale in 2008, however, the source may have been from numerous manufacturing facilities that is located in the vicinity of the alignment but unlikely to be directly adjacent; and
- A storage depot for an electricity servicing operation (Siemens NZ Ltd).

The potential for these activities / events to have resulted in ground contamination, including the likely magnitude and extent of contamination is discussed below in Section 4.

4 Potential for contamination

This investigation has identified that HAIL activities have (or are likely to have been) undertaken at locations along the alignment. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in Table 4.1 below. The inferred locations of these activities are presented on Figures 3-8 (Appendix A).

Table 4.1 also identifies whether the potentially contaminating activities meets the MfE definition of a HAIL.

Table 4.1: Potential for contamination

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference	Sampled locations
Pesticide and agrichemical use on horticultural sites and sports turfs. (refer Figures 3-8 for locations)	Metals (As, Cu, Pb) and organochlorine pesticides (OCPs) and organonitrogen and organophospha te pesticides (ONOPs)	Contaminants from this type of activity relates to the use of sprays containing persistent pesticides used prior to the late 1970s. The contaminants are mostly likely to be confined to shallow soil (typically to 400mm depth) where the activities have been undertaken. On a number of sections, the activities occurred adjacent to the location of the proposed alignment. However, in some areas, the activities previously occurred on land in which the alignment will pass through. Most areas were subject to the activities from the 1960s to 1980s. The area that is currently being used for horticultural purposes is Knights Nurseries located between Albany Highway and William Pickering Drive, Rosedale. Potential for contamination: low to moderate	Activity A10- Pesticide use	HA3, BH7, BH9, HA19, HA20, HA21, BH14, BH15, HA27, BH16 Previous sampling and testing by Kingett Mitchell at Wainoni Park (Refer Section B2 in Appendix B)
Former airstrip (refer Figure 3)	Unknown, but likely to be hydrocarbons related to refuelling. If used for aerial application of agrichemicals, metals and OCPs are likely	The airstrip is located on land adjacent to the proposed alignment. If present, contamination is likely confined to shallow surface soils where the airstrip was located. The potential for migration is low. In addition, site observations where a former air strip may have been located indicates that significant earthworks and soil removal has occurred associated with construction of the Upper-Harbour Highway. It is likely that contaminated soil that may have been present has been removed during earthworks Potential for contamination: negligible	Activity H - Contaminant migration to the alignment	HA3

Discharges of sludge into land at the former NZDF WWTP (refer Figure 3)	Contaminants are likely to include metals and polyaromatic hydrocarbons (PAH).	Sludges were previously disposed onto land within the WWTP operated by NZDF. If significant spills/overtopping of the sludge bed has occurred (during operation of the sludge drying bed), there is potential for soil down gradient of the former sludge bed to be impacted. The former NZDF sludge bed was remediated in 2008 and a validation report prepared by Fraser Thomas Ltd. The sludge and some soil surrounding the sludge bed was excavated and disposed to landfill. Material used to backfill the remediation excavation was tested and reported in the Fraser Thomas SVR to be within cleanfill criteria. Validation testing of soil downgradeint of the sludge bed is indicated to contain levels of metals (arsenic and zinc) above published background concentrations, but below levels that have the potential to pose a risk to human health. The proposed Phase 1 alignment is indicated to pass approximately 10m east (down-gradient) of the former sludge bed. Available groundwater monitoring data indicate that water quality has been impacted downgradient of the sludge bed. Potential for contamination: moderate to high	Activity H - Contaminant migration to the alignment	HA1
Electrical transformers A number have been identified adjacent to the alignment	Polychlorinated biphenyls (PCBs) if installed prior to the late 1970s, Hydrocarbons and metals	If present, contamination is likely to be localised to surface soils directly adjacent to the transformer. Excavations associated with the Phase 1 pipeline will be undertaken at a distance from all existing transformers to avoid interference with existing services. Thus contamination is not likely to be encountered Potential for contamination: negligible	None (Activity H - Contaminant migration to the alignment is highly unlikely to have occurred)	N/A
North Shore Memorial Park Cemetery (refer Figure 6)	Lead, mercury formaldehyde	Contamination associated with the cemetery is likely to be confined to soils adjacent to grave sites. The proposed alignment borders the up-gradient southern extent of the cemetery. Thus the potential for contaminant migration to affect soils	None (Activity H - Contaminant migration to the alignment is highly unlikely to have occurred)	N/A

		at the proposed alignment through groundwater is negligible. Potential for contamination: negligible		
Bulk fuel storage associated with the crematorium in North Shore Memorial Park (refer Figure 6)	Hydrocarbons including TPH, VOC and PAH	If significant spills/leakage have occurred from the underground storage tank (UST) these have the potential to contaminate soil around the tank and groundwater below the tank depending on the permeability of underlying soils. The proposed alignment is up-gradient of the former UST which has also been indicated to have been removed. Potential for contamination: negligible	None (Activity H - Contaminant migration to the alignment is highly unlikely to have occurred)	None
Pollution incident at 15 Unity Drive North, Rosedale (refer Figure 7)	Unknown, but likely to be metals, VOCs and PAH associated with inks and dyes	The incident file indicates that a moderate volume of ink/dye was spilled and recorded within a pond at the site. It is possible that contamination of residual soils beneath the site has occurred due to the proximity of the incident directly adjacent to the alignment. Potential for contamination: low to moderate	Activity I – Intentional or accidental release of a hazardous substances	HA24
Vector Electrical Substation (refer Figure 8)	Polychlorinated biphenyls (PCBs) if installed prior to the late 1970s, hydrocarbons and metals	If present, contamination is likely to be localised to surface soils directly beneath the substation. Excavations associated with the Phase 1 pipeline is likely to be undertaken at a distance from the substation to avoid interference with existing services. Thus contamination is not likely to be encountered Potential for contamination: low	None (Activity H - Contaminant migration to the alignment is highly unlikely to have occurred)	N/A
Electric equipment storage facility (refer Figure 8)	Polychlorinated biphenyls (PCBs) if installed prior to the late 1970s, hydrocarbons and metals	The alignment crosses a facility that has been used to store electric equipment (Siemens NZ Ltd). A consent for a stormwater related discharge consent (TP10 compliant) was granted to Siemens in 2007. The paving in the area of the proposed alignment is likely to have prevented underlying soils to be contaminated or to be isolated to the near surface soils. Potential for contamination: low	Activity I – Intentional or accidental release of a hazardous substances	BH16
Rosedale WWTP (refer Figure 8)	Contaminants are likely to include metals and polyaromatic hydrocarbons (PAH).	The area that the proposed alignment is located away from the WWTP facilities. Previous testing in the area where the WWTP facilities are located indicate that near surface soils generally contain low level metals and hydrocarbons, with isolated locations	Activity G6 = Wastewater treatment facility	Previous URS report (refer Section B4 in Appendix B)

		above published background concentrations for non volcanic soils and ALW Plan permitted activity criteria for discharges. The concentrations are below levels that would pose a risk to human health. The soil testing results would provide a likely worst case indication of the soil conditions in the area of the proposed alignment. Potential for contamination: Low		
Placement of imported fill during road construction (Whole alignment)	Unknown but a broad range of contaminants possible depending on whether offsite material was sourced. If sourced from industrial areas then typical contaminants include metals and polyaromatic hydrocarbons (PAH).	The fill used to construct roads are most likely to be locally derived source, and is highly unlikely to have been imported from an industrial site. If contaminants are present, they are likely to be confined to the fill material. Potential for contamination: Low to moderate	Activity I – Intentional or accidental release of a hazardous substances	All locations

5 Regulatory framework

The rules and associated assessment criteria relating to the control of contaminated sites in the Auckland region are specified in the following documents:

- NES Soil;
- Auckland Council District Plans – Waitakere Section 2003 and North Shore Section 2002 (District Plan)
- The Auckland Regional Plan: Air Land and Water (ALW Plan); and
- The Proposed Auckland Unitary Plan (PAUP).

The NES Soil and the Auckland Council District Plans generally consider issues relating to land use and the protection of human health while the ALW Plan and PAUP has regard to issues relating to the protection of the general environment, including ecological receptors. A description of the requirements are set out in the following sections.

5.1 NES Soil

The NES Soil came into effect on 1 January 2012. This regulations set out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health.

All territorial authorities are required to give effect to and enforce the requirements of the NES Soil in accordance with their functions under the Resource Management Act (RMA) relating to contaminated land. As a result, the NES Soil prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil.

The NES Soil applies to specific activities on land where a HAIL activity has, or is more likely than not to have occurred. Activities covered under the NES Soil include soil disturbance, soil sampling, fuel systems removal, subdivision and land use change. The following Table 5.1, as provided in the NES Soil Users Guide (April 2012), confirms the NES Soil applies to the project.

Table 5.1: PSI checklist

NES Soil Requirement	Applicable to site?
Is an activity described on the HAIL currently being undertaken on the piece of land to which this application applies?	Yes
Has an activity described on the HAIL ever been undertaken on the piece of land to which this application applies?	Yes
Is it more likely than not that an activity described on HAIL is being or has been undertaken on the piece of land to which this application applies?	Yes
If 'Yes' to any of the above, then the NES Soil may apply. The five activities to which the NES applies are:	
Is the activity you propose to undertake removing or replacing a fuel storage system or parts of it?	No
Is the activity you propose to undertake sampling soil?	No
Is the activity you propose to undertake disturbing soil?	Yes
Is the activity you propose to undertake subdividing land?	No
Is the activity you propose to undertake changing the use of the land?	No
Conclusion: The NES Soil applies to this project.	

The soil disturbance rules are summarised below:

- Disturbance of small volumes of soil is a permitted activity subject to the following conditions, as set out in Regulation 8(3):
  - Installation of controls to minimise exposure of humans to mobilised contaminants.
  - The soil must be reinstated to an erosion free state within one month of completing the land disturbance.
  - The volume of the disturbance must be no more than 25 m^3 per 500 m^2.
  - Soil must not be taken away unless it is for laboratory testing or, for all other purposes combined, a maximum of 5 m^3 per 500 m^2 of soil may be taken away per year.
  - Soil taken away must be disposed of at an appropriately licensed facility.
  - The duration of land disturbance must be no longer than two months.
- Disturbance or removal of greater volumes of soil requires a consent
  - if a detailed site investigation states that contamination levels are:
    - below the standards detailed in the NES – controlled activity.
    - above the standards detailed in the NES – restricted discretionary activity.
  - if a detailed site investigation is not available, the activity would be considered a discretionary activity.

The NES Soil requires soil testing data to be compared with soil contaminant standards (SCS) appropriate for the landuse. SCS for 13 priority contaminants were derived and published in the MfE, April 2012 Users' Guide. For contaminants in which SCS have not been derived, the NES requires that the *Contaminated Land Management Guideline No.2 – Hierarchy and Application in New Zealand of Environmental Guideline Values* be used.

5.2 Auckland Council District Plans

The NES Soil now prevails over contaminated land rules in the District Plans, except where the rules permit or restrict effects that are not dealt with in the NES Soil. The District Plan does not include any rules more restrictive than those set out in the NES Soil thus District Plan provisions have not been considered further.

5.3 Auckland Regional Plan: Air Land and Water

The (ALW Plan) includes a series of rules related to contaminated sites. The ALW Plan was notified for submissions on 23 October 2001. The ALW Plan was made operative on 30th April 2012 (with the exception of some minor sections still subject to appeals). The ground contamination rules in Chapter 5 (Discharges to Land and Water, and Land Management) are now operative and thus are considered for this project.

- Small scale earthworks on land containing contaminants are a Permitted Activity (PA) (Rule 5.5.40) providing the volume of earthworks open at any one time is less than 200 m^3 and works are completed within one month (this rule is principally to allow the installation of services, or similar minor works, without the need for consent). There are a number of other requirements relating to notification and appropriate storm water and erosion controls along with appropriate off-site soil disposal;
- Rule 5.5.41 states that if soil concentrations or the 95% upper confidence limit (UCL) of soil concentrations and groundwater concentrations are below the relevant guidelines and the land does not contain separate phase hydrocarbons, then a resource consent is not required for the site. If soil and groundwater contaminant concentrations exceed these

relevant guidelines or separate phase is present, then a consent for the ongoing discharge of contaminants and/or for any land disturbance activity is required (Rules 5.5.43 through 5.5.45); and

- Rule 4.5.49 states that the discharge of contaminants into air from earthworks is a PA, subject to conditions (a) to (c) of Rule 4.5.1. Rule 4.5.1 requires that there shall be no discharge into air of hazardous air pollutants that may cause adverse effects on human health, ecosystems or property, including noxious, dangerous, offensive or objectionable odour, dust, particulate, smoke or ash.

In assessing if the presence of soil contamination is a PA under Rule 5.5.41, the following requirements are specified in the Operative Contaminated Land Rules within the ALW Plan:

a Discharge criteria set out in Schedule 10 apply where the effects of land use on human health are expressly authorised through District Plan rules or a consent granted by the territorial authority. The 'discharge' criteria have been used in our assessment rather than the human health criteria in Schedule 10 because human health is already considered by the NES.

b For contaminants not included in Schedule 10, analytical results should be assessed against Tier 1 soil acceptance criteria for the current land use or, if the land use is to change, the proposed land use. The soil acceptance criteria shall protect both human health and sensitive groundwater, as specified in the following documents:

- 'Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand', Ministry for the Environment (MfE) 1999;
- 'Canadian Environmental Quality Guidelines', (Canadian Council of Ministers of the Environment, CCME 1991 (update 2002);
- 'Identifying, Investigating and Managing Risks Associated with Former Sheep-Dip Sites: A guide for local authorities', MfE 2006 (dieldrin and lindane only).

c If background levels of contaminants at the site are greater than the criteria in (a) or (b) above then the soil contamination concentrations shall be assessed against the background levels instead, derived from either:

- The natural background levels for that soil at the site; or
- ARC Technical Publication 'Background Concentrations in Inorganic Elements in Soils from the Auckland Region', TP 153, October 2001.

5.4 Proposed Auckland Unitary Plan

The PAUP was notified on 30 September 2013. The rules relating to contaminated land are identified as having immediate legal effect. The contaminated land rules are set out in Part 3 Chapter H Section 4.5.

To be a permitted activity for disturbance of land, the controls in Rule H.4.5. Contaminated Land 2.1.1 of the PAUP must be complied with. The controls include:

- Advising Council prior to commencing the work;
- Implementing appropriate storm water and erosion controls;
- That the land is not to contain separate phase liquid contaminants; and
- Any water that is discharged is to be disposed of without causing more than minor adverse effects on the environment.

There is no restriction on the volume of soil to be disturbed on the land or duration of land disturbance as required by the ALW Plan.

If the PAUP PA requirements cannot be met, then a resource consent for land disturbance is required as a controlled activity under Rule H.4.5.Contaminated Land 2.2.2. To be a controlled activity, the controls identified in Rule H.4.5. Contaminated land 2.2.2 must be complied with. These include the requirement for a detailed site investigation (DSI) and remedial action plan (RAP, also known as a SMP) to support the consent application.

5.5 Soil disposal requirements

Auckland Council also controls the management of fill moved to other sites. To be disposed of at a cleanfill site, soil must meet local background concentrations of metals at the disposal site and have no organic contamination (e.g. petroleum hydrocarbons). To make an assessment of soil disposal options the soil test results have been evaluated against the generic cleanfill criteria used for the Auckland Region.

Slightly contaminated fill may be disposed of at a managed fill site, with acceptance criteria defined by the site's resource consent. Fill not acceptable at a cleanfill or managed fill site must be disposed of at a licensed landfill.

The acceptance criteria for managed and licensed landfills are typically defined by the consent conditions issued for the individual landfill sites and have therefore not been assessed in detail here. It is recommended that disposal sites are contacted by the appointed contractor to confirm acceptance (and associated rates) prior to commencement of works.

6 Site investigations

6.1 Field works

Combined geotechnical and contaminated land site investigations were undertaken in November and December 2014. The objective of the investigations was to establish the nature and extent of any contamination as a result of the potential HAIL activities identified along the alignment.

The investigations comprised drilling 12 rotary cored boreholes and 20 hand auger holes. The boreholes were completed by a tracked rotary machine drill rig by McMillan Drilling Ltd, while hand augers were undertaken by T&T staff. The boreholes were located as close as possible to the proposed alignment on/adjacent to the HAIL activities identified in the site history review (refer Table 4.1). All areas of potential HAIL have been investigated. Soil testing within Wainoni Park and the Rosedale WWTP has been previously undertaken. We consider that those investigations provide sufficient information to inform contamination conditions at Wainoni Park and Rosedale WWTP for consenting purposes and preparation of the Site Management Plan for the proposed works.

Where boreholes were required to be drilled in proximity to buried services (BH1 & BH5) vacuum excavation was undertaken either to a depth exceeding the depth of the services or to locate the services so that a suitable offset could be developed. No core recovery was logged within the first three meters of these locations, thus no soil samples were available.

The investigation locations are illustrated on Figures 3-8 and drill logs are provided in Appendix C.

All investigation locations were as-built surveyed for x, y, z positions. A hand held Trimble Geoexplorer 6000 was utilised, with differential correction, which provided a horizontal and vertical accuracy of +/- 1m.

Sediment samples have been collected from the Upper Waitemata Harbour Crossing alignment between the Upper Harbour Motorway and Greenhithe (refer Site 1 – Site 9 in Figure 3). The samples were collected for laboratory testing to inform disposal requirements, if this is required depending on the construction methods.

6.2 Soil and sediment sampling procedures

Soil samples were collected in general accordance with the MfE Contaminated Land Management Guidelines No.5 as follows:

- A surface soil sample was generally taken from between about 0 and 100 mm depth below ground level (bgl).
- Subsequent samples were collected at approximately 0.5 m depth intervals to a depth of at least 2 m below ground level (bgl).
- The materials encountered were logged in accordance with the NZ Geotechnical Society "Guidelines for the classification and field description of soils and rocks for engineering purposes".
- Freshly gloved hands were used to collect soil samples from the recovered core. All samples were placed immediately into 300 ml glass jars.
- Any equipment used to collect the samples was decontaminated between sample locations using clean water and Decon 90 (a phosphate-free detergent).
- Samples were shipped in chilled containers to Hill Laboratories, Hamilton under chain of custody documentation.

6.3 Observations

The type of soils encountered along the alignment have been described in Section 2.4.2. Fill was encountered at approximately 50% of all sampled locations and comprised re-worked soft to stiff, clay/silt mixtures derived from natural Tauranga Group or ECBF soils.

The sediment samples collected from the Upper Waitemata Harbour Crossing comprised silt and sands consistent with marine sediments.

No visual or olfactory evidence of contamination was encountered in any of the investigated locations.

7 Analytical results

A total of 79 soil samples from between ground surface and 2m depth below ground and 5 sediment samples from the Waitemata Harbour were tested for a range of contaminants including metals, polyaromatic hydrocarbons (PAH), and total petroleum hydrocarbons (TPH). The soil within or adjacent to areas of former horticultural areas (circa 1960 – 1980) were tested for organochlorine pesticides (OCPs). Soil samples collected from Albany horticultural properties were also tested for organonitrogen pesticides (ONOPs). The testing was generally scheduled based on the findings of the PSI investigation and borehole logs.

For evaluating the carcinogenic PAH compounds, benzo(a)pyrene equivalent (B(a)P eq.) values have been calculated. B(a)P is the most studied PAH compound and the B(a)P eq. value represents an estimate of the cumulative effects of seven common carcinogenic PAH species listed by USEPA.

A summary of soil analysis results (refer Table D1) and laboratory transcripts are provided in in Appendix D.

7.1 Evaluation criteria

Soil data has been evaluated against criteria determined by the regulatory framework for contaminated sites (refer Section 5) as follows:

- The NES Soil requires soil results to be assessed against published background concentrations and soil contaminant standards (SCS) that define an adequate level of protection for human health. The SCS for commercial land use has been used to assess risks to staff undertaking the proposed works. In areas which are currently used for recreational purposes, such as Wainoni Park and the North Shore Golf Course, the SCS for recreational land use has been used to assess potential for reuse of the excavated material; and
- Permitted activity soil acceptance criteria set out in the ALW Plan/PAUP for discharges.

Sediment data has been evaluated against published background concentrations for non-volcanic soils as this is used by Auckland Council to assess potential for disposal to cleanfill (refer Section 5.5 of this report).

The various relevant criteria are displayed along with the analytical results in Table D1 (refer Appendix D).

7.2 Quality assurance/quality control

A quality assurance and quality control (QA/QC) program was implemented as part of field procedures, which included:

- Sampling equipment decontamination between sampling locations;
- Preservation of samples with ice during transport from the field to the laboratory;
- Transportation of samples with accompanying Chain of Custody documentation; and
- Compliance with laboratory sample holding times.

The laboratory testing was undertaken by Hill Laboratories Ltd, which is accredited and audited annually by International Accreditation New Zealand (IANZ). The laboratory's quality control measures include testing of blanks with all batches of samples and frequent replicates and spikes, along with peer review of worksheets.

7.3 Discussion of results

7.3.1 Soils

Analytical results of the soil samples collected along the alignment indicated no exceedances of the NES Soil commercial or recreational landuse SCS.

Contaminant levels in near surface soils (less than 0.5 m depth) in relatively short sections of the alignment contain contaminants slightly above published background concentrations and will have implications for disposal of the soil. These areas are indicated as Areas 1 - 4 on Figures 3 – 8. Results for each of the areas are summarised below.

Area 1: Section within the Hobsonville Pump Station site (Figure 3)

- A former sludge disposal bed was present within the current Watercare Hobsonville pump station, remediated in 2008. Arsenic and ammonia nitrogen levels above background, but below the relevant NES Soil SCSs and ALW Plan/PAUP criteria is indicated to remain in soils down gradient (east) of the former sludge bed;

Area 2: Section within Greenhithe between BH3 and HA8 (Figure 4)

- Results from sampling at the surface of BH6, HA6 and HA7 (BH6-0.1, BH6-0.3, HA6-Surface, and HA7-Surface) showed low but detectable levels of PAH, below the relevant NES Soil SCSs and ALW Plan/PAUP criteria.
- PAH concentrations from material directly underlying the surface material (at 0.5m depth) in BH6 – HA7 were all below laboratory detection limits, indicating that contaminants are likely to be confined to surface soils.

Area 3: Section within Wainoni Park (Figure 5)

- Previous testing by Kingett Mitchell indicated that the near surface soils from around a shed in the park showed elevated copper and DDT concentrations above the NES Soil SCS for recreational and commercial landuse. The shed is located about 100 m to the west of the proposed alignment. This area has been fenced off and is shown by the blue shaded area in Figure 5 of Appendix A.
- The Kingett Mitchell report indicates that soil samples away from the shed showed contaminant concentrations below the NES Soil SCS for recreational and commercial landuse. The actual data is not available for review. Soil testing information at the fringes of the fenced area indicate that the contaminant concentrations exceed ALW Plan/PAUP criteria for discharges (0.7 mg/kg). In the absence of further testing information, it is assumed that concentrations above the ALW Plan/PAUP discharge criteria is present.
- The report indicated that contaminant concentrations reduce significantly with depth but minor residual contaminants were still detected at 0.5 m in the vicinity of the shed.

Area 4: Section between Albany Highway and Piermark Drive (Figure 7)

Limited soil testing data is available for Area 4 due to a change to the alignment after completion of field work in late 2014.

- Results from sampling of fill material at the surface within HA24 (HA24-Surface) showed low, but detectable levels of DDT below the relevant NES Soil SCS and ALW Plan/PAUP criteria.
- Results from sampling of fill material at the surface within HA25 (HA25-Surface) showed low, but detectable levels of DDT and PAHs below the NES Soil and ALW Plan/PAUP criteria.

- Metal, DDT and PAH concentrations from soils directly underlying the surface material (at 0.5m depth) in each of the investigation locations between Albany Highway and William Pickering Drive (HA22 – HA25) were all below laboratory detection limits, indicating that contaminants are likely to be confined to surface soils.

Desk study information shows that infilling of the former valley/streams prior to formation of John Glen Drive and William Pickering Drive is the only HAIL activity identified in Area 4. Fill encountered in HA22, HA24 and HA25 is thought to have been placed at this time. Soil testing data from these locations is therefore considered to be a conservative representation of likely soil contaminant levels along this section, given that these locations were identified to be within, or adjacent to ongoing horticultural activities.

Further soil testing is proposed across Area 4 to confirm soil contaminant concentrations. Any soil handling or disposal implications for Area 4 indicated by soil testing data will be reflected in the Site Management Plan for the Phase 1 works, prepared concurrently with this DSI.

Area 5: Section between William Pickering Drive and Rosedale WWTP (Figures 7 and 8)

- Results from sampling of topsoil and underlying fill within BH14 (BH14-0.1 and 0.5) showed low, but detectable levels of DDT below the NES Soil and ALW Plan/PAUP criteria.
- Results from sampling of topsoil within HA27 (HA27-Surface) show low, but detectable levels of DTT below the NES Soil and ALW Plan/PAUP criteria.
- Further testing to establish the depth extent of contaminant concentrations in this section needs to be carried out.

In all other areas, contaminant concentrations were within background concentrations or below laboratory detection limits. One sample, HA1-Surface, showed PAH concentrations at the laboratory screen detection limits, within analytical precision and are unlikely to present implications for soil disposal.

7.3.2 Sediment

PAH concentrations in the harbour sediments samples were all below the laboratory detection limit.

Metal concentrations were generally within published background concentrations for non-volcanic soils in the Auckland Region with the exception of slightly elevated arsenic at three of the five locations (Sites 1, 5 and 7) sampled. The arsenic concentrations at those locations ranged between 17 and 38 mg/kg, relative to the published background concentration for non-volcanic soils in Auckland region of 12 mg/kg.

The results indicate that any harbour sediment, if it requires disposal at a landfill (unlikely), may not be suitable for disposal to cleanfill and may need disposal to an approved landfill.

8 Conceptual site model and assessment of environmental effects

A conceptual model as defined by the MfE in the contaminated land management guidelines[2], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

A conceptual site model has been developed generally for the project, which takes into account the available information about the site, geological, hydrological and hydrogeological site conditions and our understanding of the potential effects on human health and the environment. The model is presented below.

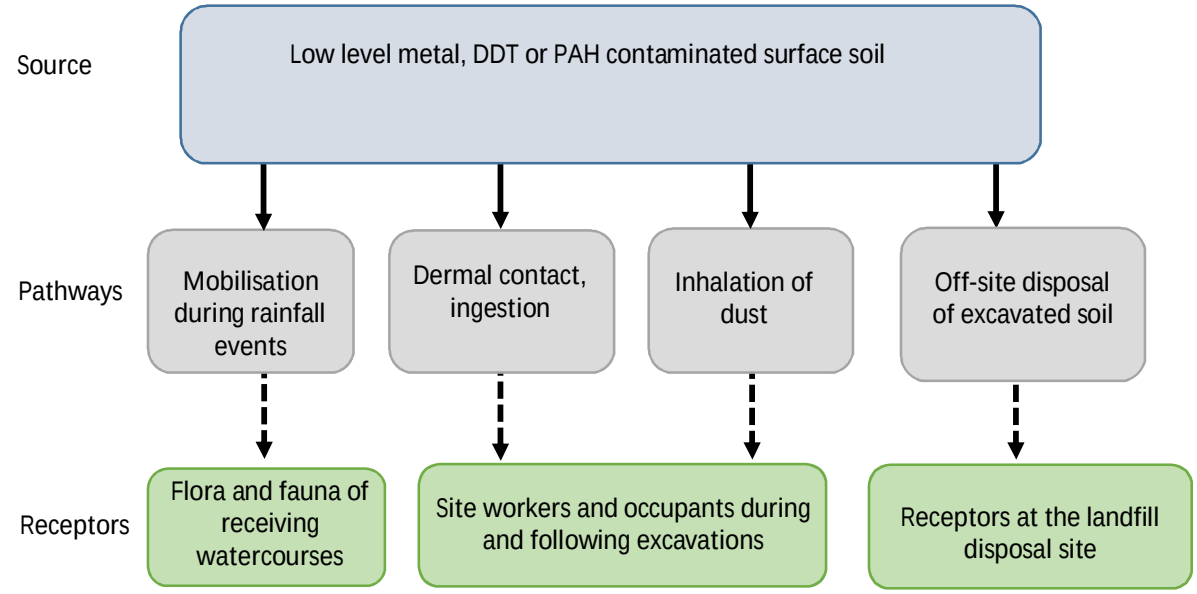

Diagram 1: Preliminary conceptual site model for project. All pathways are incomplete

The results of the testing indicate that contaminant concentrations are not at levels that would pose a human health risk to construction workers and the general public. In addition, the works can be managed using standard earthworks procedures to ensure that any environmental impacts will be less than minor. The procedures are provided in a Ground Contamination Site Management Plan which has been prepared for the project and is attached.

[2] Ministry for the Environment, updated 2011, *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils*

9 Implications for the project

Soil disturbance is required to be undertaken to complete the project. The low level contaminants in near surface soil has a number of implications for the site works. These are discussed below.

9.1 Soil disposal

Low levels of contaminants are present within surface soils across a number of sections of the alignment. The excavated soils from these parts of the alignment that cannot be reused on site will require disposal to a managed landfill. Otherwise, soils on the other parts of the alignment are indicated to meet cleanfill acceptance criteria. Table 8.1 below summarises the disposal implications for soils that cannot be reused on site.

Table 8.1: Summary of soil disposal implications

Area	Depth range	Summary of contamination	Likely disposal requirements
Area 1	0 – 5m	Arsenic and ammonia nitrogen within soils	Managed fill
Areas 2 and 3	0 - 0.5m depth	A number of contaminants present, depending on the location, including metals, PAH and DDT	Managed fill
	Below 0.5m depth	Testing indicates that the levels of contaminants within deeper surface soils are within background concentrations	Cleanfill
Area 4	0 – 0.5m depth	No soil data is available. Results from investigations nearby (refer Section 7.3) are thought to be conservative until further investigations are complete	Managed fill
Area 4	Below 0.5m depth	Testing indicates that the levels of contaminants within deeper surface soils are within background concentrations	Cleanfill

Area	Depth range	Summary of contamination	Likely disposal requirements
Area 5	0 - 0.5m depth	A number of contaminants present, depending on the location, including metals, PAH and DDT	Managed fill
	Below 1 m depth in natural soils	Further testing is required to confirm.	Cleanfill, subject to testing results
Remainder of the alignment (outside of Areas 1-4)	Surface to invert level of the trench	Testing indicates that contaminant levels within soils in areas outside of Areas 1-4 are within background levels	Cleanfill
Upper Waitemata Harbour Crossing	Harbour sediments	Low levels of arsenic	Managed fill

9.2 Regulatory implications

The following is an assessment against the contaminated land regulatory requirements (refer Section 5) and forms the basis of our evaluation of the need, or otherwise, for contamination related consents relevant to the proposed work.

9.2.1 NES Soil

As discussed in Section 5.1, the NES Soil applies to sections of the proposed works because HAIL activities have occurred along and adjacent to the alignment. As contaminant concentrations are above background levels within sections of the alignment (Areas 1-5), it is necessary to consider whether the works are a permitted activity or whether a resource consent is required.

An assessment against relevant permitted activity standards for soil disturbance is provided in Table 9.1 below. Based on the current understanding of the project and associated trenching works, the proposed works may not meet the provisions of a Permitted Activity under the NES Soil Regulation 8(3) because of the likely volume of earthworks and duration of the works. A precautionary approach has been taken and a consent is likely to be required under the NES Soil.

Table 9.1: NES Soil Permitted Activity assessment for soil disturbance

NES Soil – Soil disturbance permitted activity conditions (Regulation 8(3))	Assessment
(a) Implementation of controls to minimise exposure of humans to mobilised contaminants.	CAN COMPLY provided controls are in place to prevent mobilisation of contamination.
(b) The soil must be reinstated to an erosion free state within one month of completing the land disturbance.	COMPLIES - The trench will be backfilled and reinstated to an erosion free state on completion of the works.

NES Soil – Soil disturbance permitted activity conditions (Regulation 8(3))	Assessment
(c) The volume of the disturbance of the piece of land must be no more than 25 m^3 per 500 m^2.	DOES NOT COMPLY- The volume of disturbance within HAIL areas of the alignment is expected to exceed the allowable threshold. This is based on a conservative assumption that the piece of land of the HAIL activity is equal to the area of the excavation so that only 50 mm of soil can be disturbed.
(d) Soil must not be taken away unless it is for laboratory testing or, for all other purposes combined, a maximum of 5 m^3 per 500 m^2 of soil may be taken away per year.	CANNOT DETERMINE COMPLIANCE BASED ON CURRENT INFORMATION - If more than 20% of the excavated soil is removed from sections of the alignment through the identified HAIL areas, the volume will exceed the threshold for the site.
(e) Soil taken away must be disposed of at an appropriately licensed facility.	CAN COMPLY provided soil removed from site is disposed to an approved facility.
(f) The duration of land disturbance must be no longer than two months.	UNLIKELY TO COMPLY- The duration of the earthworks along the alignment in which could take longer than 2 months.
(g) The integrity of a structure designed to contain contaminated soil or other contaminated materials must not be compromised.	NOT APPLICABLE - as there are no structures containing contamination within the area subject to land disturbance.

The type of consent (either controlled, restricted discretionary or discretionary activity) is determined by whether:

- A detailed site investigation (DSI) exists; and
- The contaminant concentrations are above or below the relevant NES Soil SCS.

We consider that the proposed works will meet the controlled activity requirements as set out in Regulation 9 of the NES Soil for the following reasons:

- This report forms a detailed site investigation.
- It states that soil contamination does not exceed the applicable standard for the landuse.
- This report will be provided to the consent authority.
- A Ground Contamination Site Management Plan (SMP) has been prepared concurrently with this report to support the consent application.

9.2.2 Auckland Council Regional Plan: Air Land and Water

Separate phase hydrocarbons have not been encountered and, based on the nature of the potential contaminant sources, it is unlikely to be present. Contaminant concentrations in soils along the alignment are largely below the ALW Plan permitted activity criteria for discharges. However, soils within Wainoni Park could contain DDT concentrations above the ALW Plan. On this basis, a consent under the ALW Plan to undertake land disturbance work is required. The works will meet the controlled activity requirements of Rule 5.5.44 for the following reasons:

- This report forms a Site Investigation Report (SIR).
- The Contamination Site Management Plan (CSMP) that has been prepared to support the consent application is commensurate with a Remedial Action Plan (RAP).
- Both of these will be provided to Auckland Council.

9.2.3 Proposed Auckland Unitary Plan

Consent is not required under the PAUP so long as adequate controls are put in place during earthworks to minimise discharges of contaminants to the environment during works (such as via a SMP). The required controls are set out in the permitted activity conditions (refer Rule H.4.5. Contaminated land 2.1.1 of the PAUP). One of the controls requires the quality of any water that is to be discharged to surface water must comply with the ANZECC 95% protection of fresh/marine species guidelines. Any water that requires dewatering within the Wainoni Park section of works (Area 3 in Figure 5) should be tested to ensure compliance. The testing is not required if further investigation show that the contaminants are confined to near surface soils (above groundwater).

10 Conclusions

This investigation has been undertaken to confirm current and historic activities that have occurred along the proposed alignment of the Phase 1 Northern Interceptor project and the potential for these activities to have resulted in ground contamination. The investigations have been undertaken in general accordance with the requirements for both a PSI and a DSI, as described in the NES Soil Users Guide.

Based on the site history review, potential HAIL activities identified on the land of the proposed alignment were:

- Use of persistent pesticides at former and existing horticultural land and sports turfs; and
- Intentional or accidental release of hazardous substances which could migrate onto the land from:
  - Discharges of sludge into land at the former NZDF WWTP;
  - a former air strip near Hobsonville;
  - former and existing horticultural activities;
  - a dye spill incident at Unity Drive North, Rosedale in 2008;
  - electric equipment storage facility in Rosedale; and
- Intentional or accidental release of hazardous substances as a result of placement of contaminated fill during construction of roads along the alignment.

Site investigations have been undertaken to establish the nature and extent of contamination along the alignment. Key findings are discussed below:

- Analytical results of soil samples collected along the alignment indicated no exceedances of the NES Soil commercial or recreational landuse SCS. In only 1 section of the alignment (Wainoni Park), available soil testing information indicated that contaminant concentrations above the ALW Plan/PAUP criteria for discharges could be present.
- The investigations indicated that contaminant levels were largely below published background concentrations. However, in sections of the alignment, contaminants slightly above published background concentrations have been identified in the near surface soils (less than 1 m depth).
- Sediment samples collected from the proposed alignment of the Upper Waitemata Harbour Crossing indicated that it could contain arsenic concentrations above the anticipated published background concentrations which has been adopted by Auckland Council as the default cleanfill criteria. This means that any sediment, if it requires disposal at a landfill (unlikely), may not be able to be disposed to cleanfill.

The results of the testing indicate that contaminant concentrations are not at levels that would pose a human health risk to construction workers and the general public.

The following has been identified with respect to consenting requirements, based on existing information:

- A controlled activity consent under the NES Soil for land disturbance.
- A controlled activity consent under Rule 5.5.44 of the ALW Plan for land disturbance.
- Consent is not required under the PAUP, subject to the implementation of the controls in the Ground Contamination Site Management Plan.

The investigations undertaken to date indicates that the works can be managed using standard earthworks procedures to ensure that any environmental impacts will be no more than minor.

The procedures are provided in a Ground Contamination Site Management Plan which has been prepared for the project.

11 Applicability

This report has been prepared for the benefit of Watercare Services Ltd in accordance with our proposal dated 12 August 2014 with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

Recommendations and opinions contained in this report are based on our visual inspection and sampling of accessible material. The nature and continuity of the material away from the test and sample locations is inferred but it must be appreciated that actual conditions may vary from the assumed model.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

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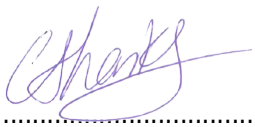	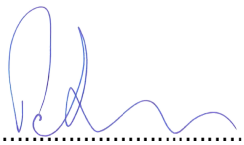
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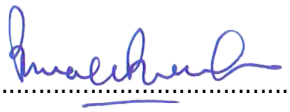
Chris Shanks	Peter Roan
Environmental Scientist	Project Director

Reviewed by a suitably qualified and experienced practitioner under the NES Soil:



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Lean Phuah

Senior Contaminated Land Specialist

29-Jun-15

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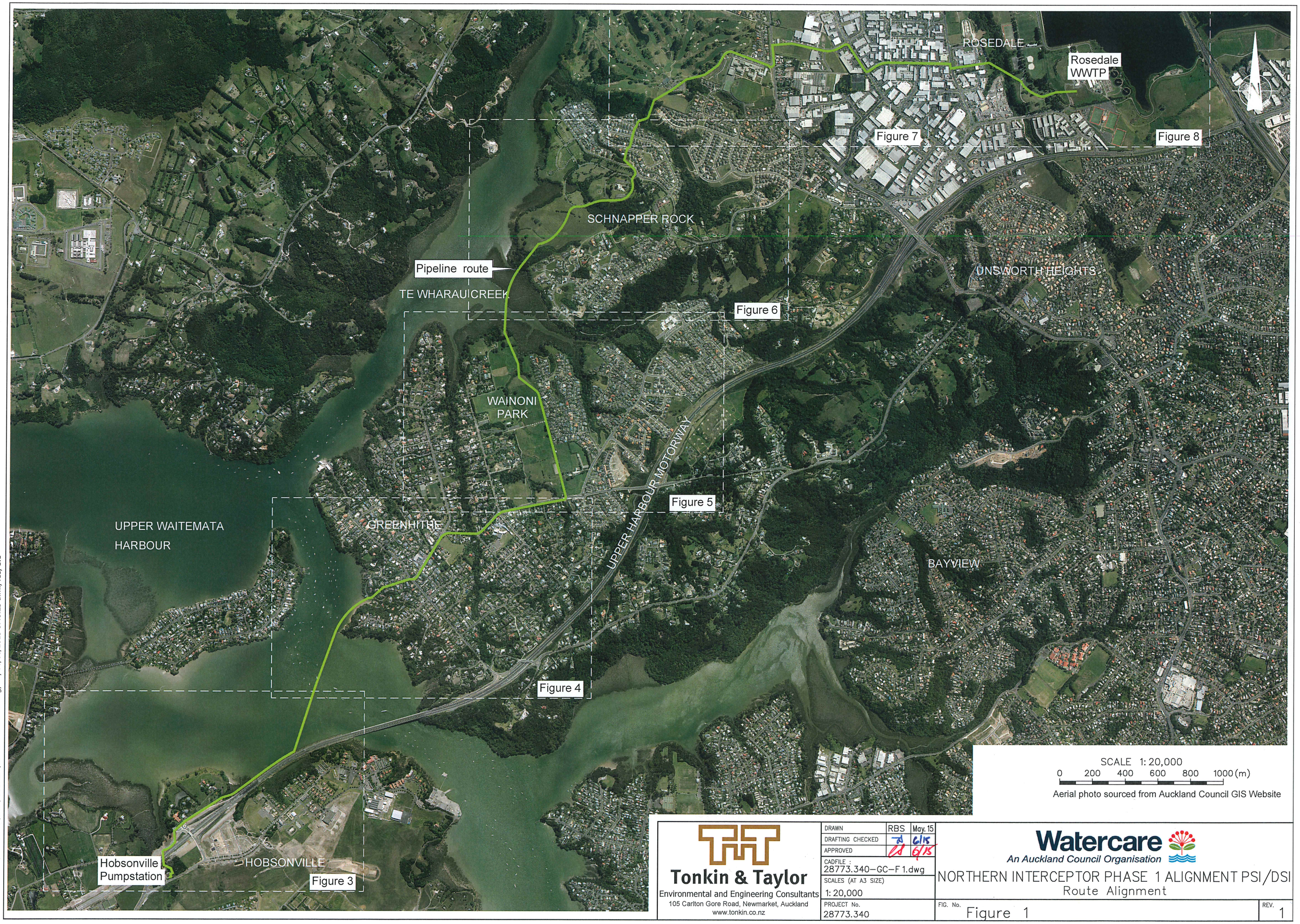
Appendix A: Figures



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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Route Alignment

FIG. No. Figure 1

REV. 1

Pipeline route

LEGEND

Symbol	Description
hf	Construction Fill
ht	Tauranga Group: Stream Alluvium
tp	Tauranga Group: Pumiceous Deposits (Alluvium)
re	East Coast Bays Formation: Alternating muddy Sandstone and Mudstone
rr	Paremoremo Formation: Mudstone and graded Sandstone

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Geological map sourced from Institute of Geological and Nuclear Sciences (Crown Copyright Reserved)

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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Route Geology

FIG. No. Figure 2

REV. 0

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UPPER WAITEMATA HARBOUR

UPPER HARBOUR MOTORWAY

BUCKLEY AVENUE

HOBSONVILLE

A10
Former Horticultural

F1
Airstrip

HA-3

HA-2

BH-2

BH-1

HA-1

Area 1

G6 - Former NZDF Sludge Disposal bed and WWTP

Watercare Pump Station

1

2

3

N

LEGEND

BH-1	Borehole location (T&T, Dec. 2014)
HA-1	Handauger location (T&T, Dec. 2014)
1	Sediment sample location
	Minor surface contamination Refer Section 7.3 of PSI/DSI Report.
G6	MfE HAIL ID reference

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Aerial photo sourced from Auckland Council GIS Website

Property boundaries sourced from Land Information New Zealand data as at 10-Nov-2014 (Crown Copyright Reserved)..

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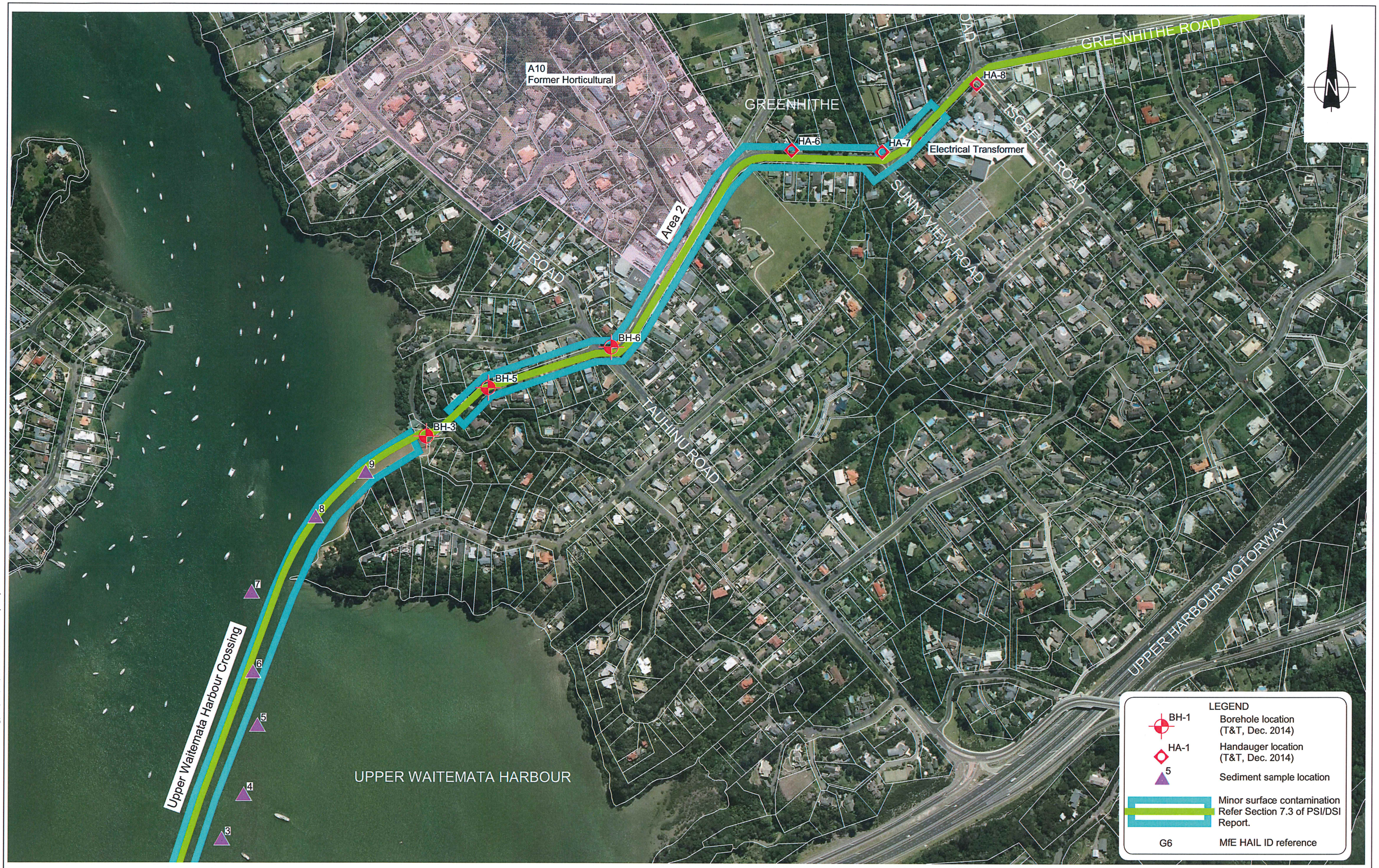
NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Hobsonville

FIG. No. Figure 3

REV. 2



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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI

Potential HAIL Activities – Greenhithe

FIG. No. Figure 4

REV. 1

TE WHARAU CREEK

A10
FormerHorticultural

Discharge Consent
(Residual DDT)

Area 3

A10
Sports Turf

Wainoni Park

GREENHITHE

ROLAND ROAD

CHURCHOUSE ROAD

GREENHITHE ROAD

UPPER HARBOUR MOTORWAY

N

LEGEND

BH-1	Borehole location (T&T, Dec. 2014)
HA-1	Handauger location (T&T, Dec. 2014)
	Minor surface contamination Refer Section 7.3 of PSI/DSI Report.
G6	MfE HAIL ID reference

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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Greenhithe–Schnapper Rock

FIG. No. Figure 5

REV. 1

SCALE 1: 5000

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Aerial photo sourced from Auckland Council GIS Website

Property boundaries sourced from Land Information New Zealand data as at 10-Nov-2014 (Crown Copyright Reserved)..

L:\28773\28773.340\CAD\FIGURES\28773.340-GC-F3-F8.dwg, F6, 30/06/2015 8:51:57 a.m., rbs, 1:1

Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
www.tonkin.co.nz

DRAWN	RBS	Jun. 15
DRAFTING CHECKED	TJ	6/15
APPROVED	CA	6/15
CADFILE : 28773.340-GC-F3-F8.dwg		
SCALES (AT A3 SIZE) 1: 5000		
PROJECT No. 28773.340		

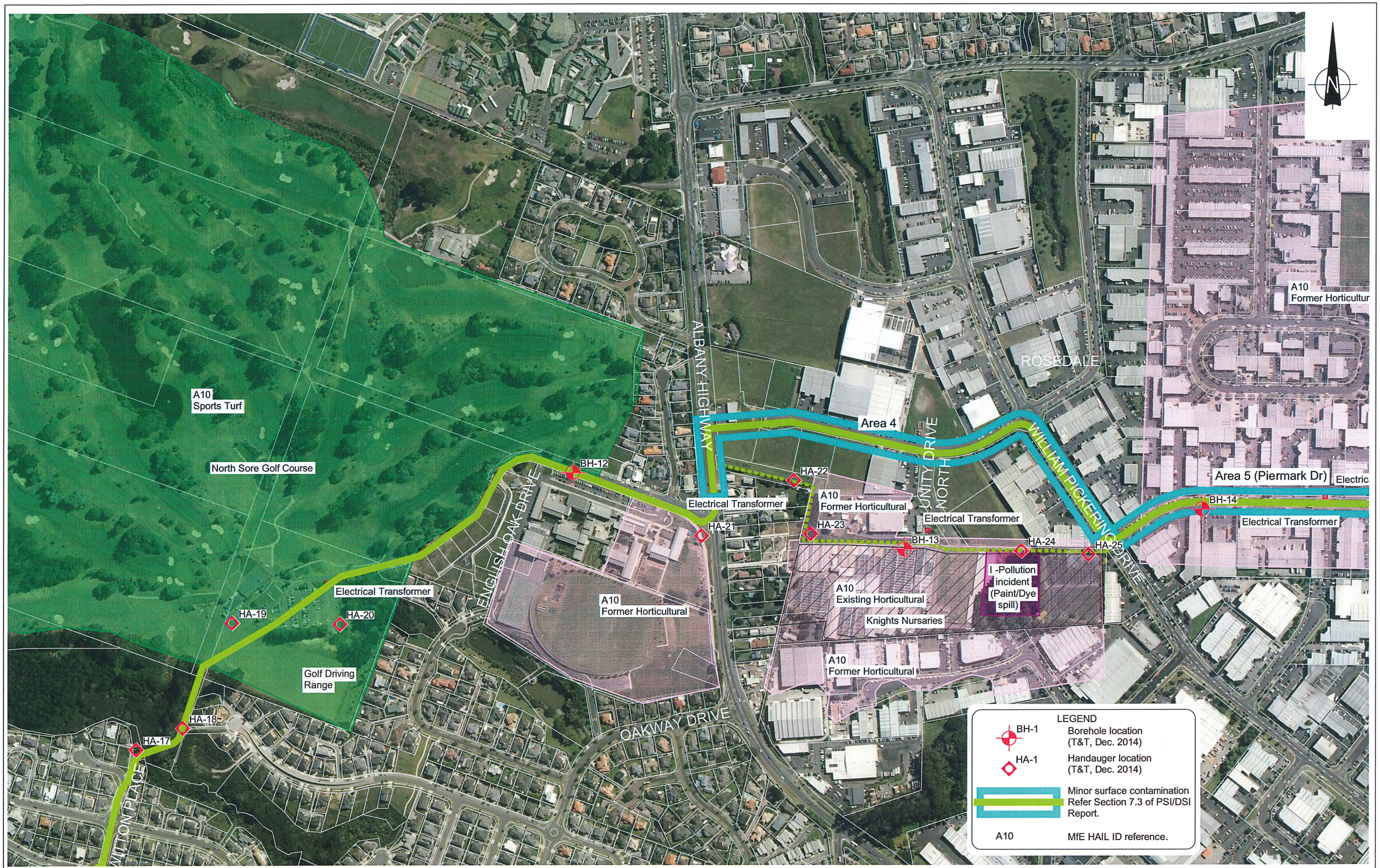
Watercare
An Auckland Council Organisation

NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI

Potential HAIL Activities – Schnapper Rock

FIG. No. Figure 6

REV. 1



SCALE 1: 5000

0 50 100 150 200 250 (m)

Aerial photo sourced from Auckland Council GIS Website

Property boundaries sourced from Land Information New Zealand data as at 10-Nov-2014 (Crown Copyright Reserved).

L:\28773\28773.340\CAD\FIGURES\28773.340-GC-F3-F8.dwg, F7, 30/06/2015 8:51:24 a.m., rbs, 1:1

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Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
www.tonkin.co.nz

DRAWN	RBS	Jun. 15
DRAFTING CHECKED		
APPROVED		
CADFILE : 28773.340-GC-F3-F8.dwg		
SCALES (AT A3 SIZE) 1: 5000		
PROJECT No. 28773.340		

Watercare
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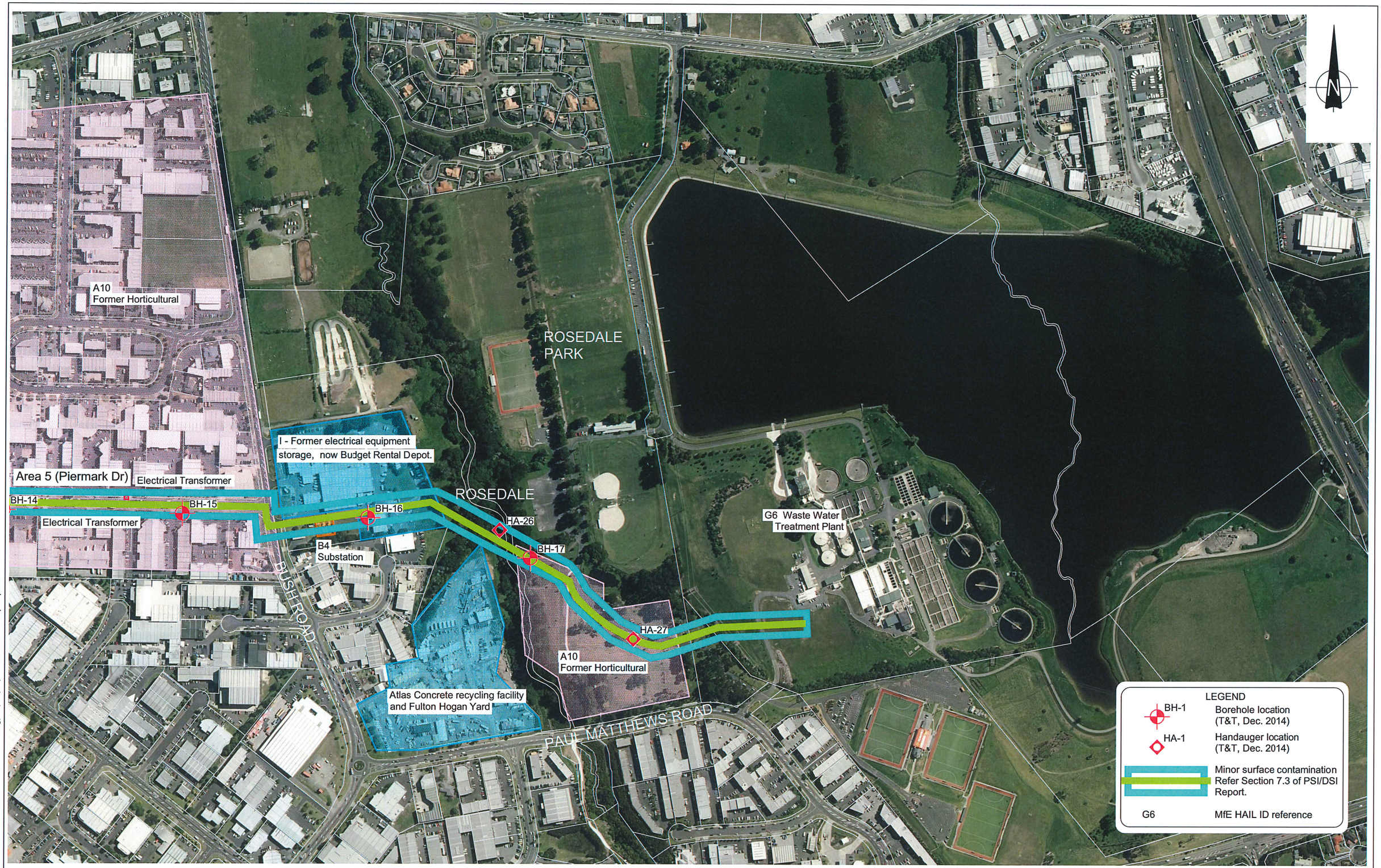
NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Rosedale

FIG. No. Figure 7 REV. 1



SCALE 1: 5000

0 50 100 150 200 250 (m)

Aerial photo sourced from Auckland Council GIS Website

Property boundaries sourced from Land Information New Zealand data as at 10-Nov-2014 (Crown Copyright Reserved).

L:\28773\28773.340\CAD\FIGURES\28773.340-GC-F3-F8.dwg, F8, 30/06/2015 8:50:51 a.m., rbs, 1:1

Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
www.tonkin.co.nz

DRAWN	RBS	Jun. 15
DRAFTING CHECKED	TJ	6/15
APPROVED		6/15
CADFILE : 28773.340-GC-F3-F8.dwg		
SCALES (AT A3 SIZE) 1: 5000		
PROJECT No. 28773.340		

Watercare
An Auckland Council Organisation

NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Rosedale

FIG. No. Figure 8

REV. 2

Appendix B: Historical information review

B1 Introduction

This document is Appendix B of Tonkin & Taylor Ltd, March 2015, Northern Interceptor - Phase 1 Ground contamination assessment report and has been prepared to detail the site historical review work undertaken for the assessment.

Historical information relating to the alignment was collected from a variety of sources. The information presented documents on-site activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use.

B2 Aerial photograph review

Historic aerial photographs available from both Auckland Council and the T&T library were reviewed. A summary of the findings, focussed on inferred potentially contaminating land uses along the alignment starting from south (Hobsonville) to north (Rosedale WWTP), are presented in Table B1 below. Areas of land not described in Table B1 are either pastoral/grazing (earlier) or residential (later), and are not considered to have the potential to have caused contamination. Addresses used refer to present day property descriptors.

Table B1: Summary of aerial photos

Source and Date	Observations
1959 Auckland Council GIS – (Only available from William Pickering Dr to Rosedale WWTP)	• The alignment (430 m) runs through an orchard from 1-15 Piermark Drive. • The section of Rosedale Park that the alignment cuts through is under cropping or market garden activity. • The land surrounding what is now John Glen drive appears to be pastoral, with a number of relatively small valleys/steams running northwards
1963 T&T Library	• An orchard borders the alignment from 6-20 Greenhithe Road, on the north side of the road. • The alignment cuts through a small orchard (1500 m^2) in the present day Wainoni Park South, directly east of 40 Churchouse Road. • The section of alignment that runs through Wainoni Park North is surrounded by cropping or market garden activity, up to the harbour/mangrove edge. • Earthworks are underway in various locations across the North Shore Golf Course site. • The Piermark Drive segment of alignment is still surrounded by orchard. • The section of Rosedale Park that the alignment cuts through is still under cropping or market garden activity.

Source and Date	Observations
1972/73 T&T Library	• Two grass airstrips, approximately 175 m long, run parallel to Squadron Drive; two associated buildings intersect the alignment at the northern end of Squadron Drive. • The road frontage of the orchard previously identified at 6-20 Greenhithe Road is now occupied by residential properties; the orchard is approximately 70 m from the alignment. • The small orchard in Wainoni Park South is still present. • Wainoni Park North is still under cropping/cultivation. • Earthworks are underway in the North Shore Cemetery. • North Shore Golf Course appears to have been recently established. The alignment cuts through the southeast corner of the golf course site. • An orchard (about 14,000 m^2) is located 150m south of the alignment, located between William Pickering Drive and Albany Highway. • The Piermark Drive segment of alignment is still surrounded by orchard. • The section of Rosedale Park that the alignment cuts through still is under cropping or market garden activity.
1980/81 T&T Library	• The airstrips along Squadron Drive are still present. • The small orchard in Wainoni Park South is still present. Image quality makes it unclear whether Wanoni Park North is still under cultivation. • North Shore Cemetery appears operational; the alignment skirts the south eastern boundary of the cemetery. • The orchard in the Unity Drive area is not present. The area appears to be under cropping or market garden. • Most of the orchard along Piermark Drive appears to have been removed. Market garden activity may be occurring in its place; image quality makes this hard to determine. • Cropping/market gardening in Rosedale Park is uncertain due to image quality.
1996 Auckland Council	• The Upper Harbour Highway is now established. Airstrips and associated buildings are no longer present in the Squadron Drive area. The alignment cuts through pastoral land, hedges and roading before entering the harbour. • The Greenhithe Road orchard has been replaced my several residential properties. No orcharding activity is evident from the image. • The small orchard in Wainoni Park South is still present. The rest of the park appears to be parkland, with some sports fields evident in the western portion. • North Shore Cemetery has been further utilised; the alignment does not appear to enter the cemetery. • The alignment crosses the eastern edge of the carpark at North Shore Golf Course. • A large horticultural operation is present in the Unity Drive vicinity. The alignment runs approximately 130m north of this site; • Earthworks are underway surrounding what is now John Glen Drive. The valley/stream systems previously noted now appear to have been infilled; • The Piermark Drive segment of alignment is flanked by large commercial/warehouse buildings to the north and south. No specific uses are discernible; further lots in the area appear under development.

Source and Date	Observations
2001 Auckland Council	• A small (3500 m^2) triangular piece of land bordering the northern edge of squadron drive on-ramp appears to be planted as an orchard. • The entire section of alignment running along Greenhithe Road is now exclusively flanked by residential properties, with the exception of one park (Collins Park). • Wainoni Park South orchard is still present, sheep are evidently grazing the majority of the southern park. The central portion of the park is occupied by soccer fields, which the alignment intersects; the northern area is grazed. • John Glen Drive has now been formed and sealed. Land surrounding this section of the alignment appears vacant/ overgrown. • A paddock on the corner of Appleby Road and Albany Highway is being used for market garden activities. • Piermark Drive has is now fully developed as a commercial area, no vacant lots remain. Specific commercial activities cannot be determined.
2006 Auckland Council	• Earthworks are underway in the Waiarohia Place – Squadron Drive area, associated with the Squadron Drive offramp. • No changes are observed in the Wainoni Park area, except for the construction of a concrete pathway and bridge cutting through the park, connecting Churchouse Road to Te Wharau Drive, and a carpark. The alignment crosses both the path and carpark. • A residential subdivision is under development in the Schnapper Rock Road-Newbury Place-Witton Place area. • A sports facility has been developed along the Appleby Road segment of the alignment. This includes asphalted car parking areas along the road frontage, several buildings, tennis courts, and a cricket oval. The market garden area visible in 2001 is now vacant land.
2008 Auckland Council	• The majority of the orchard along the Squadron Drive on ramp has been cleared. • The residential subdivision in the Schnapper Rock Road-Newbury Place-Witton Place area is almost fully developed; six vacant lots remain. • An extra block of glasshouses has been added to the horticultural operation in the Unity Drive North area; these glasshouses border the small pound. • Light commercial (warehousing/distribution) buildings appear to have been constructed along John Glen Drive • No other major changes were observed along the alignment.

B3 Council contamination enquiry

A contamination/pollution incident enquiry was placed with Auckland Council on 6 October 2014. Records relating to contamination along the proposed alignments, along with relevant resource consents in the surrounding area, are summarised in

Table B2 below. The consents/incidents that have been highlighted have been assessed to have the potential to cause contamination on soils within the alignment. The rest are consents or incidents that, due to location or nature of the consent or incident, are unlikely to have the potential to have caused soil contamination.

Table B2: Pollution incidents and resource consents in the vicinity of the alignment

Address	Incident/consent details
433 Buckley Ave, Hobsonville	The council pollution hotline received a report of a "dirty water" discharge in May 2011. The record states this was a natural incident.
Buckley Ave, Hobsonville	Hobsonville Land Company Ltd holds a consent to discharge contaminants from airforce base land to ground and groundwater, associated with the remediation of a sludge bed; granted August 2007.
RNZAF Hobsonville Base	An expired coastal permit was held by the Ministry of Defence to discharge treated wastewater into the Waitemata Harbour via Wallace Inlet; granted January 1997.
Buckley Ave, Hobsonville	Consent granted to NZ Defence Force to construct three observation bores to a depth of 5m; drilled on 8 December 2004.
1 Squadron Drive, Hobsonville	Consent granted to Summerset Villages (Hobsonville) Ltd to construct one bore for irrigation purposes; drilled on 29 August 2014.
1-2 Squadron Drive, Hobsonville	Consent granted to Summerset Villages (Hobsonville) Ltd to discharge contaminants, associated with earthworks involved with the development of a retirement complex.
5 Upper Harbour Drive, Hobsonville	Consent granted to MR & AK Evans to construct a bore to approximately 200 m, for stock, domestic, and restaurant supply.
Upper Harbour Road/Greenhithe Bridge, Hobsonville	A report of "rubbish on bank of Upper Harbour Road" received by the council pollution hotline, July 2008.
Sunderland Ave, Hobsonville	Multiple permits to discharge contaminants granted to Hobsonville Land Company Ltd, from land disturbance during redevelopment of former airbase; granted July 2014.
Buckley Ave, Hobsonville	Permit to discharge contaminants granted to Hobsonville Land Company Ltd, from disturbance of contaminated land; granted March 2014.
9 Rame Road, Greenhithe	A report of "water pollution" " received by the council pollution hotline, November 2011; pollutant found to be sediment or inert materials.
5 Rame Road, Greenhithe	Permit to discharge contaminants to the air granted to the NZ Fire Service, from the burning of a building for live fire training.
2 Upper Harbour Drive, Greenhithe	Consent to occupy and use part of the Coastal Marine Area issued to Vector Ltd, to attach a gas pipeline to the underside of Greenhithe Bridge; granted January 2006.
Corner of the Close and Tauhinu Road, Greenhithe	A report of an "orange stream" " received by the council pollution hotline, November 2010; the pollutant was not found, and was identified as a non-issue by council staff.
4 Sunnyview Road, Greenhithe	A report of a "sewage overflow" received by the council pollution hotline, December 2012; a volume between 10-200 L was found to be impacting natural water.
33 Greenhithe Road, Greenhithe	A report of "water pollution" received by the council pollution hotline, December 2012; the pollution incident was not found by council staff.
33 Greenhithe Road, Greenhithe	A report of a "sewer overflow" received by the council pollution hotline, December 2012; a volume between 200-1000 L was found to be impacting natural water.
9 Isobelle Road, Greenhithe	A report of a "sewer overflow" received by the council pollution hotline, October 2013; a volume < 10 L was found to have a potential (undefined) impact.

Address	Incident/consent details
11 Roland Road, Greenhithe	Consent to construct a bore to approximately 150 m depth granted to R Miller, for stock and domestic supply; granted April 1989.
52 Greenhithe Road, Greenhithe	Consent to dam water in a category 1 stream, for the purpose of wetland restoration, granted to Auckland Council, December 2006.
56 Churchouse Road, Greenhithe	A contaminated site discharge permit, associated with an environmental investigation undertaken in Wainoni Park by North Shore City Council, 2006. Localised DDT contamination found in subsurface soil on previously horticultural land. Remediation and deeper sampling "required". Additional information was sought from Auckland Council in relation to this permit. A copy of the Kingett Mitchell Ltd, November 2006, Wainoni Main Park Remediation Action Plan (RAP) was provided. The RAP referenced a site investigation report, also prepared by Kingett Mitchell Ltd in November 2006, however, Auckland Council reported that the report was not publicly available (i.e. confidential). The RAP indicated the following: - Soil samples collected from the former horticultural areas met the adopted recreational criteria for arsenic, copper, lead and OCPs - Soil samples collected from around a shed in the park near the northwest corner of the park showed elevated copper and DDT. The DDT concentrations exceeded the adopted recreational criteria by around 70 times. This area has been fenced off (refer blue shaded area in Figure 5 of Appendix A). - The report indicates that the adopted recreational criteria (25 mg/kg for DDT) is outdated and is about 16 times lower than the current NES Soil SCS for that landuse (400 mg/kg). The concentrations in the fenced area are above the NES Soil SCS for recreational and commercial/industrial use.
211B Schnapper Rock Road, Albany South	Consent to authorise the use of "*Meteor Lower*" stormwater dams granted to Auckland Council, October 2009.
209A Schnapper Rock Road, Albany South	Consent to authorise the use of "*Kittiwake Lower*" stormwater dams granted to Auckland Council, October 2009.
185 Schnapper Rock Road, Schnapper Rock	Consent to discharge contaminants to air granted to Dil's Funeral Services Ltd, associated with the establishment of a crematorium, February 2014.
235 Schnapper Rock Road, South Albany	Consent to authorise the use of "*Cemetery 1*" stormwater dams granted to Auckland Council, October 2009.
235 Schnapper Rock Road, South Albany	Consent to discharge contaminants to air from a crematorium granted to Auckland Council, October 2008.
235 Schnapper Rock Road, South Albany	Diesel and petrol underground storage tanks removed from crematorium; date un-noted. No report is available for the removal of the tanks
11 Witton Place, Albany	A report of a "sewage overflow" received by the council pollution hotline, April 2014; a volume between 10-200 L was found to have a potential impact.
21 Oakley Drive, Albany	Consent to authorise the use of "*English Oak Ponds*" stormwater dams granted to Auckland Council, October 2009.

Address	Incident/consent details
50 English Oak Drive, Albany	Consent to authorise the damming and discharge of an unnamed tributary of Lucas Creek, for stormwater quality management, granted to Auckland Council, June 1996.
21 Oakway Drive, Albany South	Consent to authorise the use of "*Oakway Pond*" stormwater dams granted to Auckland Council, October 2009.
297 Albany Highway, Rosedale	Consent for an existing dam granted to IA Knight, May 1979.
Unity Drive North, Rosedale	A report of a "blue pond" received by the council pollution hotline in June 2008. A volume of between 10-200 L of paint/dye/inks was found to be impacting natural water. No information relating to the source of the contamination was recorded in the contamination enquiry. Based on the drive by, the pond is located 150m south of the alignment. However, there are no apparent industrial facilities directly adjacent to the alignment that could be a potential source. A google search indicated that there are numerous plastic manufacturing facilities which could include the use of dyes are present in the vicinity of Unity Dive.
22 William Pickering Drive	A report of a "sewage overflow" received by the council pollution hotline, March 2013; an undefined volume was found to have a potential impact.
1 Unity Drive, Rosedale	Consent to discharge contaminants to air, from a plastic packaging manufacturing operation, granted to Alto Packaging Ltd, November 2007. Processes on site include the extrusion and thermoforming of polystyrene using butane and carbon dioxide. Three extruders and five thermoformers on site; maximum butane use 30 kg/hr.
169 Bush Road, Rosedale	Consent to discharge contaminants to land from an industrial trade process (storage depot for an electricity servicing operation) granted to Siemens (NZ) Ltd, November 2007 but the consent has been surrendered. Works consented involved the installation of an interceptor tank for an impervious catchment area.
8 Paul Matthews Road, Rosedale	Consents to discharge contaminants to land, water and air from an industrial trade process, associated with the crushing of recycled concrete, granted to Atlas concrete Ltd; granted May 2011.
320 Paul Matthews Road (320 Rosedale), Albany	A report of "diesel in cesspit" received by the council pollution hotline, June 2013; an undetermined volume was found to be impacting stormwater.
Rosedale Wastewater Treatment Plant	Consent to construct five observation bores to approximately 30 m granted to Pattle Delamore Partners Ltd, October 1999.
Jack Hinton Drive, Albany	Consent to construct two observation bores to approximately 20 m granted to North Shore City Council, November 2001.
320 Rosedale Road, Rosedale	Consent to discharge contaminants to air from wastewater treatment processes granted to North Shore City Council, September 2003.
2 Jack Hinton Drive, Rosedale	Consent to construct nine investigation bores to 10-30 m depth, granted to URS New Zealand Ltd, March 2014; for site investigation purposes.

B4 Client supplied information

Contaminated land investigation have been carried out at the Rosedale WWTP for Watercare and reported in URS, May 2014, Rosedale Plant Expansion Geotechnical Factual and Detailed Contaminated Land Investigation Report. Key findings of a review of the report indicated the following:

- No soil sampling and testing have been undertaken to date in the area of the proposed alignment within the Rosedale WWTP. The investigations undertaken to date have been focussed on the eastern part of the WWTP where the treatment facilities are located.
- Given that the area of the proposed alignment is away from the WWTP facilities, the results of the existing soil testing would provide a likely worst case indication of the soil conditions in the area of the proposed alignment.
- The results of testing show the following:
  - No exceedances of the NES Soil SCS for commercial landuse.
  - The soils generally contain low level metals and hydrocarbons, with isolated locations above published background concentrations for non volcanic soils and ALW Plan permitted activity criteria for discharges.

B5 Fraser Thomas 2008; Hobsonville Sewage Treatment Plant Remediation, Validation Report

Remediation of the former sludge bed at the former Hobsonville WWTP (now the Hobsonville pump station site) was undertaken during 2008. Following the remedial works, Fraser Thomas produced a SVR[3]. The validation report indicates the following regarding residual levels of contamination on the site following the remediation:

- A number of samples from within soils at the base and sides of the excavation show levels of metals (arsenic and zinc) above published background concentrations, but below levels that have the potential to pose a risk to underlying groundwater and the receiving environment.
- Relatively high ammonia nitrogen levels are indicated in soils at the north eastern wall of the excavation (location indicated to be on the eastern boundary of the site).
- Sampling taken 1m outside the eastern face of the excavation using a hand auger, also indicated relatively high ammonia nitrogen levels. The depth at which the sample was taken is not indicated in the SVR;
- Groundwater monitoring following completion of the remediation was undertaken downstream of the former sludge bed. Results indicated that the levels of ammonia-nitrogen and number of metals in groundwater exceeded the ANZECC 80% marine and freshwater trigger. Groundwater tested at an up-gradient location, was within ANZECC 80% (marine and freshwater) trigger levels;
- The excavation was backfilled with tested cleanfill material.

Correspondence reviewed indicated that discussions were held regarding elevated nitrogen and isolated zinc results in validation samples. ARC agreed with NZDF that further excavations would not be practical, but requested that NZDF undertake further groundwater monitoring. No records of further groundwater monitoring or preparation of a Long Term Management Plan (LTMP) were indicated in the property file.

[3] Fraser Thomas; *Hobsonville Sewage Treatment Plant: Environmental Remediation of Sludge Drying Bed: Site Validation Report;* Version 2; Prepared for New Zealand Defence Force; October 2008; Project # 31478

Appendix C: Drill logs

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t1**

SHEET 1 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 11/12/14
FINISH DATE: 12/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville Pump Station

CO-ORDINATES: 5926829.8 mN 1747471.6 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 7.00m
R.L. COLLAR: 7.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	0m: TOPSOIL 0.1m: Construction Debris: Concrete, cobble sized blocks with steel wire.																	
TAURANGA GROUP	Sandy SILT; light grey. Stiff, wet, low plasticity.			VACUUM EXCAVATION	0	93/6 kPa 109/12 kPa in situ	6.5	0.5										
	- becomes very stiff.					194/54 kPa in situ	6.0	1.0										
	Clayey SILT, minor medium sand; light brown. Stiff, wet, low plasticity.						5.5	1.5										
	- becomes firm.					54/34 kPa in situ	5.0	2.0										
						38/30 kPa in situ	4.5	2.5										
	3-4.3m: CORE LOSS. Very soft zone, very poor recovery. Colour on drill rods is dark - suggests peat.			HQ3	15	47/28 kPa in situ	4.0	3.0										
							3.5	3.5										
	SILT, with some organics, minor gravels; brown, mottled light greyish brown. Soft, wet, low plasticity.			PUSH TUBE			3.0	4.0										
							2.5	4.5										
								5.0										

Water Level: 12/12/2014

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t1**

SHEET 2 OF 4

DRILLED BY: McMillan Drilling

LOGGED BY: JWY

CHECKED:

START DATE: 11/12/14

FINISH DATE: 12/12/14

CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial

JOB No: 28773.210

LOCATION: Hobsonville Pump Station

CO-ORDINATES: 5926829.8 mN 1747471.6 mE

DIRECTION: 0.00°

ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 7.00m

R.L. COLLAR: 7.00m

DATUM: AUCK1946

SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES S WS WW EW								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
TAURANGA GROUP	Clayey SILT, trace organics; light brownish grey. Firm, wet, moderate plasticity.			SPT	100	0 0 0 0 1 2 N=3	1.5	5.5										
	- becomes minor organics, organic bands every 50mm, 5mm thick.			HQ3	100													
						39/9 kPa in barrel	1.0	6.0										
				SPT	100	0 0/ 0 0 0 0 N=0												
	Silty CLAY, minor organics; light brownish grey. Firm, wet, moderate to high plasticity.			HQ3	100		0.5	6.5										
							0.0	7.0										
				PUSH TUBE		31/8 kPa in barrel	-0.5	7.5										
	PEAT, some clayey silt, wood (decomposed); brownish black. Firm, wet.			SPT	100	0 0/ 0 0 1 2 N=3	-1.0	8.0										
	Silty CLAY, minor fine sand, trace organics; light greyish brown. Stiff, wet, low plasticity.			HQ3	100		-1.5	8.5										Box 1
	Silty CLAY, trace fine sand and organics; light greyish brown. Stiff, wet, low to moderate plasticity.					90/12 kPa in barrel	-2.0	9.0										
				SPT	100	0 0/ 0 0 1 2 N=3												
	Clayey SILT, trace fine sand and organics; greenish grey. Stiff, wet, low plasticity.			HQ3	100		-2.5	9.5										
	Fine SAND, minor silt, trace organics; dark brown. Loose, wet.							10.0										Box2

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t1**

SHEET 3 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 11/12/14
FINISH DATE: 12/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville Pump Station

CO-ORDINATES: 5926829.8 mN 1747471.6 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 7.00m
R.L. COLLAR: 7.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS WW VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
TAURANGA GROUP	- grades siltier. - grades sandier, becomes trace silt.			HQ3	100													
				SPT	100	2 2/ 3 4 4 5 N=16	-3.5	10.5										
	11-11.15m: CORE LOSS						-4.0	11.0										
	Silty, fine SAND, trace medium sand and organics; dark greyish brown. Medium dense, wet.			HQ3	90													Box 2
	Silty, fine SAND, some organics and decomposed wood; greyish brown. Medium dense, wet.						-4.5	11.5										
	Sandy SILT, minor clay and organics; greyish brown. Stiff, wet, low plasticity.																	
EAST COAST BAYS FORMATION	Highly weathered, greenish grey SANDSTONE, interbeds of siltstone. Extremely weak			SPT	100	3 7/ 8 13 13 16 N=50	-5.0	12.0					Bedding 20°, PL,SM,T, CN.					
	12.5-12.7m: CORE LOSS						-5.5	12.5										
	Highly weathered, grey SILTSTONE. Extremely weak, uncemented.			HQ3	80							65						
	Highly weathered, dark grey SILTSTONE, minor carbonaceous lenses. Extremely weak						-6.0	13.0										
	Highly weathered, dark grey SANDSTONE. Extremely weak			SPT	100	4 7/ 8 11 13 8 N=50	-6.5	13.5										
	Highly weathered, dark grey, medium to fine grained SANDSTONE, small interbeds of siltstone. Extremely weak						-7.0	14.0										Box 3
	Moderately weathered, grey, fine SANDSTONE. Very weak, minor carbonaceous material.			HQ3	100		-7.5	14.5				100						
								15.0										

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t1**

SHEET 4 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 11/12/14
FINISH DATE: 12/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville Pump Station

CO-ORDINATES: 5926829.8 mN 1747471.6 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 7.00m
R.L. COLLAR: 7.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS MW VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	Moderately weathered, dark grey SANDSTONE, interbeds of siltstone. Very weak			SPT	100	4 9/ 11 15 23 26 N>50												
	Moderately weathered, dark grey SANDSTONE. Very weak						-8.5	15.5										
	Moderately weathered, dark grey SILTSTONE. Very weak - becomes extremely weak.			HQ3	100		-9.0	16.0				100						
	Moderately weathered, dark grey SILTSTONE, interbedded with medium to fine SANDSTONE. Very weak			SPT		40 45 53 for 10mm N>50	-9.5	16.5										Box 4
	END OF BOREHOLE AT 16.8m. TARGET DEPTH REACHED. Standpipe piezometers installed in hole, screened from 3m to 6m and 9m to 12m below ground level.						-10.0	17.0										
							-10.5	17.5										
							-11.0	18.0										
							-11.5	18.5										
							-12.0	19.0										
							-12.5	19.5										
								20.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

BH t1 - Northern Interceptor Phase 1

BH01-3.0-8.45m.jpg

BH01-8.45-10.95m.jpg

BH01-10.95-14.30m.jpg

BH01-14.3-16.8m-E.O.H.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t2**

SHEET 1 OF 3

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville

CO-ORDINATES: 5926949.37 mN 1747484.01 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 6.40m
R.L. COLLAR: 6.40m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 17/12/14
FINISH DATE: 17/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS WW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Fine to coarse GRAVEL, with trace silt; dark grey. Loosely packed, moist; gravel, angular, basalt [Basecoarse].						6.0	0.5										
	Silty CLAY, with minor fine gravel; greyish brown mottled orange brown. Stiff, moist, moderate plasticity; gravel, angular, basalt.			HAND AUGER	100	108/67 kPa							0.4m: ENVIRO SAMPLE TAKEN					
TAURANGA GROUP	Silty CLAY; greyish brown streaked, orange brown. Stiff, moist, moderate plasticity.					108/70 kPa	5.5	1.0					1m: ENVIRO SAMPLE TAKEN					
	1.2m: grades silty CLAY, with trace sand.						5.0	1.5										
	Clayey SILT, with minor sand, trace organics; greyish brown, streaked orange brown. Stiff, moist, low to moderate plasticity.					107/56 kPa							1.5m: ENVIRO SAMPLE TAKEN					
	1.62-1.95m: CORE LOSS. Sample dropped, could not be recovered.			SPT	27	1 1/ 1 0 1 1 N=3	4.5	2.0										
	1.95-2.2m: CORE LOSS.												2m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, with minor sand; greyish brown, streaked orange brown. Stiff, moist, low to moderate plasticity.			HQ3	76		4.0	2.5							22/12/14 (Top & Bottom Screen)			
	2.35m: grades sandy SILT. with trace clay; bluish grey.																	
	2.55m: grades light brown, streaked orange brown.																	
	2.8m: grades grey.																	
	2.9m: grades sandy SILT.			PUSH TUBE	0												Box 1	
	3.5m: grades SILT, with some sand, trace clay.			SPT	100	0 1/ 1 2 7 3 N=13	3.5	3.0										
	SILT/fine SAND; white. Very dense, dry																	
	Sandy SILT, with minor clay, trace gravel. Stiff, moist, low plasticity; gravel, fine, sub-rounded, white pumiceous material from above.			HQ3	100		3.0	3.5										
	4.3m: grades sandy SILT. Non-plastic.																	
				PUSH TUBE			2.5	4.0										
							2.0	4.5										
								5.0									Box2	

COMMENTS:

Log Scale 1:25

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t2**

SHEET 2 OF 3

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 17/12/14
FINISH DATE: 17/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville

CO-ORDINATES: 5926949.37 mN 1747484.01 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 6.40m
R.L. COLLAR: 6.40m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
TAURANGA GROUP	Medium to coarse SAND, minor silt, trace organics; grey, speckled black. Medium dense, wet.			SPT	100	1 1/ 3 3 3 6 N=17	1.0	5.5										
	5.75-6m: CORE LOSS.			HQ3	55		0.5	6.0										
	Medium to coarse SAND, with minor silt, trace organics; grey, speckled black. Loose, wet.			SPT	100	1 1/ 2 2 2 2 N=8	0.0	6.5										
	6.45-7.3m: CORE LOSS.			HQ3	19		-0.5	7.0										
	Medium to coarse SAND, with some silt and organics; grey, speckled white, streaked black. Medium dense, moist; organics, wood.						-1.0	7.5										
	SILT, with some clay; greenish grey. Very stiff, moist, low plasticity.			SPT	100	1 4/ 4 7 6 9 N=26	-1.5	8.0										
WEATHERED EAST COAST BAYS FORMATION	Medium to coarse SAND, minor silt, trace organics; grey speckled black. Medium dense, wet. 7.55m: grades silty, fine SAND. Moist.						-2.0	8.5										Box 2
	SILT; grey. Hard, moist, non-plastic. Thinly interbedded with medium dense, grey silty fine SAND. Moderately inclined bedding. Retains relict rock structure 8m: grades coarse sand. 8.1m: SILT beds grade moderately thinly bedded, silty SAND beds grade moderately thickly bedded. 8.2m: grades fine to medium sand 8.8m: grades medium to coarse sand			HQ3	100		-2.5	9.0										
	Unweathered, white/grey speckled black SILTSTONE. very weak.			SPT	100	3 7/ 9 10 12 23 N=54	-3.0	9.5										
	Unweathered, whtie/grey speckled black, fine SANDSTONE. Weak. 9.65-10.5m: CORE LOSS. Above sample core bound and washed/pushed away remaining sample.			HQ3	14			10.0				14						Box3

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t2**

SHEET 3 OF 3

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Hobsonville

CO-ORDINATES: 5926949.37 mN 1747484.01 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 6.40m
R.L. COLLAR: 6.40m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 17/12/14
FINISH DATE: 17/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	9.65-10.5m: CORE LOSS. Unweathered, white/grey speckled black, fine SANDSTONE. Weak. Unweathered, grey, silty, fine SANDSTONE. Very weak, moderately thickly bedded with moderately thick interbeds of grey, very weak SILTSTONE. Gently inclined bedding.			HQ3 SPT HQ3	14 44 100	3 8/ 14 12 24 for 75mm N>50	-4.0 / 10.5 -4.5 / 11.0 -5.0 / 11.5 -5.5 / 12.0 -6.0 / 12.5 -6.5 / 13.0 -7.0 / 13.5 -7.5 / 14.0 -8.0 / 14.5 15.0				14 100						Box 3
	END OF BOREHOLE AT 12m. TARGET DEPTH REACHED. Standpipe piezometer installed at screen depths of 4 m to 7 m and 10 m to 11.5 m below ground level.																

COMMENTS:

BH t2 - Northern Interceptor Phase 1

BH2_0.0-2.9m.jpg

BH2_2.9-7.95m.jpg

BH2_7.95-12.0m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t3**

SHEET 1 OF 2

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 17/12/14
FINISH DATE: 18/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Rahui Road Reserve, Greenhithe

CO-ORDINATES: 5928463 mN 1748726 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 3.20m
R.L. COLLAR: 3.20m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS WS MW SW VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Silty TOPSOIL, some sand, trace organics; dark brownish black. Firm, moist, non-plastic			HAND AUGER	100	163/34 kPa	3.0	0.0					0.1m: ENVIRO SAMPLE TAKEN					
	Silty SAND; light grey. Loose, moist																	
	Silty SAND, some fine gravels, trace medium gravels; dark brown. Loose, moist.					UTP	0.5	2.5					0.3m: ENVIRO SAMPLE TAKEN 0.5m: ENVIRO SAMPLE TAKEN					
	Gravelly SILT, some medium gravel and fine sand; brown mottled grey. Firm, moist.					100/45 kPa	1.0	2.0					1m: ENVIRO SAMPLE TAKEN					
	Gravelly, fine SAND, some clay, trace medium gravel; brown mottled grey, streaked white. Loose, moist.					90/31 kPa	1.5	1.5										
	Silty, fine SAND, minor coarse sand, trace medium gravels; light greyish brown. Loose, wet.			SPT	100	UTP 2 2/ 2 2 1 3 N=8	1.5	1.5					1.5m: ENVIRO SAMPLE TAKEN		18/12/2014			Box 1
	Medium SAND, minor organics, trace silt; dark grey. Medium dense, wet, poorly cemented.			HQ3	90		2.0	1.0					2m: ENVIRO SAMPLE TAKEN					
EAST COAST BAYS FORMATION	Moderately weathered, dark grey, fine SANDSTONE. Extremely weak			PUSH TUBE			3.0	0.0										
	Slightly weathered, dark grey SILTSTONE. Extremely weak.			SPT(SC)		4 5/ 12 13 20 24 N>50	3.5	-0.5					Bedding 40°, PL,SM,T					Box 2
	Slightly weathered, dark grey, fine to medium SANDSTONE. Very weak			HQ3	100		4.0	-1.0				0	Bedding 30°, PL,SM,T					
	Unweathered, dark grey, medium SANDSTONE. Very weak			SPT(SC)		7 11/ 17 25 8 50 for 150mm N>50	4.5	-1.5										
	Unweathered, dark grey SANDSTONE, some coarse gravels in sandstone. Extremely weak			HQ3	100		5.0						Bedding 30°, PL,R,T Joint 50°, PL,SM,T					Box3

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t3**

SHEET 2 OF 2

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Rahui Road Reserve, Greenhithe

CO-ORDINATES: 5928463 mN 1748726 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 3.20m
R.L. COLLAR: 3.20m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 17/12/14
FINISH DATE: 18/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5)	RQD %	Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	Unweathered, dark grey, fine to medium SANDSTONE. Very weak. Interbedded with thin (~10cm) lenses of unweathered SILTSTONE. Extremely weak			HQ3	100 100		-2.0 / 5.5				20						
				HQ3	100		-2.5 / 6.0				65	5.4m: Joint 60°, PL,SM,T 5.5m: Joint 60°, UN,SM,VN 5.8m: Joint 30°, UN,SM,VN					
	Unweathered, dark grey, medium to coarse SANDSTONE. Very weak to weak. Occasional interbedded with SILTSTONE. Extremely weak, 20-30cm spaced beds.			SPT(SC)		10 15/ 50 for 300mm N>50	-3.0 / 6.5										Box 3
	6.15-6.3m: CORE LOSS																
	Unweathered, dark grey, medium to coarse SANDSTONE. Very weak to weak. Occasional interbedded with SILTSTONE. Extremely weak, 20-30cm spaced beds.			HQ3	90		-3.5 / 7.0 -4.0 / 7.5				50	6.25m: Joint 45°, PL,R,VN 6.4m: Joint 25°, PL,R,VN 6.5m: Joint 30°, UN,R,VN					
				SPT(SC)		7 22/ 50 for 300mm N>50	-4.5 / 8.0 -5.0 / 8.5 -5.5 / 9.0 -6.0 / 9.5 -6.5 / 10.0									Box 4
	END OF BOREHOLE AT 7.7m. TARGET DEPTH REACHED. Standpipe piezometers installed in hole, screened from 0.5m to 2m and 5.5m to 7m below ground level.																

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

BH t3 - Northern Interceptor Phase 1

BH03-0.0-1.4m.jpg

BH03-1.4-3.95m.jpg

BH03-3.95-6.2m.jpg

BH03-6.20-7.7m (E.O.H).jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t5**

SHEET 1 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5928532.45 mN 1748815.03 mE	R.L. GROUND: 22.40m
JOB No: 28773.210		R.L. COLLAR: 22.40m
LOCATION: Traffic Road, Greenhithe	DIRECTION: 0.00°	DATUM: AUCK1946
	ANGLE FROM HORIZ.: -90.00°	SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 15/12/14
FINISH DATE: 15/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	EW VW WS MS SS ES								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
NO RECOVERY	0-3m: VACUUM EXCAVATED. NO RECOVERY.			VACUUM EXCAVATED	0		22.0	0.5										
							21.5	1.0										
							21.0	1.5										
							20.5	2.0										
							20.0	2.5										
							19.5	3.0										
WEATHERED EAST COAST BAYS FORMATION	3-3.5m: PUSH TUBE			PUSH TUBE														
	SILT, with some clay, trace carbonaceous specks; grey. Very stiff, moist, low plasticity			SPT	100	1 1/ 1 2 2 3 N=8	19.0	3.5										
	Silty, fine to medium SAND; grey. Loose, moist.						18.5	4.0										
				HQ3	100		18.0	4.5										
				PUSH TUBE	100		5	5.0							22/12/14 (Top & Bottom Screen)			Box1

COMMENTS:

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t5**

SHEET 2 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 15/12/14
FINISH DATE: 15/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Traffic Road, Greenhithe

CO-ORDINATES: 5928532.45 mN 1748815.03 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 22.40m
R.L. COLLAR: 22.40m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	SILT; grey. Hard, moist, non-plastic. Moderately thinly interbedded with medium dense, grey silty fine SAND. Steeply inclined bedding. Retains relict rock structure			SPT	100	22/ 33 55 N=16	17.0	5.5										Box 1
	5.5m: silty sand beds grades thinly to very thinly bedded.			HQ3	100		16.5	6.0										
				SPT	100	23/ 44 58 N=21	16.0	6.5										
	Silty medium to coarse SAND; grey. Medium dense, moist			HQ3	76		15.5	7.0										
	7.25-7.5m: CORE LOSS.						15.0	7.5										
	SILT; grey. Hard, moist, non-plastic. Moderately thickly bedded with thin interbeds of medium dense, grey silty fine SAND. Steeply inclined bedding. Retains relict rock structure			SPT	100	33/ 45 67 N=22	14.5	8.0										
				HQ3	85		14.0	8.5										Box 2
	8.8-9m: CORE LOSS.						13.5	9.0										
	SILT; grey. Hard, moist, non-plastic. Moderately thinly interbedded with medium dense, grey silty fine SAND. Steeply inclined bedding. Retains relict rock structure			SPT	100	23/ 55 68 N=24	13.0	9.5										
				HQ3	100		5	10.0										Box3

COMMENTS:

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t5**

SHEET 3 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5928532.45 mN 1748815.03 mE	R.L. GROUND: 22.40m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 22.40m	LOGGED BY: PRMM
LOCATION: Traffic Road, Greenhithe	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 15/12/14
			FINISH DATE: 15/12/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	SILT; grey. Hard, moist, non-plastic. Moderately thinly interbedded with medium dense, grey silty fine SAND. Steeply inclined bedding. Retains relict rock structure 10.25m: grades thinly interbedded			HQ3	100		12.0										
				SPT	100	4 4/ 6 7 7 10 N=30	10.5										
				HQ3	100		11.5 / 11.0										
	Silty fine SAND; grey. Dense, moist			SPT	100	3 4/ 6 6 9 9 N=30	11.0 / 10.5										Box 3
	12.85m: grades silty coarse SAND 12.9m: grades silty fine SAND			HQ3	57		12.0 / 9.5										
	13.1-13.5m: CORE LOSS.						13.0 / 9.0										
	Silty fine SAND; grey. Dense, moist. Moderately thinly bedded with thin interbeds of grey, hard SILT. Steeply inclined bedding with carbonaceous laminations throughout. Retains relict rock structure 13.9m: silt beds grade moderately thinly bedded. 14.4m: silt beds grade thinly bedded.			SPT	100	3 5/ 7 8 8 11 N=34	13.5 / 8.5										
	14.45m: grades silty medium SAND 14.55m: grades silty fine SAND			HQ3	100		14.0 / 8.0										
	Silty fine SAND; grey. Dense, moist						14.5 / 15.0										Box4

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t5**

SHEET 4 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5928532.45 mN 1748815.03 mE	R.L. GROUND: 22.40m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 22.40m	LOGGED BY: PRMM
LOCATION: Traffic Road, Greenhithe	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 15/12/14
			FINISH DATE: 15/12/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
	Silty fine SAND; grey. Dense, moist			SPT	100	3 5/ 6 6 8 12 N=32	7.0											Box 4
	END OF BOREHOLE AT 15.45m. TARGET DEPTH REACHED. Standpipe piezometer installed at screen depths of 3.5 m to 5 m and 13 m to 14.5 m below ground level.						15.5 6.5 16.0 6.0 16.5 5.5 17.0 5.0 17.5 4.5 18.0 4.0 18.5 3.5 19.0 3.0 19.5 20.0											

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

BH t5 - Northern Interceptor Phase 1

BH5_0.0-5.45m.jpg

BH5_5.45-8.6m.jpg

BH5_8.6-11.55m.jpg

BH5_11.55-15.0m.jpg

BH5_15.0-15.45m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t6**

SHEET 1 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 15/12/14
FINISH DATE: 16/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Cnr Tauhinu and Greenhithe Roads

CO-ORDINATES: 5928591 mN 1748991.7 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 33.90m
R.L. COLLAR: 33.90m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS MS MW VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	ROCK DEFECTS Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Sandy TOPSOIL; brownish black. Dry.												0.1m: ENVIRO SAMPLE TAKEN					
	Sandy GRAVEL, some organics; brown. Dry.																	
WEATHERED EAST COAST BAYS FORMATION	Clayey SILT, minor limonite gravels; brown streaked red. Very stiff, moist, low plasticity.			HAND AUGER	100	UTP 116/47 kPa	33.5	0.5					0.3m: ENVIRO SAMPLE TAKEN 0.5m: ENVIRO SAMPLE TAKEN					
	Clayey SILT; light grey mottled brown, some red streaks. Stiff, moist, low plasticity.					109/47 kPa 117/47 kPa	33.0	1.0					1m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, trace fine sand; light grey, mottled brown. Firm, wet, low plasticity.			SPT	100	125/56 kPa 12/ 23 33 N=11	32.5	1.5					1.5m: ENVIRO SAMPLE TAKEN					Box 1
	2.5-3m: CORE LOSS.			HQ3	50		32.0	2.0					2m: ENVIRO SAMPLE TAKEN		6/12/2014			
	Clayey SILT, trace fine sand; light grey, mottled brown. Firm, wet, low plasticity.			PUSH TUBE			31.5	2.5										
	Silty, fine SAND, trace clay; light grey mottled brown, streaked red. Loose, wet.			SPT	100	12/ 12 22 N=7	31.0	3.0										
	SILT, trace clay and fine sand; light grey mottled brown, streaked red.						30.5	3.5										
	3.95-4.15m: CORE LOSS						30.0	4.0										
	Silty CLAY; light grey streaked red, minor brown mottling. Stiff, wet, moderate plasticity.			HQ3	60		29.5	4.5										Box 2
				PUSH TUBE			)	5.0										Box3

COMMENTS:

T+T DATATEMPLATE.GDT prnm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t6**

SHEET 2 OF 4

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Cnr Tauhinu and Greenhithe Roads

CO-ORDINATES: 5928591 mN 1748991.7 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 33.90m
R.L. COLLAR: 33.90m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 15/12/14
FINISH DATE: 16/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	Silty, fine SAND, trace clay; brown mottled grey. Medium dense, wet.			SPT	100	2 2/ 2 2 4 3 N=11	28.5	5.5										
	Sandy SILT; dark grey. Firm, wet, low plasticity.																	
	5.45-6m: CORE LOSS.			HQ3	18		28.0	6.0										
	Sandy SILT; dark grey. Firm, wet, low plasticity.			SPT	100	2 2/ 2 2 4 3 N=11												
	6.9m: grades sandier.			HQ3	100		27.5	6.5										
	Silty, fine SAND; grey. Medium dense, wet			SPT	100	3 4/ 3 3 4 5 N=15	27.0	7.0										Box 3
	Sandy SILT. Soft, wet, low plasticity.			HQ3	60		26.5	7.5										
	Silty, fine SAND; grey. Medium dense, moist						26.0	8.0										
	8.6-9m: CORE LOSS						25.5	8.5										
	Silty fine to medium SAND; brownish orange. Loose, moist. Thinly bedded. Retains relict rock structure			SPT	100	2 1/ 2 1 2 2 N=7	25.0	9.0					Bedding 15°, PL,SM,T					
	SILT; orangish brown. Hard, moist, non-plastic			HQ3	70		24.5	9.5										Box4
							)	10.0										

COMMENTS:

T+T DATATEMPLATE.GDT prnm

Log Scale 1:25

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t6**

SHEET 3 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5928591 mN 1748991.7 mE	R.L. GROUND: 33.90m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 33.90m	LOGGED BY: JWY
LOCATION: Cnr Tauhinu and Greenhithe Roads	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 15/12/14
			FINISH DATE: 16/12/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	Silty fine SAND; light brownish grey, streaked red. Medium dense, moist			HQ3	70		23.5	10.5										
	10.2-10.5m: CORE LOSS.																	
	Silty fine SAND; light grey. Medium dense, moist			SPT	100	32/ 32 33 N=11	23.0	11.0										
	Band of orange staining in grey sand matrix.			HQ3	60		22.5	11.5										Box 4
				SPT	100	33/ 23 44 N=13	22.0	12.0										
	12.5-12.7m: CORE LOSS.						21.5	12.5										
	Silty fine SAND; light grey mottled brown. Medium dense, moist			HQ3	80		21.0	13.0										
	Silty medium SAND; brownish grey. Medium dense, moist			SPT	100	00/ 13 24 N=10	20.5	13.5										
	14-14.5m: CORE LOSS.						20.0	14.0										
	Silty fine SAND; orange brown. Medium dense, moist			HQ3	50		19.5	14.5										Box5
								15.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t6**

SHEET 4 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 15/12/14
FINISH DATE: 16/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Cnr Tauhinu and Greenhithe Roads

CO-ORDINATES: 5928591 mN 1748991.7 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 33.90m
R.L. COLLAR: 33.90m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW EW)	Rock Strength (ES VS S Ms W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
	Silty fine SAND; orange brown. Medium dense, moist			SPT	100	3 2/ 3 3 4 6 N=16	18.5										Box5
	END OF BOREHOLE AT 15.45m. TARGET DEPTH REACHED. Standpipe piezometers installed, screened from 4m to 7m and 11.5m to 14.5m below ground level.						15.5 18.0 16.0 17.5 16.5 17.0 17.0 16.5 17.5 16.0 18.0 15.5 18.5 15.0 19.0 14.5 19.5 20.0										

COMMENTS:

T+T DATATEMPLATE.GDT prnm

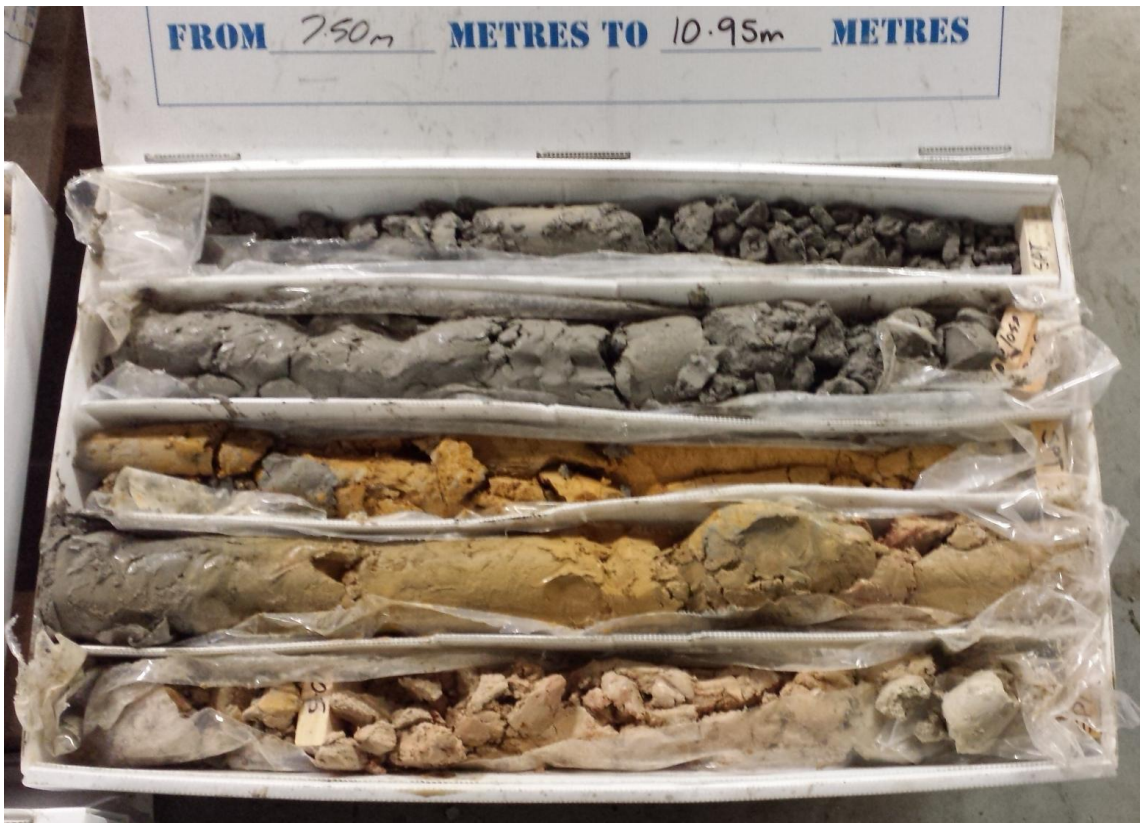
Log Scale 1:25

BH t6 - Northern Interceptor Phase 1

BH06-0.0-1.35.jpg

BH06-1.35-4.50m.jpg

BH06-4.5-7.50m.jpg



BH06-7.50-10.95m.jpg

BH06-10.95-15.00m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t10**

SHEET 1 OF 3

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 9/12/14
FINISH DATE: 10/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: North Shore Memorial Park

CO-ORDINATES: 5930635 mN 1749757 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 13.40m
R.L. COLLAR: 13.40m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (US VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
T/S	Sandy TOPSOIL, some fine gravel, trace organics; brown. Loose, dry.												0.1m: ENVIRO SAMPLE TAKEN					
WEATHERED EAST COAST BAYS FORMATION	SILT, minor clay, trace medium sand and organics; light reddish brown. Firm, dry, low plasticity.																	
	SILT, some clay, trace organics; orangish brown mottled light grey. Firm, moist, low plasticity. 0.8m: becomes light grey mottled orangish brown.			HAND AUGER	100		13.0	0.5					0.5m: ENVIRO SAMPLE TAKEN		10/12/2014			
	Clayey SILT; light grey mottled orangish brown. Firm, moist, moderate plasticity. 1.4m: becomes wet, mottling becomes minor.						12.5	1.0					1m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, minor fine sand; light grey mottled brown. Stiff, moist, moderate plasticity.			SPT	100	1 1/ 2 2 2 3 N=9	12.0	1.5					1.5m: ENVIRO SAMPLE TAKEN					Box 1
	2.25-3m: CORE LOSS.			HQ3	30		11.5	2.0										
	Clayey SILT, minor fine sand; light grey mottled brown. Stiff, moist, moderate plasticity.			PT	100		11.0	2.5										
	Silty fine SAND; dark greyish brown. Medium dense, wet. Retains relict rock structure			SPT	100	1 2/ 5 5 5 6 N=21	10.5	3.0										
EAST COAST BAYS FORMATION	Moderately weathered, dark brownish grey SILTSTONE. Very weak, bedding appears to be sub-vertical.			HQ3	100		10.0	3.5				100						
	Moderately weathered, dark brownish grey, medium to coarse SANDSTONE. Interbedded vertically with SILTSTONE. Very weak						9.5	4.0										
	Moderately weathered, dark brownish grey, medium SANDSTONE. Very weak			SPT	100	3 8/ 10 12 13 19 N=54	9.0	4.5										
					70		5.0					100						

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t10**

SHEET 2 OF 3

DRILLED BY: McMillan Drilling

LOGGED BY: JWY

CHECKED:

START DATE: 9/12/14

FINISH DATE: 10/12/14

CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial

JOB No: 28773.210

LOCATION: North Shore Memorial Park

CO-ORDINATES: 5930635 mN 1749757 mE

DIRECTION: 0.00°

ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 13.40m

R.L. COLLAR: 13.40m

DATUM: AUCK1946

SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	VS S MS W VW EW								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
EAST COAST BAYS FORMATION	4.95-5.3m: CORE LOSS																	
	Slightly weathered, dark brownish grey, medium SANDSTONE, interbedded with SILTSTONE, sub-vertical bedding. Extremely weak, uncemented			HQ3	70		8.0	5.5				100						
	Slightly weathered, brownish grey, medium SANDSTONE, interbedded with SILTSTONE. Very weak																	
	Slightly weathered, dark brownish grey, medium to fine SANDSTONE. Very weak						7.5	6.0										Box 2
	6-6.2m: CORE LOSS																	
	Small bed of interbedded slightly weathered SANDSTONE and very fine SANDSTONE. Extremely weak, uncemented																	
	Unweathered, dark greyish brown SANDSTONE, medium gravels. Very weak			HQ3	80		7.0	6.5				95	6.6m: Joint 30°, PL,R, polished surface, tight, no infill					
	7.4m: becomes extremely weak			SPT(SC)		7 46/ 50 for 0mm N>50	6.5	7.0					7.4m: Softened zone, clayey silt zone 10cm thick.					
	7.7-7.75m: CORE LOSS																	
	Unweathered, dark greyish brown SANDSTONE, medium gravels. Extremely weak						6.0	7.5					J60°, U,R, moderately narrow, silt infill 7.5-8m: Fractured zone with silt infilled joints.					
	Unweathered, reddish brown with grey, coarse volcaniclastic SANDSTONE. Weak [Parnell Grit]						5.5	8.0					8m: Joint 5°, PL,SM, moderately wide, silty clay infill 8.1m: Bedding 25°, PL,SM,T 8.15m: Bedding 25°, PL,SM,T					
	Unweathered, dark greyish brown, fine to medium SANDSTONE, minor organic lenses. Weak			HQ3	95		5.0	8.5				50						
	Unweathered, dark greyish brown, medium to fine SANDSTONE. Extremely weak												8.5m: Joint 30°, PL,SM, moderately narrow, clayey silt infill.					Box 3
	Unweathered, dark grey, medium SANDSTONE. Weak			SPT(SC)		17 96/ 50 for 20mm N>50	4.5	9.0					9.1m: Bedding 0°, PL,SM, moderately narrow. 9.15m: Bedding 0°, PL,SM, moderately narrow.					
	9.5m: becomes extremely weak.			HQ3	95		4.0	9.5				50	9.2m: Bedding 0°, PL,SM, moderately narrow. 9.25m: Bedding 0°, PL,SM, moderately narrow.					Box3
								10.0										

COMMENTS:

Log Scale 1:25

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t10**

SHEET 3 OF 3

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: North Shore Memorial Park

CO-ORDINATES: 5930635 mN 1749757 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 13.40m
R.L. COLLAR: 13.40m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: JWY
CHECKED:
START DATE: 9/12/14
FINISH DATE: 10/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ESS SS WS MW VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
ECBF	Unweathered, dark grey, medium to coarse SANDSTONE. Very weak			HQ3	95		3.0 / 10.5				50	10m: Softened, extremely weak zone, clay infilled joints.					Box 3
	END OF BOREHOLE AT 10.5m. TARGET DEPTH REACHED. Standpipe piezometers installed in hole, screened from 8.5m to 10m and 2.5m to 4.0m below ground level.						2.5 / 11.0 2.0 / 11.5 1.5 / 12.0 1.0 / 12.5 0.5 / 13.0 0.0 / 13.5 -0.5 / 14.0 -1.0 / 14.5 15.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

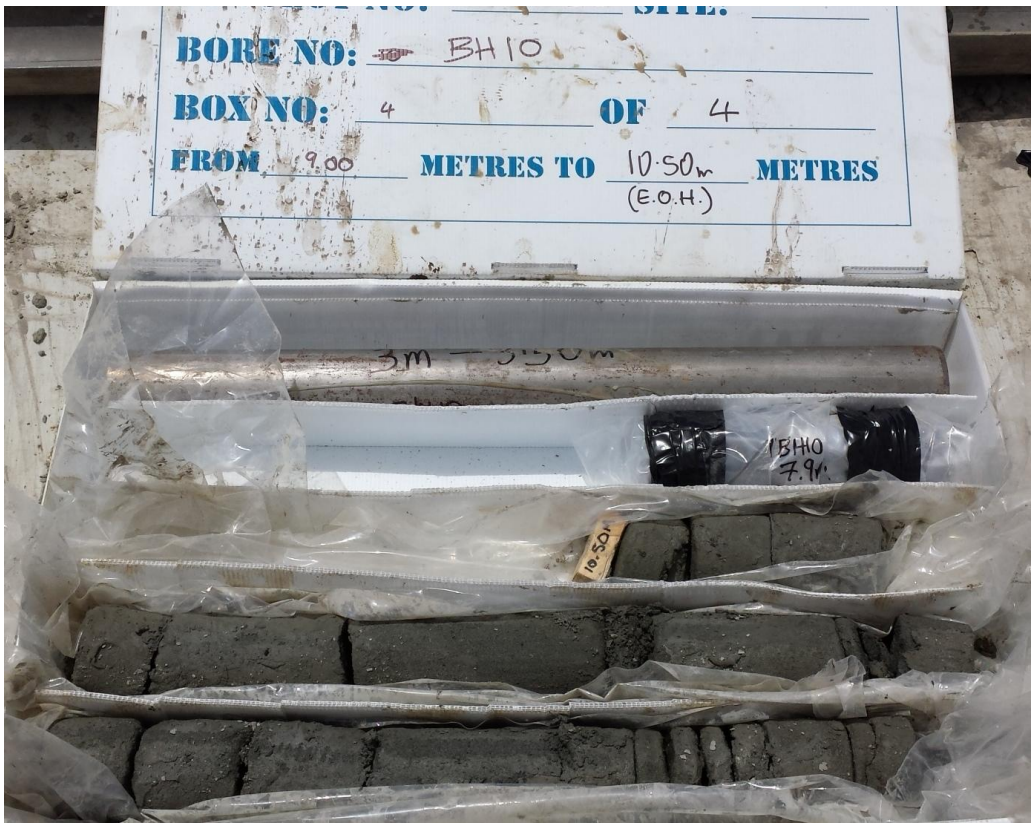
Log Scale 1:25

BH t10 - Northern Interceptor Phase 1

BH10-0-1.5m.jpg

BH10-1.5-5.80m.jpg

BH10-5.80-9.00m.jpg



BH10-9.00-10.50 (E.O.H).jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t12**

SHEET 1 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 9/12/14
FINISH DATE: 9/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Appleby Road, Rosedale

CO-ORDINATES: 5931784.49 mN 1750978.22 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.90m
R.L. COLLAR: 39.90m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS MS VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
T/S	Organic SILT; dark brown. Stiff, dry, non-plastic.																	
FILL	Clayey SILT, with minor gravel; orange brown mottled light grey and dark grey. Very stiff, moist, low plasticity; gravel, fine.																	
	0.2m: - plastic.																	
	Silty, fine to coarse GRAVEL; grey and brown. Tightly packed, moist; gravel, sub-angular, basalt.			HAND AUGER	100		39.5	0.5					0.1m: ENVIRO SAMPLE TAKEN 0.5m: ENVIRO SAMPLE TAKEN					Box 1
	Silty CLAY, with minor gravel; orange brown. Very stiff, moist, moderate plasticity; gravel, fine to medium.					>223 kPa	39.0	1.0					0.8m: ENVIRO SAMPLE TAKEN					Box 2
	1m: gravel grades fine.																	
	1.2m: grades silty CLAY.												1.2m: ENVIRO SAMPLE TAKEN					
TAURANGA GROUP	Clayey SILT; light grey mottled orange brown. Very stiff, moist, low to moderate plasticity.			SPT	100	>223 kPa 2 1/ 1 2 2 3 N=8	38.5	1.5										
	Silty CLAY; white/light grey mottled orange brown. Stiff, moist, moderate plasticity.						38.0	2.0										
	2.2m: grades white, firm, wet.																	
	Clayey SILT, with minor sand; brown. Stiff, moist, moderate plasticity.			HQ3	52		37.5	2.5										Box 3
	2.5-3m: CORE LOSS.																	
	3-3.5m: Push tube			PUSH TUBE			37.0	3.0							17/12/14 (Top Screen)			
	SILT, with minor clay and sand; greyish brown mottled orange brown speckled white (pumiceous grains). Stiff, moist, low plasticity.			SPT	100	2 1/ 1 2 2 3 N=8	36.5	3.5										
	3.7m: grades clayey SILT, with minor sand. Moderate plasticity.						36.0	4.0										
	3.95m: grades brown.																	
	4.05m: grades greyish brown. Moderate to high plasticity.			HQ3	45		35.5	4.5										
	4.2-4.5m: CORE LOSS.																	
	Clayey SILT, with trace organics; brownish grey streaked orange brown. Firm, moist, low plasticity.			SPT	100	0 0/ 1 2 1 3 N=7	)	5.0										Box 4
	4.95-5m: NO RECOVERY. Sample washed away.																	

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t12**

SHEET 2 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 9/12/14
FINISH DATE: 9/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Appleby Road, Rosedale

CO-ORDINATES: 5931784.49 mN 1750978.22 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.90m
R.L. COLLAR: 39.90m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES S WS W VW EW								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
TAURANGA GROUP	5-5.5m: Push tube			PUSH TUBE				5.5										
	Silty CLAY; light grey mottled orange brown. Firm, moist, high plasticity.			HQ3	40		34.5											
	5.65m: grades silty CLAY, with minor organics; light grey streaked black.																	
	5.7-6m: CORE LOSS.							6.0										
	6-6.5m: Push tube			PUSH TUBE			34.0								17/12/14 (Bottom Screen)			
	Clayey SILT; light grey. Soft, moist, moderate plasticity.			SPT	100	1 1/ 1 2 1 1 N=5		6.5										
	7m: grades sandy SILT, with minor clay. Wet, low plasticity.			HQ3	100		33.5	7.0										Box 5
WEATHERED EAST COAST BAYS FORMATION	Sandy SILT, with trace clay; light grey streaked grey. Firm, moist, low plasticity.			SPT	100	1 2/ 4 3 2 2 N=11		7.5										
	7.95-8.4m: CORE LOSS.			HQ3	100		33.0	8.0										Box 6
	Clayey SILT, with trace sand; light grey/cream streaked grey. Firm, moist, low plasticity.			HQ3	57		32.5											
	9m: grades sandy SILT. Soft, moist to wet, non-plastic.			SPT	100	0 1/ 1 2 2 2 N=7		8.5										
	9.3m: grades sandy SILT, with minor clay. Low plasticity.						32.0	9.0										
	9.45m: grades clayey SILT. Very soft, wet. Disturbed by SPT			HQ3	100													
	9.75m: grades sandy SILT. Firm, moist, low plasticity.						31.5	9.5										Box 7
							31.0	10.0										
							30.5											

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t12**

SHEET 3 OF 4

DRILLED BY: McMillan Drilling

LOGGED BY: PRMM

CHECKED:

START DATE: 9/12/14

FINISH DATE: 9/12/14

CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial

JOB No: 28773.210

LOCATION: Appleby Road, Rosedale

CO-ORDINATES: 5931784.49 mN 1750978.22 mE

DIRECTION: 0.00°

ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.90m

R.L. COLLAR: 39.90m

DATUM: AUCK1946

SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (US VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	Sandy SILT; light grey/cream streaked grey. Firm, moist, low plasticity.			HQ3	100		29.5	10.5										
	10.5m: grades non-plastic.																	
	10.65m: grades clayey SILT. Stiff, moderate plasticity.			SPT	100	10/ 4 6 5 3 N=18	29.0	11.0										Box 7
	Silty, fine SAND; light grey/cream. Medium dense, moist.			HQ3	100		28.5	11.5										
	Clayey SILT, with trace sand; light grey/cream streaked grey. Very stiff, moist, low to moderate plasticity.																	
	Silty, fine SAND; light grey/cream. Medium dense, moist.			SPT	100	23/ 5 4 3 4 N=16	28.0	12.0										
	Sandy SILT, with minor clay; light grey/cream streaked grey. Very stiff, moist, low plasticity.						27.5	12.5										
	Sandy SILT; dark grey streaked black. Very stiff, moist, non-plastic. Gently inclined carbonaceous laminations throughout. Retains relict rock structure			HQ3	62		27.0	13.0										
	13.1-13.5m: CORE LOSS.																	
	Silty medium SAND; grey. Dense, moist. Retains relict rock structure			SPT	100	34/ 5 7 8 10 N=30	26.5	13.5										Box 8
							26.0	14.0										
ECBF	Unweathered, grey SILTSTONE. Very weak, thinly interbedded with very weak, grey, silty fine SANDSTONE. Gently inclined bedding.			HQ3	62		25.5	14.5				33						
	14.6-15m: CORE LOSS.						25.0	15.0										Box9

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t12**

SHEET 4 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 9/12/14
FINISH DATE: 9/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Appleby Road, Rosedale

CO-ORDINATES: 5931784.49 mN 1750978.22 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.90m
R.L. COLLAR: 39.90m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW ES)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
ECBF	Unweathered, grey, silty, fine SANDSTONE. Very weak.			SPT	100	5 10/ 14 19 28 45 N>50	24.5										Box 9
	END OF BOREHOLE AT 15.45m. TARGET DEPTH REACHED. Standpipe piezometer installed at screen depths of 3 m to 6 m and 13 m to 14.5 m below ground level.						15.5 24.0 16.0 23.5 16.5 23.0 17.0 22.5 17.5 22.0 18.0 21.5 18.5 21.0 19.0 20.5 19.5 20.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 4-Feb-2015

BH t12 - Northern Interceptor Phase 1

BH12_0.0-0.6m.jpg

BH12_0.6-0.9m.jpg

BH12_0.9-3.0m.jpg

BH12_3.0-5.0m.jpg

BH12_5.0-7.15m.jpg

BH12_7.15-7.95m.jpg

BH12_7.95-10.95m.jpg

BH12_10.95-13.5m.jpg

BH12_13.5-15.45m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t13**

SHEET 1 OF 3

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Knights Nurseries, Rosedale

CO-ORDINATES: 5931674.72 mN 1751454.65 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 42.00m
R.L. COLLAR: 42.00m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 2/12/14
FINISH DATE: 3/12/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS WS WW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Fine to coarse GRAVEL; grey. Loosely packed.			HAND AUGER	100		42.0	0										
	Organic SILT, with minor gravel; brown. Very stiff, moist, non-plastic; gravel, fine, sub-angular.												0.1m: ENVIRO SAMPLE TAKEN					
	0.15m: grades organic SILT.												0.3m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, with minor gravel; orange brown mottled brown. Stiff, moist, moderate plasticity; gravel, fine.					>228 kPa	41.5	0.5					0.5m: ENVIRO SAMPLE TAKEN					
	0.5m: Grades clayey SILT, with trace gravel; orange brown mottled brown. Very stiff, wet, moderate plasticity.					119/29 kPa 163/49 kPa												
	Silty CLAY; grey mottled orange brown. Very stiff, moist, moderate plasticity.					211/ 114 kPa	41.0	1.0					1m: ENVIRO SAMPLE TAKEN		22/12/14 (Top Screen)			Box 1
	1.5-1.95m: CORE LOSS. SPT sample dropped out.			SPT	0	153/62 kPa 0/ 2 3 N=5	40.5	1.5					1.5m: ENVIRO SAMPLE TAKEN					
TAURANGA GROUP	Silty CLAY, minor organic silt; grey mottled orange brown. Very stiff, moist, moderate plasticity.						40.0	2.0					2m: ENVIRO SAMPLE TAKEN					
	Silty CLAY; light grey mottled orange brown. Very stiff, moist, moderate plasticity.			HQ3	100													
	2.2m: grades orange brown.																	
	Clayey SILT, with minor fine sand; greyish brown, streaked red, orange brown and black.						39.5	2.5							22/12/14 (Bottom Screen)			
	2.5m: grades light grey mottled orange brown.																	
				PUSH TUBE			39.0	3.0										
	3.55m: grades sandy SILT.						38.5	3.5										
	Silty, fine SAND; light grey mottled orange brown. Medium dense, moist.			SPT	100	3/ 5 7 N=12												
	Sandy SILT, with minor clay; light grey mottled orange brown. Very stiff, moist, low plasticity.						38.0	4.0										
	Clayey SILT, with minor sand; orange brown mottled light grey. Very stiff, moist, moderate plasticity.			HQ3	100													
				PUSH TUBE			37.5	4.5										Box2
								5.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t13**

SHEET 2 OF 3

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 2/12/14
FINISH DATE: 3/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Knights Nurseries, Rosedale

CO-ORDINATES: 5931674.72 mN 1751454.65 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 42.00m
R.L. COLLAR: 42.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
TAURANGA GROUP	Sandy SILT, trace organics; light grey, streaked dark grey. Stiff, moist, non-plastic.			SPT	100	1/4 4 N=8	36.5	5.5										
	Silty CLAY, with minor organics and sand; dark grey, streaked black. Stiff, moist, moderate plasticity.																	
	5.6m: grades silty CLAY; brownish grey.			HQ3	100													Box 2
WEATHERED EAST COAST BAYS FORMATION	Sandy SILT; grey. Stiff, moist, low plasticity.																	
	Silty CLAY; grey. Stiff, moist, high plasticity.			SPT	100	1/3 2 N=5	36.0	6.0										
	Silty SAND; grey. Loose, moist.																	
	Clayey SILT, with minor sand; grey. Stiff, moist, moderate plasticity.			HQ3	100		35.5	6.5										
	6.9m: grades clayey SILT. Very stiff.						35.0	7.0										
	Silty CLAY; grey. Very stiff, moist, high plasticity.			SPT	100	2/2 4 N=6	34.5	7.5										
	Clayey SILT, with minor sand; grey. Stiff, moist, moderate plasticity.			HQ3	100		34.0	8.0										
	Silty CLAY; grey. Very stiff, moist, high plasticity.			HQ3	86		33.5	8.5										Box 3
	Sandy SILT, with trace clay; grey. Firm, moist, non-plastic.			SPT	100	1/3 4 N=7	33.0	9.0										
	9.45m: grades clayey SILT. Stiff, moderate plasticity.			HQ3	100		32.5	9.5										
	9.7m: grades sandy SILT. Non-plastic.							10.0										Box4

COMMENTS:

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t13**

SHEET 3 OF 3

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 2/12/14
FINISH DATE: 3/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Knights Nurseries, Rosedale

CO-ORDINATES: 5931674.72 mN 1751454.65 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 42.00m
R.L. COLLAR: 42.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	ROCK DEFECTS Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	SILT; grey. Very stiff, moist, non-plastic. Retains relict rock structure			HQ3	100													
	Silty fine SAND; grey. Medium dense, moist. Retains relict rock structure			SPT	100	4/ 5 8 N=13	31.5	10.5										
	SILT; grey. Very stiff, moist, non-plastic. Retains relict rock structure						31.0	11.0										
	Silty fine SAND; grey. Medium dense, moist. Retains relict rock structure			HQ3	100		30.5	11.5										Box 4
EAST COAST BAYS FORMATION	Unweathered, grey, SILTSTONE. Very weak.																	
	Unweathered, grey, silty, medium SANDSTONE. Extremely weak, uncemented; recovered as very dense, silty SAND.			SPT	100	20/ 22 28 for 35mm N>50	30.0	12.0										
	Unweathered, grey SILTSTONE. Very weak.																	
	Unweathered, grey, silty, medium SANDSTONE. Extremely weak, uncemented; recovered as very dense SAND.			HQ3	100		29.5	12.5				100	12.5-12.6m: Joint 70°, PL,SM,VN,CN 12.6m: UCS Sample taken					
	13.2m: Sandstone grades very weak.						29.0	13.0										
	Unweathered, grey SILTSTONE. Very weak, gently inclined, with carbonaceous laminations.			SPT	100		28.5	13.5										
	Unweathered, grey, silty, fine SANDSTONE. Very weak.												13.725-14.125m: Core recovered in very thin segments due to drilling 13.8-13.85m: Joint 80°, PL,SM,VN,CN					
	14.125-15m: CORE LOSS. Sample dropped and couldn't be recovered.			HQ3	31		28.0	14.0				0						
	END OF BOREHOLE AT 15m. TARGET DEPTH REACHED. Standpipe piezometer installed at screen depths of 2.5 m to 5.5 m and 8 m to 11 m below ground level.						27.5	14.5										Box5
								15.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

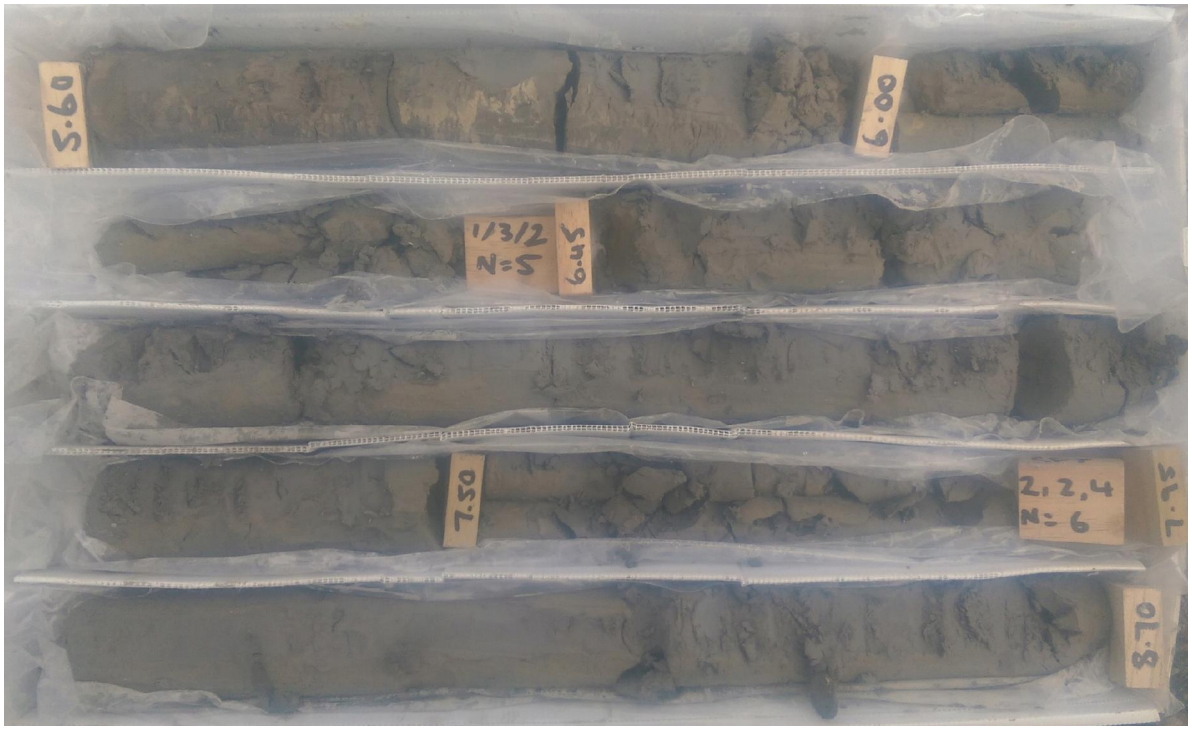
Log Scale 1:25

GENERAL LOG 28773.210.GPJ 21-Jan-2015

BH t13 - Northern Interceptor Phase 1

BH13_0.0-1.4m.jpg

BH13_1.4-5.6m.jpg



BH13_5.6-8.7m.jpg

BH13_8.7-11.6m.jpg

BH t13 - Northern Interceptor Phase 1

BH13_11.6-15.0m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t14**

SHEET 1 OF 3

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 19/11/14
FINISH DATE: 19/11/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 14 Piermark Drive, Rosedale

CO-ORDINATES: 5931731.68 mN 1751882.42 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 34.20m
R.L. COLLAR: 34.20m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
FILL	Organic SILT; dark brown. Firm, moist, non-plastic.						34.0	0										
	Clayey SILT; grey mottled orange brown and black. Very stiff, moist, low plasticity.							0.5					0.5m: ENVIRO SAMPLE TAKEN					
	0.6m: Silty CLAY; brownish grey mottled orange brown. Stiff, moist, moderate plasticity.						33.5											
	0.8m: Gravelly SILT, minor fine sand; light bronw. Very stiff, moist, non-plastic; gravel, fine to medium, sandstone			HAND AUGER	100	>228 kPa		1.0					1m: ENVIRO SAMPLE TAKEN					
TG	Clayey SILT; brownish grey streaked orange brown. Very stiff, moist, moderate plasticity.						33.0						1.2m: ENVIRO SAMPLE TAKEN					
WEATHERED EAST COAST BAYS FORMATION	Silty CLAY, with trace sand; orange brown streaked grey. Very stiff, moist, moderate plasticity. 1.4m: grades grey mottled orange brown.					206/ 127 kPa		1.5					1.5m: ENVIRO SAMPLE TAKEN					Box 1
	Clayey SILT, with minor sand; grey streaked orange brown. Very stiff, moist, moderate plasticity; sand, fine.			HQ3	100		32.5						2m: ENVIRO SAMPLE TAKEN					
	Silty CLAY; grey. Stiff, moist, moderate to high plasticity.			SPT	100	1 3 3 N=6	32.0	2.0										
	3.45-3.5m: Wash drilled sample.			HQ3	0		31.5	2.5										
	Sandy SILT, with some clay; grey mottled orange brown. Very stiff, moist, low plasticity; sand, fine			PUSH TUBE			31.0	3.0							14/01/14 (Top & Bottom Screen)			
	4.25m: grades orange brown.			HQ3	100		30.5	3.5										
	4.45m: grades grey mottled orange brown.			SPT	100	0 2 2 N=4	30.0	4.0										
	4.95-5m: Wash drilled sample following push tube			HQ3	0		29.5	4.5										Box 2
								5.0										

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t14**

SHEET 2 OF 3

DRILLED BY: McMillan Drilling

LOGGED BY: PRMM

CHECKED:

START DATE: 19/11/14

FINISH DATE: 19/11/14

CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial

JOB No: 28773.210

LOCATION: 14 Piermark Drive, Rosedale

CO-ORDINATES: 5931731.68 mN 1751882.42 mE

DIRECTION: 0.00°

ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 34.20m

R.L. COLLAR: 34.20m

DATUM: AUCK1946

SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	Sandy SILT, with some clay; grey mottled orange brown. Very stiff, moist, low plasticity; sand, fine			PUSH TUBE			29.0											
	Silty fine SAND; grey. Medium dense, moist			HQ3	100		28.5	5.5				100						
	Silty fine SAND; dark green. Medium dense, moist. Moderately thinly interbedded with hard, dark green SILT. Gently inclined bedding. Retains relict rock structure			SPT	100	2 4 9 N=15	28.0	6.0										
				HQ3	100		27.5	6.5					6.5m: Bedding 10°, PL,SM,VN,CN					
							27.0	7.0				100	6.9m: Bedding 10°, PL,SM,VN,CN					
EAST COAST BAYS FORMATION	Unweathered, bluish grey, silty fine to medium SANDSTONE. Very weak.			SPT (SC)		15 27 23 for 75mm N>50	26.5	7.5										
				HQ3	100		26.0	8.0					8.05m: Joint 45°, PL,SM,VN,CN					
													8.25m: Joint 45°, PL,SM,VN,CN				Box 3	
							25.5	8.5				100						
				SPT (SC)		50 for 135mm N>50	25.0	9.0					9.2m: Joint 50°, PL,SM,VN,CN 9.25m: joint 50°, PL,SM,VN,CN					
	9.55-9.6m: very closely spaced carbonaceous laminations, moderately inclined. 9.6m: grades silty, fine SANDSTONE.			HQ3	100		24.5	9.5				96					Box4	
								10.0										

COMMENTS:

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 21-Jan-2015

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t14**

SHEET 3 OF 3

PROJECT: NI Terrestrial	CO-ORDINATES: 5931731.68 mN 1751882.42 mE	R.L. GROUND: 34.20m
JOB No: 28773.210		R.L. COLLAR: 34.20m
LOCATION: 14 Piermark Drive, Rosedale	DIRECTION: 0.00°	DATUM: AUCK1946
	ANGLE FROM HORIZ.: -90.00°	SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 19/11/14
FINISH DATE: 19/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	ROCK DEFECTS Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	Unweathered, bluish grey, silty fine SANDSTONE. Very weak.			HQ3	100		24.0	10.0				96	10m: Joint 30°, PL,SM,VN,CN 10.1m: Joint 15°, PL,R,VN,CN					
	10.4-10.5m: Very thin carbonaceous laminations, extremely closely soaced, moderately inclined.						23.5	10.5										
	Unweathered, bluish grey streaked black, fine SANDSTONE. Very weak, thinly bedded with thin interbeds of very weak sandy SILTSTONE. Carboanceous laminations throughout, moderately inclined.			HQ3	100		23.0	11.0				100						Box 4
	Unweathered, bluish grey silty, fine to medium SANDSTONE. Very weak.						22.5	11.5					11.65m: Joint 25°, PL,SM,VN,CN					
	Unweathered, grey, sandy SILTSTONE. Very weak, thinly to very thinly bedded with very thin interbeds of bluish grey, very weak SANDSTONE. Gently inclined bedding.						22.0	12.0					12-13.5m: Broken into segments 100mm spaced when pushed out of barrel.					
	Unweathered, bluish grey, fine to medium SANDSTONE. Very weak.			HQ3	100		21.5	12.5				100						
	Unweathered, grey SILTSTONE. Very weak, very thinly bedded with very thin interbeds of very weak, silty fine SANDSTONE. Gently inclined bedding.						21.0	13.0					13.5-15m: Drilling induced breaks at 100-200m intervals.					
	Unweathered, bluish grey, silty fine to medium SANDSTONE. Extremely weak						20.5	13.5										Box 5
	Unweathered, grey SILTSTONE. Very weak, very thinly bedded with very thin interbeds of bluish grey, very weak, silty fine SANDSTONE. Moderately inclined bedding.			HQ3	100		20.0	14.0				100	UCS Sample taken at 14m.					
	Unweathered, bluish grey, silty fine to medium SANDSTONE. Very weak.						19.5	14.5					**END OF BOREHOLE AT 15m. TARGET DEPTH REACHED.** Standpipe piezometer installed at screen depths of 3 m to 6 m and 12 m to 15 m below ground level.					Box6
								15.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 21-Jan-2015

BH t14 - Northern Interceptor Phase 1

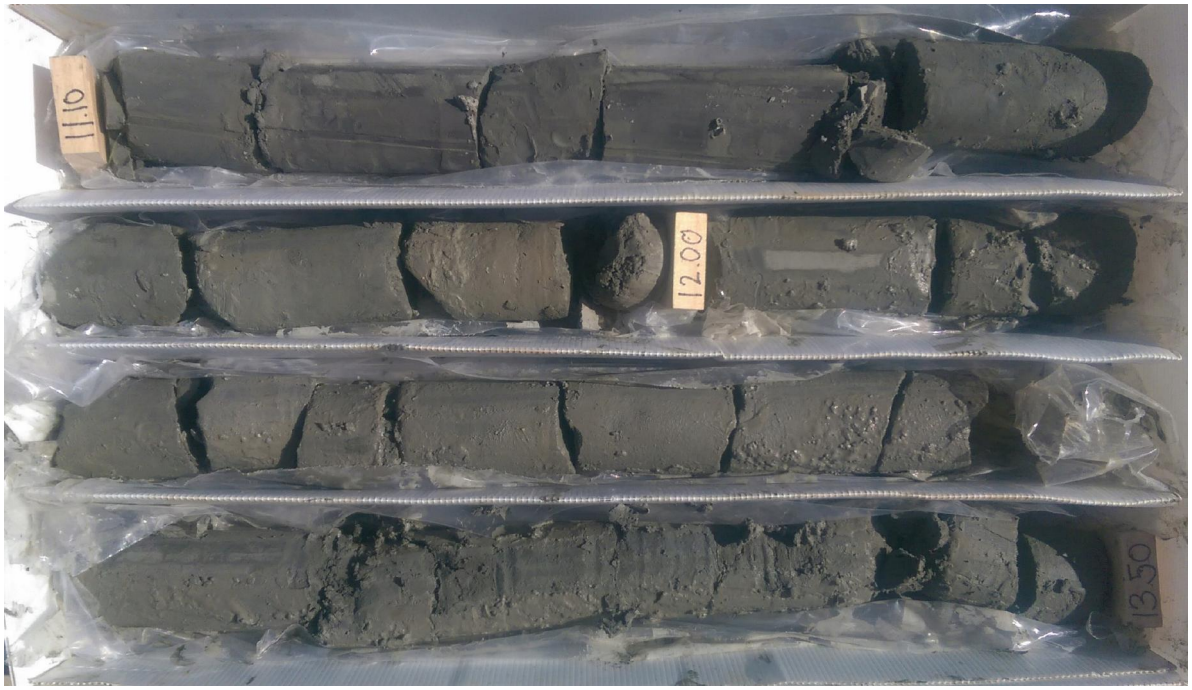
BH14_0.0-1.4m.jpg

BH14_1.6-4.95m.jpg

BH t14 - Northern Interceptor Phase 1

BH14_5-8.4m.jpg

BH14_8.4-11.1m.jpg



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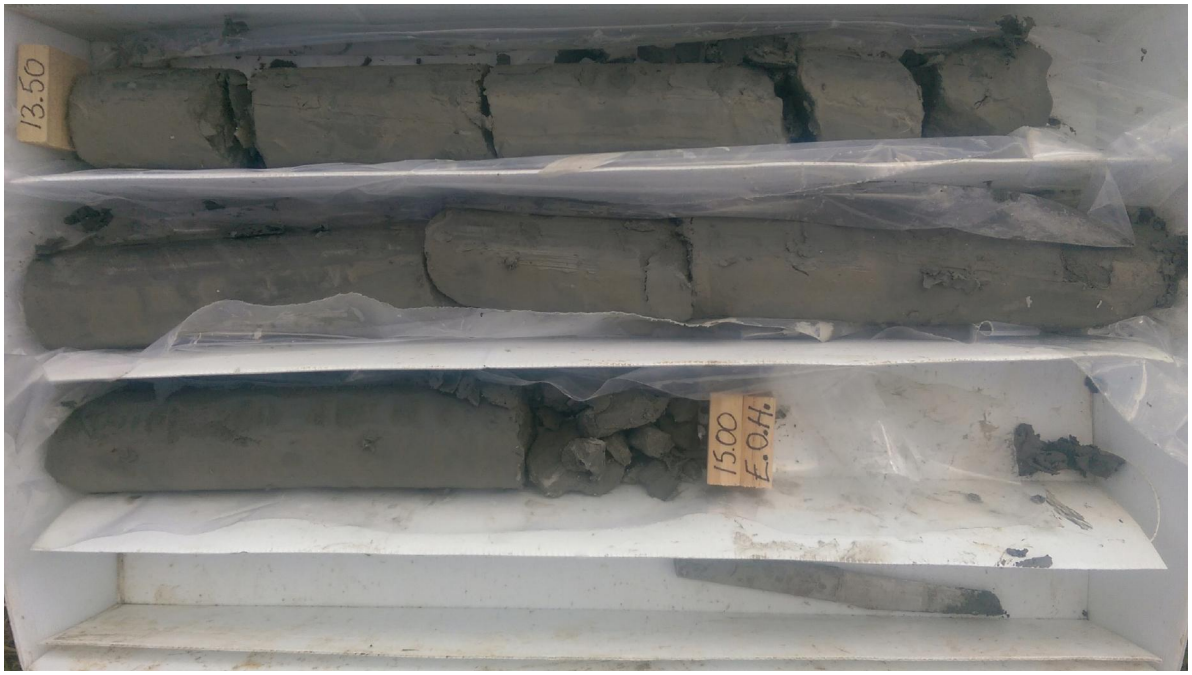


BH14_13.5-15m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t15**

SHEET 1 OF 5

PROJECT: NI Terrestrial	CO-ORDINATES: 5931726.47 mN 1752140.25 mE	R.L. GROUND: 39.20m
JOB No: 28773.210		R.L. COLLAR: 39.20m
LOCATION: 6A Piermark Drive, Rosedale	DIRECTION: 0.00°	DATUM: AUCK1946
	ANGLE FROM HORIZ.: -90.00°	SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 21/11/14
FINISH DATE: 21/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
NO RECOVERY	0-2m: NO RECOVERY - vacuum excavated.	UW SW MW HW CW	EW VW MW WS SS ES	VACUUM EXCAVATED	0	115/40 kPa	39.0	0			50 10 5 1		0.1m: ENVIRO SAMPLE TAKEN 0.4m: ENVIRO SAMPLE TAKEN	25 50 75				
TAURANGA GROUP	Silty CLAY, minor rootlets; light grey streaked red. Stiff, moist, moderate to high plasticity.			HQ3	100	96/48 kPa	38.5	0.5					2.1m: ENVIRO SAMPLE TAKEN		14/01/14 (Top & Bottom Screen)			
	Sandy SILT, with some clay; light grey, streaked red. Stiff, moist, moderate plasticity.						38.0	1.0										
	Sandy CLAY, with some silt; orange brown mottled light grey and red. Stiff, moist, moderate plasticity.						37.5	1.5										
	2.7m: grades silty CLAY; light grey mottled red and orange brown.						37.0	2.0										
	Sandy SILT; brownish grey. Firm, moist, low plasticity; sand, medium.			SPT	100	1/1 3 N=4	36.5	2.5										
	3.45-3.5m: NO RECOVERY - wash drilled sample.			HQ3	0		36.0	3.0										
	4m: Grades clayey SILT, with minor sand. Stiff, moderate plasticity; sand, fine. 4.15m: grades brown grey, mottled red.			PUSH TUBE			35.5	3.5										
	4.35m: grades clayey SILT, with some sand; brownish grey, mottled orangey brown. 4.5m: Grades sandy SILT; brownish grey. Sand, medium.			HQ3	100		35.0	4.0										
	4.95-5m: NO RECOVERY - wash drilled sample.			SPT HQ3	100 0	1/2 3 N=5	34.5	4.5 5.0										Box1

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t15**

SHEET 2 OF 5

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 6A Piermark Drive, Rosedale

CO-ORDINATES: 5931726.47 mN 1752140.25 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.20m
R.L. COLLAR: 39.20m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 21/11/14
FINISH DATE: 21/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
TAURANGA GROUP	5-5.5m: NO RECOVERY - Push tube			PUSH TUBE			34.0 / 5.5										Box 1
	Sandy SILT, with some clay; brownish grey streaked red and orange brown. Firm, moist, moderate plasticity; sand, fine.			HQ3	100		33.5 / 6.0										
	6m: Grades sandy SILT, trace clay. Low plasticity.																
	6.1-6.45m: CORE LOSS - Sample slipped out.			SPT	22	1/ 1 3 N=4	33.0 / 6.5										
	Sandy SILT, trace clay; brownish grey, mottled orange brown. Firm, moist, low plasticity.			HQ3	100		32.5 / 7.0										
	6.65m: Grades sandy SILT. with some clay. Moderate plasticity.																
	Silty CLAY; brownish grey, mottled orange brown. Stiff, moist, moderate plasticity.						32.0 / 7.5										
	Clayey SILT, with minor sand; brownish grey, mottled orange brown. Firm, moist, moderate plasticity; sand, fine.			SPT	56	1/ 1 3 N=4	31.5 / 8.0										
	7.75-7.95m: CORE LOSS - sample slipped out.																
	7.95m: Clayey SILT; with minor sand; brownish grey, mottled orange brown. Firm, moist, moderate plasticity; sand, fine.			HQ3	100		31.0 / 8.5										Box 2
	8.2m: Grades sandy SILT; grey. Low plasticity.																
	8.7m: Grades sandy SILT with minor clay; mottled orange brown. Moderate plasticity.						30.5 / 9.0										
	9-9.45m: CORE LOSS - sample washed out.			SPT	0	0/ 2 2 N=4	30.0 / 9.5										
	Sandy SILT, trace clay; grey, mottled orange brown. Soft, moist, low plasticity.			HQ3	100		29.5 / 10.0										Box3
	9.9m: Grades firm.																

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t15**

SHEET 3 OF 5

PROJECT: NI Terrestrial	CO-ORDINATES: 5931726.47 mN 1752140.25 mE	R.L. GROUND: 39.20m
JOB No: 28773.210		R.L. COLLAR: 39.20m
LOCATION: 6A Piermark Drive, Rosedale	DIRECTION: 0.00°	DATUM: AUCK1946
	ANGLE FROM HORIZ.: -90.00°	SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 21/11/14
FINISH DATE: 21/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES S MS W VW EW								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
TAURANGA GROUP	Sandy SILT, trace clay; grey, mottled orange brown. Firm, moist, low plasticity.			HQ3	100		29.0											
	10.5-10.95m: CORE LOSS.			SPT	0	0/ 2 2 N=4	28.5	10.5										
	Sandy SILT; grey mottled orange brown. Firm to soft, moist, low plasticity.			HQ3	100		28.0	11.0										
	11.4m: Grades grey streaked orange brown.						27.5	11.5										
	11.65m: Grades grey. Firm to stiff.																	Box 3
	12-12.45m: CORE LOSS - sample slipped out.			SPT	0	0/ 1 2 N=3	27.0	12.0										
	Clayey SILT, with some sand; grey, streaked dark grey. Stiff, moist, moderate plasticity; sand, fine.							12.5										
WEATHERED EAST COAST BAYS ALLUVIUM	Clayey SILT, with some sand; grey, streaked dark grey. Very stiff, moist, moderate plasticity; sand, fine. Retains relict rock structure			HQ3	100		26.5	13.0										
	13.9m: Grades sandy SILT, with some clay. Firm, low plasticity.			SPT	100	1/ 3 3 N=6	26.0	13.5										
	14.2m: Grades clayey SILT, with some sand. Stiff, moderate plasticity.			HQ3	100		25.5	14.0										
							25.0											
							24.5	14.5										
								15.0										Box4

COMMENTS:

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t15**

SHEET 4 OF 5

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 6A Piermark Drive, Rosedale

CO-ORDINATES: 5931726.47 mN 1752140.25 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.20m
R.L. COLLAR: 39.20m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 21/11/14
FINISH DATE: 21/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS ALLUVIUM	Clayey SILT, with some sand; grey, streaked dark grey. Stiff, moist, moderate plasticity.			SPT	100	2/ 1 5 N=6	24.0										
	15.25m: Grades sandy SILT. Soft, wet, non-plastic.																
	15.35m: Grades clayey SILT, with minor sand. Stiff, moist, moderate plasticity.						15.5										
	15.45m: Grades sandy SILT, with some clay.																
	15.7m: Grades sandy SILT. Soft, moderate plasticity.						23.5										
	15.85m: Grades sandy SILT, with some clay. Stiff, moderate plasticity.			HQ3	100		16.0										
	6.15m: Grades dark grey.						23.0										
	Silty CLAY; dark grey. Very stiff, moist, moderate plasticity.						16.5										
	Clayey SILT, with minor sand; dark grey. Stiff, moist, low plasticity.			SPT	100	5/ 6 8 N=14	22.5										
	16.7-16.8m: carbonaceous laminations.																
	16.9m: Grades sandy SILT.						17.0										
	17.1m: Grades sandy SILT, with minor clay.						22.0										
	17.55m: Grades light grey.			HQ3	100		17.5										Box 5
	17.75m: Grades clayey SILT, with trace sand. Moderate plasticity.						21.5										
	Silty SAND; light grey. Medium dense, moist.						18.0										
	Clayey SILT, with minor sand; light grey. STiff, moist, moderate plasticity.			SPT	100	3/ 7 9 N=16	21.0										
	18.4m: Grades sandy SILT, with minor clay. Firm, low plasticity.																
	18.5m: Grades clayey SILT, with minor sand. Moderate plasticity.						18.5										
							20.5										
	19.1m: Grades clayey SILT; grey, streaked light grey. Very stiff.			HQ3	100		19.0										
	19.35m: Grades sandy SILT with minor clay. Firm, low plasticity.						20.0										Box 6
	Silty CLAY; grey, streaked light grey. Stiff, moist, moderate plasticity.						19.5										
	Clayey SILT, with minor sand; grey streaked light grey. Stiff, moist, moderate plasticity.			SPT	100	3/ 5 7 N=12	19.5										
							20.0										

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t15**

SHEET 5 OF 5

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 21/11/14
FINISH DATE: 21/11/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 6A Piermark Drive, Rosedale

CO-ORDINATES: 5931726.47 mN 1752140.25 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 39.20m
R.L. COLLAR: 39.20m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m) / Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
	19.9m: Silty CLAY; grey, streaked light grey. Very stiff, moist, moderate to high plasticity. / Sandy SILT, with minor clay; light grey. Firm, moist, low to moderate plasticity. 20.65m: Grades clayey SILT, with minor sand; light grey. Stiff, moderate plasticity.			HQ3	100		19.0 20.5 18.5 21.0										Box 7
	END OF BOREHOLE AT 21m. TARGET DEPTH REACHED. Standpipe piezometer installed at screen depths of 3 m to 4.5 m and 5.5 m to 7 m below ground level.						18.0 21.5 17.5 22.0 17.0 22.5 16.5 23.0 16.0 23.5 15.5 24.0 15.0 24.5 14.5 25.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

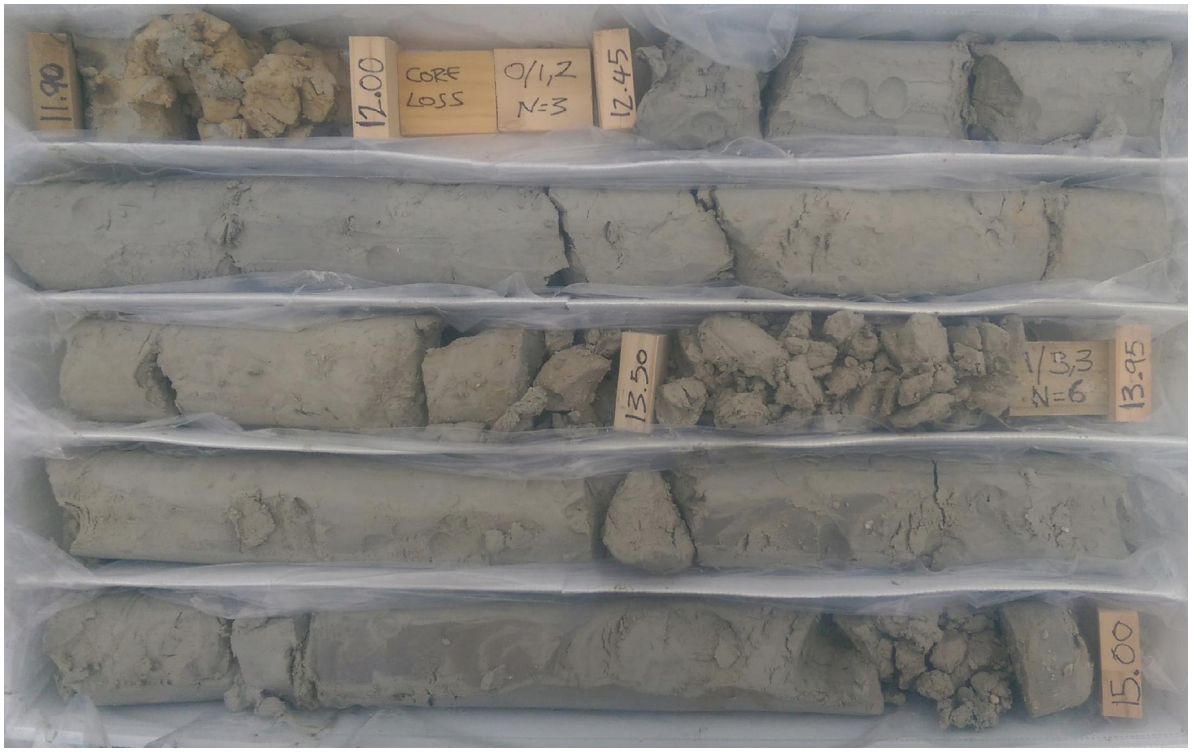
Log Scale 1:25

BH t15 - Northern Interceptor Phase 1

BH15_0.0-5.5m.jpg

BH15_5.5-8.65m.jpg

BH15_8.65-11.9m.jpg



BH15_11.9-15m.jpg

BH15_15-17.55m.jpg

BH15_17.55-19.95m.jpg

BH t15 - Northern Interceptor Phase 1

BH15_19.95-21m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t16**

SHEET 1 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5931720.47 mN 1752407.52 mE	R.L. GROUND: 38.60m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 38.60m	LOGGED BY: PRMM
LOCATION: 169 Bush Road, Rosedale	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 28/11/14
			FINISH DATE: 28/11/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE (SOIL: Classification, colour, consistency / density, moisture, plasticity; ROCK: Weathering, colour, fabric, name, strength, cementation)	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS WS VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	ROCK DEFECTS Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
T/S	Organic SILT, with mnor rootlets. Firm, moist, non-plastic.																	
TAURANGA GROUP	Silty CLAY, with minor rootlets; light grey mottled orange brown. Very stiff, moist, moderate plasticity.			HAND AUGER	100		38.5	0					0.1m: ENVIRO SAMPLE TAKEN					
							38.0	0.5					0.5m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, with minor sand; light grey mottled orange brown. Stiff, moist, low plasticity; sand, medium.							1.0					1m: ENVIRO SAMPLE TAKEN					
	Silty CLAY; light grey mottle orange brown. Firm, moist, moderate plasticity.						37.5	1.5					1.5m: ENVIRO SAMPLE TAKEN		17/12/14 (Top & Bottom Screen)			Box 1
	Clayey SILT; light grey mottled yellow brown. Firm, moist, moderate plasticity.						37.0	2.0					2m: ENVIRO SAMPLE TAKEN					
	Clayey SILT, with minor organics; brown speckled black. Soft, moist, low plasticity; organics, wood.			HQ3	100		36.5	2.5										
WEATHERED EAST COAST BAYS FORMATION	Sandy SILT; grey mottled orange brown. Soft, wet, non-plastic; sand, fine.						36.0	3.0										
	2.9m: grades grey.			PUSH TUBE			35.5	3.5										
	3m: grades fine to coarse sand.			SPT	100	1/2 4 N=6	35.0	4.0										
	3.5m: grades stiff, moist.			HQ3	91		34.5	4.5									Box 2	
	3.95-4m: CORE LOSS.			PUSH TUBE			34.0	5.0									Box3	
	Sandy SILT; grey. Stiff, moist, non-plastic; sand, fine to coarse.																	
	4.25m: grades clayey SILT, with minor fine sand. Firm, moderate plasticity.																	

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 21-Jan-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t16**

SHEET 2 OF 4

PROJECT: NI Terrestrial	CO-ORDINATES: 5931720.47 mN 1752407.52 mE	R.L. GROUND: 38.60m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 38.60m	LOGGED BY: PRMM
LOCATION: 169 Bush Road, Rosedale	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 28/11/14
			FINISH DATE: 28/11/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE	Rock Weathering	Rock Strength	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm)	RQD %	Description	Water Loss (%)	Water Level	Casing	Installation	Core Box
	SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	UW SW MW HW CW	ES S MS W VW EW								50 10 5 1		Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	25 50 75				
WEATHERED EAST COAST BAYS FORMATION	5m: grades very stiff, low plasticity.			HQ3	100		33.5	5.0										
	5.45m: grades sandy SILT. Stiff; sand, medium to coarse. 5.6m: grades clayey SILT, with minor sand. Very stiff; sand, fine.			SPT	100	3/4/5 N=9	33.0	5.5										
				HQ3	100													
	Silty fine SAND; grey. Medium dense, moist. Retains relict rock structure			SPT	100	4/6/10 N=16	32.5	6.0										
				HQ3	100		32.0	6.5										
	7.9m: grades silty, medium SAND			SPT	100	5/8/13 N=21	31.5	7.0										
				HQ3	100		31.0	7.5										
				SPT	100	4/7/14 N=21	30.5	8.0										Box 3
				HQ3	100		30.0	8.5										
	9.5m: grades silty, fine SAND			SPT	100		29.5	9.0										
				HQ3	100		29.0	9.5										Box4
								10.0										

COMMENTS:

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t16**

SHEET 3 OF 4

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 169 Bush Road, Rosedale

CO-ORDINATES: 5931720.47 mN 1752407.52 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 38.60m
R.L. COLLAR: 38.60m
DATUM: AUCK1946
SURVEY:

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 28/11/14
FINISH DATE: 28/11/14
CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description: Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
WEATHERED EAST COAST BAYS FORMATION	Silty fine SAND; grey. Medium dense, moist. Retains relict rock structure			HQ3	100		28.5											
	10.25-10.35m: Gently inclined carbonaceous laminations, extremely closely spaced.							10.5										
	10.65m: grades silty, fine to medium SAND			SPT	100	5/8 14 N=22	28.0											
	11m: grades dense			HQ3	100		27.5	11.0										Box 4
							27.0	11.5										
				SPT	100	7/13 25 N=38	26.5	12.0										
				HQ3	100		26.0	12.5										
							25.5	13.0										
				SPT	100	9/13 18 N=31	25.0	13.5										
	Sandy SILT; grey. Hard, moist, non-plastic; sand, fine. Retains relict rock structure							14.0										
ECBF	Slightly weathered, grey speckled orange and white, medium SANDSTONE. Extremely weak, uncemented, medium dense silty SAND.						24.5											Box 5
	14.1m: grades grey, silty, fine SANDSTONE.																	
	Unweathered, grey, sandy SILTSTONE. Extremely weak, softened to hard SILT; sand, fine.			HQ3	100		24.0	14.5				100						
	Unweathered, grey silty medium SANDSTONE. Extremely weak, uncemented, medium dense silty SAND																	
	14.45m: grades silty, fine SANDSTONE, with carbonaceous flecks, grey speckled black.							15.0										Box6

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

GENERAL LOG 28773.210.GPJ 21-Jan-2015

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t16**

SHEET 4 OF 4

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 28/11/14
FINISH DATE: 28/11/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: 169 Bush Road, Rosedale

CO-ORDINATES: 5931720.47 mN 1752407.52 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 38.60m
R.L. COLLAR: 38.60m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	Defect Log	ROCK DEFECTS: Fracture Spacing (cm) (50 10 5 1)	ROCK DEFECTS: RQD %	ROCK DEFECTS: Description (Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill)	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	14.5m: Unweathered, grey, sandy SILTSTONE. Very weak. Very thinly interbedded with extremely weak, uncemented, dense, grey, silty, fine SANDSTONE. Gently inclined bedding. 15m: Siltstone grades thinly to very thinly bedded, sandstone grades very weak.			SPT	100	24/ 42 8 for 30mm N>50	23.5	15.5										
				HQ3	100		23.0					93	15.41m: Bedding 10°, PL,SM,VN,CN UCS Samples taken at 15.6 and 16.3m.					
	16.7m: Sandstone grades silty, medium.			SPT	100	35/ 35 15 for 22mm N>50	22.5	16.0										Box 6
	END OF BOREHOLE AT 16.82m. TARGET DEPTH REACHED. Standpipe piezometer installed with screened depths at 2 m to 4 m and 9 m to 12 m below ground level.						22.0	16.5										
							21.5	17.0										
							21.0	17.5										
							20.5	18.0										
							20.0	18.5										
							19.5	19.0										
							19.0	19.5										
								20.0										

COMMENTS:

T+T DATATEMPLATE.GDT prmm

Log Scale 1:25

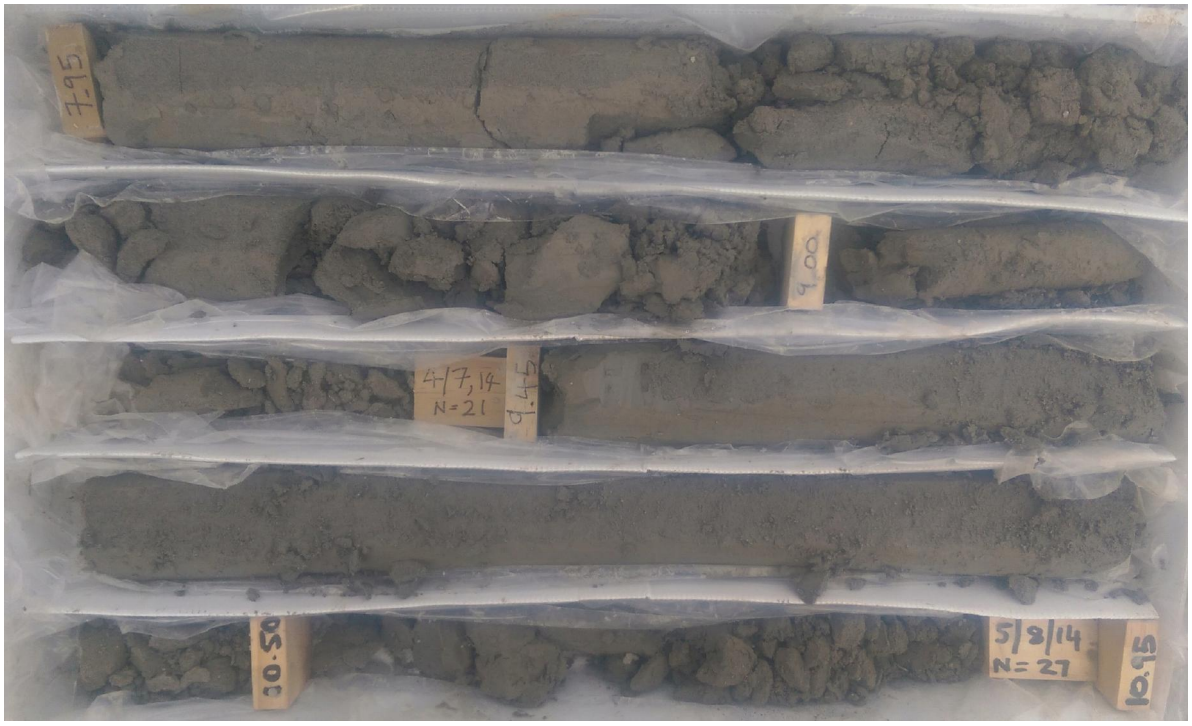
GENERAL LOG 28773.210.GPJ 21-Jan-2015

BH t16 - Northern Interceptor Phase 1

BH16_0.0-1.3m.jpg

BH16_1.3-4.5m.jpg

BH16_4.5-7.95m.jpg



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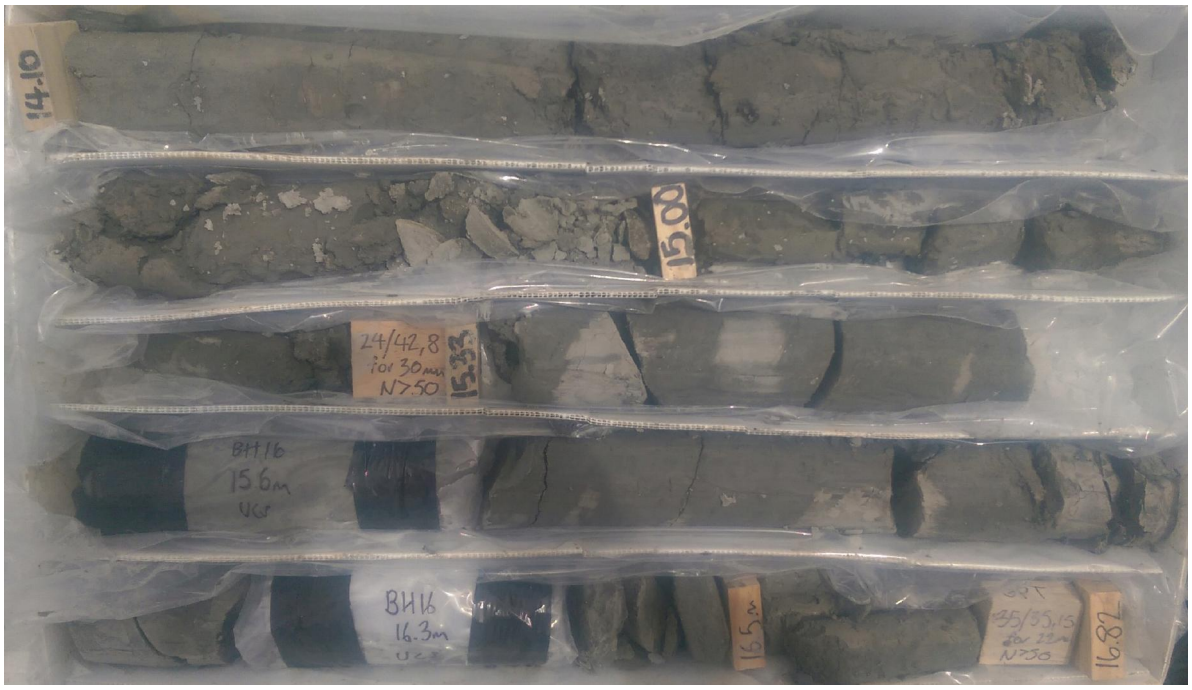
BH16_10.95-14.1m.jpg



BH16_14.1-16.82m.jpg

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t17**

SHEET 1 OF 2

PROJECT: NI Terrestrial	CO-ORDINATES: 5931662.93 mN 1752641.05 mE	R.L. GROUND: 25.00m	DRILLED BY: McMillan Drilling
JOB No: 28773.210		R.L. COLLAR: 25.00m	LOGGED BY: PRMM
LOCATION: Rosedale Reserve	DIRECTION: 0.00°	DATUM: AUCK1946	CHECKED:
	ANGLE FROM HORIZ.: -90.00°	SURVEY:	START DATE: 12/12/14
			FINISH DATE: 12/12/14
			CONTRACTOR: McMillan Drilling

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (US VS S MS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
T/S	Organic SILT, with minor rootlets; dark brown. Stiff, moist, non-plastic.												0.1m: ENVIRO SAMPLE TAKEN					
WEATHERED EAST COAST BAYS FORMATION	SILT, with minor clay; dark brown mottled orange brown. Very stiff, moist, non-plastic																	
	0.4m: grades orange brown. Low plasticity.																	
	0.5m: grades clayey SILT; orange brown, mottled light grey. Moderate plasticity.			HAND AUGER	100	113/60 kPa	24.5	0.5					0.5m: ENVIRO SAMPLE TAKEN					
	0.8m: grades SILT, with some clay, trace fine sand; light grey mottled orange brown. Low plasticity.																	
	1m: grades SILT, with some clay and minor sand.					105/55 kPa	24.0	1.0					1m: ENVIRO SAMPLE TAKEN		22/12/14			Box 1
	1.5m: grades clayey SILT, trace fine sand (white pumiceous grains) and carbonaceous specks; light grey speckled white and black, mottled orange brown.			SPT	100	88/55 kPa 12/ 11 12 N=5	23.5	1.5					1.5m: ENVIRO SAMPLE TAKEN					
	1.9m: grades SILT, with some clay and moist sand; light grey mottled orange brown.			HQ3	100		23.0	2.0					2m: ENVIRO SAMPLE TAKEN					
	SILT; grey. Hard, moist, non-plastic. Retains relict rock structure						22.5	2.5					2.75m: Bedding 20°, PL,SM,VN,CN					
	Silty fine SAND; grey. Medium dense, moist. Retains relict rock structure			PUSH TUBE	100		22.0	3.0										
	3.5m: grades dense.			SPT	100	34/ 5 11 14 19 N=44	21.5	3.5										
	SILT; grey. Hard, moist, non-plastic. Retains relict rock structure			HQ3	100		21.0	4.0										Box 2
	Silty fine SAND; grey. Dense, moist. Retains relict rock structure			HQ3	100													
ECBF	Unweathered, grey, silty, fine SANDSTONE. Very weak, very thinly bedded, with very thin interbeds of very weak, grey SILTSTONE. Moderately inclined bedding (~20°).			HQ3	100		20.5	4.5				100						
	Unweathered, grey, silty, medium SANDSTONE. Very weak.			SPT	100	8 12/ 14 22 27 30 N=91		5.0										Box3

COMMENTS:

T+T DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BORE HOLE LOG

BOREHOLE No: **BH-t17**

SHEET 2 OF 2

DRILLED BY: McMillan Drilling
LOGGED BY: PRMM
CHECKED:
START DATE: 12/12/14
FINISH DATE: 12/12/14
CONTRACTOR: McMillan Drilling

PROJECT: NI Terrestrial
JOB No: 28773.210
LOCATION: Rosedale Reserve

CO-ORDINATES: 5931662.93 mN 1752641.05 mE
DIRECTION: 0.00°
ANGLE FROM HORIZ.: -90.00°

R.L. GROUND: 25.00m
R.L. COLLAR: 25.00m
DATUM: AUCK1946
SURVEY:

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation	Rock Weathering (UW SW MW HW CW)	Rock Strength (ES S WS W VW EW)	Sampling Method	Core Recovery (%)	Testing	RL (m)	Depth (m)	Graphic Log	ROCK DEFECTS: Defect Log	Fracture Spacing (cm) (50 10 5 1)	RQD %	Description Type, Orientation, Spacing, Shape, Persistence, Roughness, Aperture, Weathering, Infill	Water Loss (%) (25 50 75)	Water Level	Casing	Installation	Core Box
EAST COAST BAYS FORMATION	Unweathered, grey, silty, medium SANDSTONE. Very weak.						19.5	5.5										
	Unweathered, grey, silty, fine SANDSTONE. Very weak, thinly to very thinly bedded, with very thin interbeds of very weak, grey SILTSTONE. Moderately inclined bedding, with carbonaceous laminations throughout.			HQ3	100							90	5.15m: Bedding 20°, PL,SM,VN,CN 5.25m: Bedding 20°, PL,SM,VN,CN 5.3m: Bedding 20°, PL,SM,VN,CN					
	Unweathered, grey, silty, medium SANDSTONE. Very weak.						19.0	6.0										Box 3
	Unweathered, grey SILTSTONE. Very weak, very thinly to thinly bedded, with very thin interbeds of grey, very weak, silty, fine SANDSTONE. Moderately inclined bedding.						18.5	6.5					6.47m: Bedding 15°, PL,SM,VN,CN 6.5m: Bedding 15°, PL,SM,VN,CN 6.52m: Bedding 15°, PL,SM,VN,CN					
	6.7-7.1m: CORE LOSS.			HQ3	73							68						
	Unweathered, grey, silty, medium SANDSTONE. Very weak.						18.0	7.0										
	Unweathered, grey SILTSTONE. Very weak.												7.25m: Bedding 20°, PL,SM,VN,CN 7.27m: Bedding 20°, PL,SM,VN,CN					
	Unweathered, grey, silty, medium SANDSTONE. Very weak.						17.5	7.5					7.37-7.5m: Discing at core, very thin.					Box 4
	END OF BOREHOLE AT 7.5m. TARGET DEPTH REACHED. Standpipe piezometer installed with screen depth of 2.5 m to 4 m below ground level.						17.0	8.0										
							16.5	8.5										
							16.0	9.0										
							15.5	9.5										
								10.0										

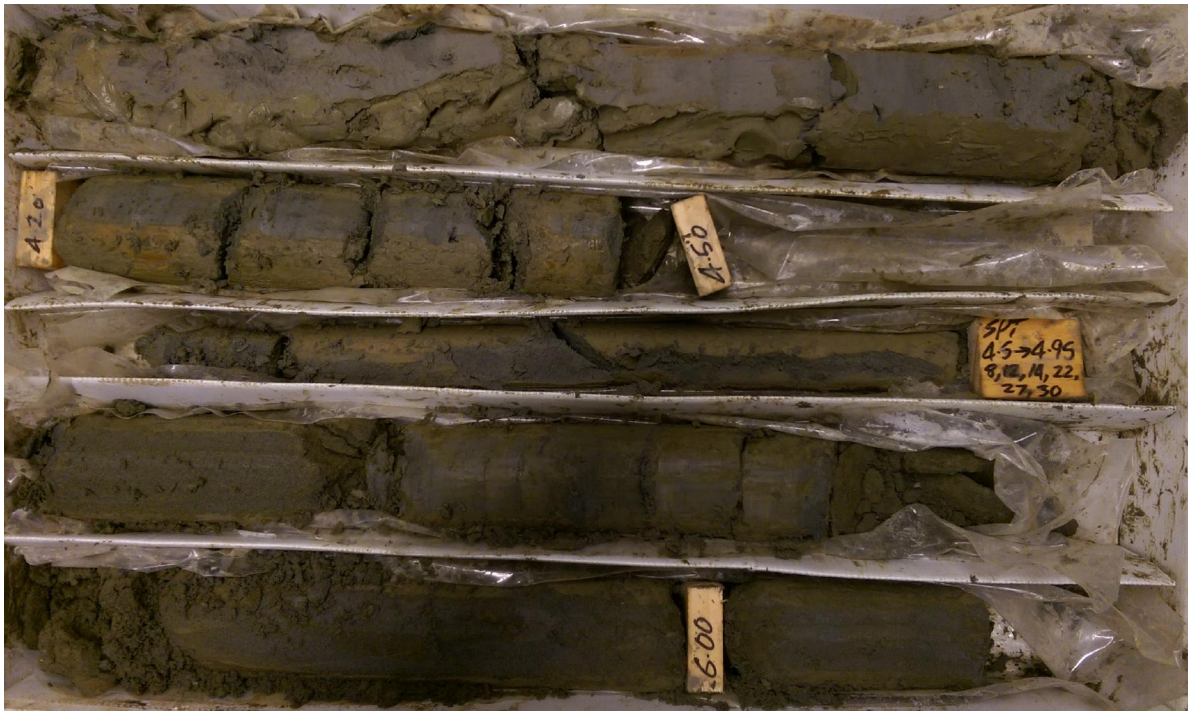
COMMENTS:

Log Scale 1:25

BH t17 - Northern Interceptor Phase 1

BH17_0.0-1.1m.jpg

BH17_1.1-3.95m.jpg



BH17_3.95-6.1m.jpg

BH17_6.1-7.5m.jpg

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA01
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor		LOCATION: Hobsonville, Greenhithe, Albany	JOB No: 28773.210
CO-ORDINATES:	5926808.18 mN 1747516.32 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 16/12/14 HOLE FINISHED: 16/12/14
R.L.:	4.20 m	DRILL METHOD: HA	DRILLED BY: RBE
DATUM:	AUCK1946	DRILL FLUID:	LOGGED BY: RBE CHECKED: PRMM

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)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	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.
FILL		Water in				*ENV		4					F				sandy SILT, non plastic, wet, dark brown, with minor gravel
						46kPa											clayey SILT, low plasticity, wet, dark brown, with yellowish brown inclusions and organic inclusions
						*ENV 74/06kPa							St				
						*ENV 38kPa			1				F				SILT, non plastic, wet, dark brown (topsoil)
																	clayey SILT, low plasticity, wet, dark brown, with inclusions of peat 1
						98/22kPa		3					VSt				clayey SILT, low plasticity, wet, dark brown and yellowish brown, with abundant inclusions of peat
						*ENV											
						*ENV 114/30kPa											
						97/22kPa							St				
						*ENV 85/27kPa		2	2								silty CLAY, medium plasticity, wet, light brown and yellowish brown 2
BURIED TOPSOIL											ML		S				clayey SILT, low plasticity, wet, dark brown, with organic inclusions
TAURANGA GROUP						14/01kPa					CH		VS				CLAY, high plasticity, wet to saturated, dark brown
		Water level on completion				10kPa							S				
						19/06kPa			3								3
								1			CL						silty CLAY, organic, medium plasticity, saturated, dark brown
						19kPa					ML						SILT, non plastic, saturated, brown, difficult to recover
						139kPa					ML		H				SILT, non plastic, wet, white, pumiceous, beoming dilatant at 4m
						>202kPa			4								4
						155/23kPa		0					VSt				
											CH		St				CLAY, high plasticity, brown
						UTP					ML		H				SILT, non plastic, wet, white, pumiceous
											SW						SAND, saturated, grey
						49/20kPa					CL		F				silty CLAY, medium plasticity, wet, grey
						145/48kPa		-1	5				VSt				5
											CH		F				CLAY, high plasticity, wet, light grey
						46/23kPa							St				
						69/27kPa											
						UTP			6		MCS		H				clayey SILT, sandy, low plasticity, wet, light brownish grey, becoming sandy SILT at 6.1m 6
								-2									**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-8.3m (blows per 100mm): 3,2,3,7,8,8,8,10,8 13,12,11,14,14,15,17,16,18,19,18,22,28
									7								

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA02
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5926999.18 mN, 1747540.68 mE
R.L.: 8.80 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 16/12/14
HOLE FINISHED: 16/12/14
DRILLED BY: RBE
LOGGED BY: RBE | CHECKED: PRMM

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.
FILL		W/L after 3.5hrs				*ENV 43/12kPa *ENV 169/65kPa 147/64kPa *ENV >202kPa *ENV 136/90kPa 130/67kPa *ENV 110/55kPa 132/46kPa >202kPa 103/48kPa 103/48kPa 201/59kPa 145/59kPa 77/33kPa 150/90kPa 64/38kPa 142/74kPa 147/78kPa 71/29kPa		8 7 6 5 4 3 2	1 2 3 4 5 6			St VSt St VSt St VSt St				SILT, non plastic, wet, dark brown, minor gravel (topsoil)
																	clayey SILT, medium plasticity, wet, light grey, with inclusions of topsoil and abundant fine gravel
																	fine GRAVEL (scoria), wet to saturated, reddish brown
																	clayey SILT, medium plasticity, wet, grey and yellowish brown
																	SILT, some clay, non plastic, wet, yellowish brown
																	clayey SILT, low to medium plasticity, wet, light greyish white and yellowish brown, with inclusions of grey clay and yellowish brown silt
																	clayey SILT, medium plasticity, wet, brown, with inclusions of grey silt
																	clayey SILT, low plasticity, wet, light greyish white mottled yellowish brown -inclusions of brown silt, occasional well preserved small leaf
FILL OR TAURANGA GROUP						133/65kPa		3 2	6 7		ML		St VSt				clayey SILT, low plasticity, wet, light grey mottled yellowish brown
																	END OF BOREHOLE 6.2m (target depth) Scala 6.2-8.2m (blows per 100mm): 5,6,8,9,9,9,9,11,11,11 13,14,12,13,16,18,20,18,19,25

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA03
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5927141.97 mN, 1747653.61 mE
R.L.: 14.80 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 16/12/14
HOLE FINISHED: 16/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL	*ENV			ML	VSt	SILT, non plastic, wet, dark brown
TAURANGA GROUP				MC		clayey SILT, low plasticity, wet, yellowish brown
	143/40kPa					
	*ENV >202kPa	14				
	169/71kPa		1			
	*ENV					-yellowish brown mottled light greyish white
	106/51kPa					-medium plasticity
	*ENV 142/61kPa					-low plasticity, light grey mottled orange brown
	158/67kPa	13				
	*ENV 150/69kPa		2			-light greyish white mottled yellowish and reddish brown; light grey from 2.2m
	146/56kPa					
	168/65kPa	12				
	103/16kPa		3	ML		SILT, some clay, minor sand, low plasticity, wet, light whitish grey
	134/36kPa			MS		sandy SILT, non plastic, wet, light whitish grey
				SM		silty fine to medium SAND, light whitish grey
	84/20kPa	11		MS	St	
				SM		fine to medium sandy SILT, light whitish grey
			4			silty fine to medium SAND, wet, grey
	>202kPa			MS	H	fine sandy SILT, non plastic, wet to saturated, light brown
	>202kPa	10				
	>202kPa		5			
	>202kPa					
				SM	MD	silty fine SAND, wet to saturated, light brown
		9	6			**END OF BOREHOLE 6m (target depth)**
						Scala 6.0-8.1m (blows per 100mm): 5,5,5,4,5,8,6,7,7,12 12,12,14,14,14,15,16,16,21,24,24
		8	7			

Water level after 2 hours

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA06
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5928874.51 mN 1749249.6 mE
R.L.: 28.10 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 15/12/14
HOLE FINISHED: 15/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
TOPSOIL	*ENV	28		ML	H	SILT, non plastic, wet, dark brown (topsoil)
TAURANGA GROUP	>202kPa			ML		SILT, some clay, non plastic, wet, light brown mottled yellowish brrown
	*ENV >202kPa					-yellowish brown
					VSt	-low plasticity, minor yellowish brown mottles
	163/55kPa		1			
	*ENV	27				
	176/59kPa					
	*ENV 182/97kPa					
	156/75kPa		2			
	*ENV 142/81kPa	26				-slightly sandy, light greyish brown and yellowish brown speckled white
	145/87kPa					
Water level after 9 hours				MC		clayey SILT, sandy, medium plasticity, wet, light brown
	146/93kPa				St	
	90/56kPa	25	3			-light brown mottled yellowish brown
	78/61kPa				VSt	-low to medium plasticity, light whitish brown; brown from 3.2m
	110/40kPa					
				MC		clayey SILT, trace sand, low plasticity, wet, dark brown
	107/35kPa		4	MS		sandy SILT, minor clay, non plastic, wet to saturated, dark brown; black organic inclusions at 4.5m
	134/36kPa	24				
Water in	142/46kPa					
WEATHERED EAST COAST BAYS FORMATION				MS	St	sandy SILT, non plastic, wet, yellowish brown and reddish brown
	78/27kPa			MC		clayey SILT, low plasticity, wet, yellowish brown
			5		VSt	
	133/35kPa	23		MS		sandy SILT, minor clay, non plastic, wet, yellowish brown and light greyish white mottled pink
	159/36kPa					**END OF BOREHOLE 6.2m (target depth)**
	194/52kPa					Scala 6.2-6.7m (blows per 100mm): 9,13,17,21,27
	>202kPa	22	6		H	
			7			

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.

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA07
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5928872.35 mN, 1749380.67 mE
R.L.: 18.10 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 12/12/14
HOLE FINISHED: 12/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
FILL	*ENV	18			VSt	gravelly SILT, non plastic, moist to wet, dark brown (topsoil)
	*ENV					clayey SILT, low plasticity, wet, yellowish brown and brown. Medium plasticity from 0.3m, with abundant angular fine gravel
	124/23kPa *ENV					- inclusions of topsoil, gravel and fragments of brick
	90/23kPa *ENV	17	1		St	
	75/25kPa				VSt	
BURIED TOPSOIL	*ENV 124/35kPa			ML		SILT, non plastic, wet, dark brown
TAURANGA GROUP	117/59kPa			MC		clayey SILT, medium plasticity, wet, yellowish brown, with minor rusty mottles
	*ENV 80kPa	16	2	CL	St	silty CLAY, medium plasticity, wet, light whitish grey mottled yellowish brown
	75/20kPa					
	77/29kPa					
	65/25kPa	15	3			
	64/26kPa					
	68/20kPa				VSt	
	121/16kPa			MS		sandy SILT, non plastic, wet, dark brown
	143/40kPa	14	4	MC		clayey SILT, low plasticity, wet, dark grey
	192/23kPa			MS		sandy SILT, non plastic, wet, dark grey
	165/30kPa					
	>202kPa	13	5	ML	H	SILT, non plastic, wet, dark grey
	UTP			MS		sandy SILT, non plastic, wet, dark grey
				SM		silty fine to medium SAND, dark grey
	UTP			ML		SILT, non plastic, wet, dark grey
			6	MS		sandy SILT, non plastic, wet, dark grey
		12				**END OF BOREHOLE 6m (target depth)** Scala 6.0-7.0m (blows per 100mm): 15,13,13,13,11,14,19,15,26,26
			7			

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA08
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5928970.35 mN, 1749516.42 mE
R.L.: 32.30 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 12/12/14
HOLE FINISHED: 12/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL	*ENV	32	0	ML	VSt	SILT, non plastic, wet, dark brown (topsoil)
TAURANGA GROUP	119/30kPa			MC		clayey SILT, medium plasticity, wet, yellowish brown
	*ENV 116/45kPa					
	133/65kPa		1			yellowish brown mottled light greyish white
	*ENV 107/51kPa	31				
	*ENV 139/64kPa					
	133/78kPa		2			-low plasticity, white mottled reddish brown
	*ENV 195/93kPa	30				
	171/108kPa					
	185/106kPa					
	168/74kPa		3			
	127/72kPa	29		ML		SILT, some clay, low to no plasticity, wet, white mottled reddish brown
	117/69kPa					
	120/61kPa		4			
	147/64kPa	28				
	107/61kPa			MC		clayey SILT, trace sand, medium plasticiyt, wet, yellowish brown mottled pink
	130/59kPa			MS		sandy SILT, minor clay, non plastic, wet, light greyish white mottled pinkish and yellowish brown
	129/38kPa		5			
	72/51kPa	27			St	
	142/52kPa				VSt	
	149/55kPa		6			
		26				**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-7.3m (blows per 100mm): 3,5,9,10,14,17,18,20,18,18,20,23
			7			

Water level after 1hr20min

Water in

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.

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA14
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5930706.29 mN 1749868.6 mE
R.L.: 24.50 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 12/12/14
HOLE FINISHED: 12/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	DEPTH (m)	R.L. (m)	TESTS	GRAPHIC LOG	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
TOPSOIL	0	24	*ENV		ML	VSt	fine sandy SILT, friable, dry to moist, light brown
TAURANGA GROUP			145/43kPa		MC		clayey SILT, low plasticity, moist to wet, yellowish brown
			*ENV 94/46kPa			St	
	1		88/40kPa				
		23	*ENV 67/29kPa				
			*ENV 55/19kPa				
			87/22kPa		ML	F	SILT, some clay, low plasticity, wet, light greyish white mottled yellowish brown
	2		*ENV 40/07kPa			St	
		22	56/12kPa				
			124/19kPa				
	3		93/20kPa				-wet to saturated, orange brown
			75/23kPa				
		21	103/20kPa			VSt	-wet, light greyish white mottled orange brown
			133/20kPa				-saturated, orange brown
	4						-wet, light greyish white
			201/58kPa		MS		fine sandy SILT, minor clay, low to no plasticity, wet, yellowish orange brown
		20	153/29kPa				
			140/35kPa				
	5		142/25kPa				
			117/20kPa				
		19	147/48kPa		MS		sandy SILT, minor clay, low to no plasticity, wet, grey
	6		>202kPa			H	
		18					**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-7.3m (blows per 100mm): 5,4,7,11,15,16,22,18,22,18,26,34
	7						

Water in/ level after 3.5hrs

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.

T+T_DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA15
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5930859.15 mN, 1749950.85 mE
R.L.: 16.60 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 12/12/14
HOLE FINISHED: 12/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL	*ENV			ML	VSt	sandy SILT, non plastic to friable, moist, brown
TAURANGA GROUP	191/52kPa			ML		SILT, non plastic, moist to wet, yellowish brown
	*ENV UTP	16		SM		silty fine SAND, well packed, moist, light greyish white mottled yellowish brown
	159/87kPa		1	MC	VSt	clayey SILT, low to medium plasticity, wet, yellowish brown
	*ENV 136/64kPa					-medium plasticity
	*ENV 127/64kPa	15				
	117/49kPa		2			
	*ENV 110/23kPa				St	-low to medium plasticity, yellowish brown mottled light greyish white
	64/14kPa			ML	VSt	SILT, some clay, low plasticity, wet, light greyish white mottled yellowish brown
	189/16kPa	14				
	133/09kPa		3			
	162/35kPa					
	127/20kPa	13		ML	St	SILT, non plastic, wet to saturated, yellowish brown and orange brown
	95/17kPa		4		VSt	-white
	127/30kPa					
	140/46kPa	12			St	
	59/14kPa		5	ML	VSt	SILT, some clay, low plasticity, wet, yellowish brown mottled light greyish white
	142/42kPa					-white
	81/26kPa				St	-clayey, yellowish brown
	116/23kPa	11			VSt	
	147/40kPa		6	ML		SILT, some clay, low plasticity, wet, grey
		10	7			**END OF BOREHOLE 6.15m (target depth)** Scala 6.15-6.75m (blows per 100mm): 6,11,15,19,21,25

Water in/ level after 1.5hrs

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA16
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5930901.19 mN, 1750153.22 mE
R.L.: 18.50 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 12/12/14
HOLE FINISHED: 12/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL / ROCK DESCRIPTION
FILL	*ENV				St	SILT, non plastic, wet, brown (topsoil)
	71/17kPa					
	*ENV	18			F	clayey SILT, low plasticity, wet, white mottled yellowish brown with inclusions of topsoil
	27/03kPa					
TAURANGA GROUP	45kPa		1	MCS		clayey SILT, sandy, low plasticity, wet, light brownish grey; wet to saturated from 1m
	*ENV				VS	
	12kPa					1
	*ENV	17		MCS		clayey SILT, sandy, low to medium plasticity, wet, light brownish grey
	09kPa					
	20/01kPa				S	
	*ENV		2			
	32/07kPa				F	-minor sandy layers, occasional organics
	23/07kPa				S	2
		16		MSC		sandy SILT, clayey low plasticity, wet, light brownish grey
	38/06kPa			MCS	F	
				ML		clayey SILT, sandy, low to medium plasticity, wet, light brownish grey
	48/04kPa		3			clayey SILT, medium plasticity, wet, light brownish grey; with intervals of sandy SILT, light brownish grey
	74/09kPa			MCS	St	3
		15				clayey SILT, sandy, medium plasticity, wet, light brownish grey
	71/07kPa			MS		sandy SILT, non plastic, wet, light brownish grey
	75/07kPa		4			4
	81/06kPa					
WEATHERED EAST COAST BAYS FORMATION	>202kPa	14		MS	H	sandy SILT, non plastic, wet, light brownish grey, more competent
	>202kPa					
	>202kPa		5			5
	UTP	13				
	>202kPa					
	>202kPa		6			6
		12				**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-6.7m (blows per 100mm): 9,15,22,24,26,27
			7			

Water level after 20min

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA17
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931388.46 mN, 1750350.49 mE
R.L.: 16.20 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 15/12/14
HOLE FINISHED: 15/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
FILL	*ENV	16			VSt	SILT, non plastic, wet, dark brown (topsoil)
	156/23kPa *ENV					clayey SILT, low plasticity, wet, yellowish brown
BURIED TOPSOIL	*ENV			ML		SILT, non plastic, wet, dark brown
WEATHERED EAST COAST BAYS FORMATION	163/43kPa			MC		clayey SILT, low plasticity, wet, yellowish brown
	145/45kPa *ENV		1	ML		SILT, some clay, non plastic, wet, yellowish brown
	126/55kPa	15				
	*ENV 104/38kPa					
	200/42kPa		2			
	*ENV 146/27kPa	14				
	143/33kPa					
	140/27kPa					
	162/36kPa		3			
	136/39kPa	13				
	150/46kPa					
	146/38kPa		4			
	100/38kPa	12				
	106/33kPa			MC	H	clayey SILT, low plasticity, wet, yellowish brown and light brownish white
	>202kPa			ML		SILT, some clay, non plastic, wet, light greyish white and yellowish brown
	>202kPa	11	5			-light greyish white mottled grey and rusty brown
	UTP					
	>202kPa					-rusty cemented oxides at base
	>202kPa		6	MC		clayey SILT, low plasticity, wet, grey
		10				**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-6.4m (blows per 100mm): 14,22,34
			7			

Water level after 5 hours
Water in

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.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA18
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor		LOCATION: Hobsonville, Greenhithe, Albany	JOB No: 28773.210
CO-ORDINATES:	5931419.31 mN 1750417.65 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 15/12/14 HOLE FINISHED: 15/12/14
R.L.:	21.90 m	DRILL METHOD: HA	DRILLED BY: RBE
DATUM:	AUCK1946	DRILL FLUID:	LOGGED BY: RBE CHECKED: PRMM

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)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	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.
FILL						*ENV 147/36kPa *ENV 103/22kPa 90/26kPa *ENV 78/35kPa *ENV 71/27kPa		21	1				VSt St				SILT, non plastic, wet, dark brown (topsoil) clayey SILT, medium plasticity, wet, yellowish brown, with minor gravel -minor inclusions of topsoil
WEATHERED EAST COAST BAYS FORMATION		Water level after 3hr20min				*ENV >202kPa *ENV UTP UTP 202/84kPa >202kPa >202kPa >202kPa >202kPa UTP 169/46kPa >202kPa UTP UTP UTP UTP		20 19 18 17 16	2 3 4 5 6		MC MS		H VSt H				clayey SILT, medium plasticity, wet, orange brown sandy SILT, non plastic, wet, orange brown mottled light greyish white -light yellowish brown -orange brown light brown -orange brown -light whitish brown
								15	7								**END OF BOREHOLE 6.05m (target depth)** Scala 6.05-6.2m (blows per 50mm): 16,17,30

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA19
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931569.93 mN 1750488.6 mE
R.L.: 33.30 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 24/11/14
HOLE FINISHED: 24/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

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.
FILL						*ENV		33					H				SILT, friable, wet, dark brown, with small inclusions of clayey SILT, yellowish brown and light greyish white; minor fine gravel
						>202kPa											
BURIED TOPSOIL						*ENV 77/14kPa					ML		St				SILT, non plastic, wet, dark brown (topsoil)
TAURANGA GROUP						53/03kPa					MC						clayey SILT, medium plasticity, wet, light yellowish brown with orange brown silt inclusions
						*ENV			1				VSt				
						117/43kPa		32									-yellowish brown
						162/84kPa											-yellowish brown mottled light greyish white
						*ENV											
						129/49kPa			2								-whitish light grey mottles
		W/L after 6hrs				*ENV 172/103kPa											
						149/82kPa		31									-light brownish grey
						146/98kPa											
						139/78kPa			3								-purplish brown with reddish brown mottles
						>202kPa		30									-light greyish brown with occasional black and reddish brown mottles
											ML						SILT, some clay, non plastic, wet, light greyish white
						119/93kPa					MC						clayey SILT, low plasticity, wet, light greyish white mottled yellowish brown -low to medium plasticity
						116/85kPa			4				St				
						58/42kPa		29			CL						silty CLAY, medium plasticity, wet, yellowish brown mottled light greyish white
						43/26kPa											
						53/17kPa					MC						clayey SILT, medium plasticity, wet, light greyish white mottled yellowish brown
						88/27kPa			5								
		Water in				78/29kPa		28			MCS						clayey SILT, sandy, low plasticity, wet, light brown with occasional black organic mottles
						69/26kPa											
						127/26kPa			6				VSt				
						126/39kPa		27									
																	END OF BOREHOLE 6.4m (target depth) Scala 6.4-7.8m (blows per 100mm): 3,5,6,8,9,12 12,16,16,20,20,22,23,25
									7								

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA20
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931567.79 mN, 1750643.78 mE
R.L.: 36.30 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 24/11/14
HOLE FINISHED: 24/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	DEPTH (m)	R.L. (m)	TESTS	GRAPHIC LOG	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
FILL/ REWORKED GROUND	0	36	*ENV 162/29kPa *ENV 142/22kPa 94/06kPa			VSt	SILT, non plastic, wet, dark brown, with minor fine gravel
	1		*ENV 72/23kPa		ML	St	-yellowish brown, minor fine gravel
TAURANGA GROUP		35			MC		SILT non plastic, wet, yellowish brown mottled brown
			93/43kPa *ENV 124/43kPa			VSt	clayey SILT, medium plasticity, wet, yellowish brown
	2	34	*ENV 140/67kPa 188/61kPa		MCS		-becoming sandy
					MS		clayey SILT, sandy, low plasticity, wet, light greyish white and yellowish brown
			133/64kPa		MCS		sandy SILT, non plastic, wet, light greyish white and yellowish brown
	3		136/62kPa		MC		clayey SILT, sandy, low plasticity, wet, yellowish brown and light greyish white
		33	139/69kPa		MCS		clayey SILT, low to medium plasticity, wet, light brown
			114/65kPa				clayey SILT, sandy, medium plasticity, wet, light brownish white
							-light greyish brown mottled reddish brown
	4		104/61kPa		MC		clayey SILT, medium plasticity, wet, light greyish white mottled reddish brown and yellowish brown
		32	117/59kPa 143/84kPa				-slightly sandy, light whitish brown
			51/07kPa		MC	St	clayey SILT, medium plasticity, wet, brown, some organic fragments
	5		87/32kPa				
		31	64/17kPa			VSt	
			121/33kPa				
	6		120/55kPa				
		30	111/45kPa				
	7						**END OF BOREHOLE 6.5m (target depth)**

Water level after 4hrs

Water in

Scala 6.5-8.6m (blows per 100mm):
5,10,15,16,16,13,17,17,17,17,20,17,18,17,20
18,18,20,20,21,22

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA21
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931694.2 mN, 1751163.13 mE
R.L.: 46.90 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 24/11/14
HOLE FINISHED: 24/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	MOISTURE CONDITION	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
TOPSOIL	*ENV			ML		St	SILT, non plastic, wet, dark brown
TAURANGA GROUP				MC			clayey SILT, medium plasticity, wet, yellowish brown
	94/33kPa						-yellowish brown mottled light greyish white
	*ENV 146/67kPa						
	85/43kPa	46	1				
	*ENV						
	116/53kPa						
	*ENV						
	81/42kPa	45	2				-minor reddish brown mottles
	*ENV 88/43kPa						-low plasticity, light greyish white mottled reddish and yellowish brown
	77/30kPa						
	75/32kPa	44	3				
	58/23kPa						
	58/25kPa					F	
	59/23kPa						
	45/20kPa	43	4	ML			SILT, some clay, low plasticity, wet, light yellowish brown
	48/14kPa						
	49/23kPa			MC			clayey SILT, low plasticity, wet, yellowish brown
	43/16kPa	42	5				-yellowish orange brown
	61/23kPa					St	
	101/38kPa			ML		VSt	SILT, some clay, low plasticity, wet, grey
WEATHERED EAST COAST BAYS FORMATION	162/56kPa			MC			clayey SILT, low plasticity, wet, grey
	132/43kPa	41	6	ML			SILT, low to no plasticity, wet, grey
	134/29kPa			MC			clayey SILT, low plasticity, wet, grey
				ML			SILT, non plastic, wet, grey
		40	7				**END OF BOREHOLE 6.4m (target depth)** Scala 6.4-7.6m (blows per 100mm): 4,6,8,9,10,12,14,16,19,20,22,24

Water level after 7.45hrs

Water in

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.

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA22
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931773.3 mN, 1751295.45 mE
R.L.: 41.30 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 24/11/14
HOLE FINISHED: 24/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
TOPSOIL	*ENV	41	0	ML	VSt	SILT, non plastic, wet, dark brown; yellowish brown inclusions from 0.2m
TAURANGA GROUP	145/51kPa			MC		clayey SILT, low plasticity, wet, yellowish brown
	*ENV 169/54kPa		1			-yellowish brown mottled light grey
	147/78kPa					
	*ENV 178/110kPa	40				-light whitish grey mottled yellowish brown
	160/110kPa					
	*ENV 106/59kPa		2			-light greyish white mottled reddish and yellowish brown
	*ENV 100/48kPa	39			St	
	59/32kPa					
	59/23kPa				F	
	48/22kPa		3			-yellowish brown
	45/23kPa	38			St	
	43/16kPa					
	98/22kPa		4		F	-low plasticity, light greyish white mottled yellowish orange brown and reddish brown
	116/25kPa	37				
	40/20kPa				VSt	
	108/16kPa			ML		SILT, some clay, low plasticity, wet, light greyish white mottled yellowish brown
	137/19kPa		5			
	107/16kPa	36				
	101/25kPa					-light grey
	81/23kPa		6		St	
	110/30kPa	35			VSt	
			7			**END OF BOREHOLE 6.4m (target depth)** Scala 6.4-9.0m (blows per 100mm): 3,2,3,3,4,4,6,7,8,9,8,8,8,8,9,8 9,12,13,13,14,16,16,17,23,23

Water level after 2hrs.
Water in

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.

T+T_DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA23
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931696.59 mN, 1751319.79 mE
R.L.: 45.10 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 24/11/14
HOLE FINISHED: 24/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
FILL	*ENV	45			VSt	SILT, non plastic, wet, dark brown, with yellowish brown inclusions
	134/25kPa					clayey SILT, low plasticity, wet, yellowish brown and grey
	*ENV 124/33kPa				St	-yellowish brown mottled reddish brown and light greyish white, minor grey inclusions
	82/30kPa		1			1
	*ENV	44			VSt	
TAURANGA GROUP	130/65kPa			MC		clayey SILT, low plasticity, wet, light greyish white mottled yellowish brown and reddish brown
	119/61kPa					
	*ENV				St	
	85/40kPa		2			-medium plasticity 2
	*ENV 64/30kPa	43				
	67/26kPa					
	52/20kPa				F	
	43/19kPa		3			3
	40/26kPa	42				-yellowish brown
	46/25kPa					-yellowish orange brown
	62/21kPa				St	
	59/38kPa		4			4
	43/20kPa	41			F	
	75/30kPa				St	-yellowish brown mottled white and reddish brown
	59/23kPa		5			5
	103/64kPa	40		ML		SILT, non plastic, wet, grey
	98/45kPa			MC		clayey SILT, low plasticity, wet, grey
	80/45kPa		6			6
	119/48kPa	39			VSt	
			7			**END OF BOREHOLE 6.4m (target depth)** Scala 6.4-8.1m (blows per 100mm): 3,4,5,7,10,10, 11,13,14,15,14,18,19,18,19,23,27

Water in

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.

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA24
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor		LOCATION: Hobsonville, Greenhithe, Albany	JOB No: 28773.210
CO-ORDINATES:	5931672.21 mN 1751622.91 mE	DRILL TYPE: 50mm hand auger	HOLE STARTED: 28/11/14 HOLE FINISHED: 28/11/14
R.L.:	30.80 m	DRILL METHOD: HA	DRILLED BY: RBE
DATUM:	AUCK1946	DRILL FLUID:	LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL	ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	ENGINEERING DESCRIPTION
FILL	*ENV	30	1		VSt	SILT, non plastic, moist to wet, brown (topsoil)
	145/49kPa					-non plastic, minor gravel, brown and yellowish brown
	*ENV 171/33kPa					
	146/38kPa					-brown mottled light greyish white
	*ENV				St	
	74/16kPa				VSt	clayey SILT, low plasticity, wet, light greyish white mottled yellowish brown, with inclusions of silt, brown
	114/38kPa					
	*ENV				F	
	46/20kPa	29	2		St	
	*ENV 80/35kPa					-wet to saturated
FILL OR ALLUVIUM	85/30kPa			MC		clayey SILT, low plasticity, wet, brown
	74/22kPa	28	3			-light greyish white mottled yellowish brown and brown, with inclusions of green and brown silt from 3m
	90/22kPa			ML	VSt	SILT, minor clay, non plastic, wet, light greyish white mottled green
	110/07kPa					
WEATHERED EAST COAST BAYS FORMATION	117/26kPa			ML		SILT, non plastic, wet, light greyish white mottled brown, mottled yellowish brown from 3.5m
	>202kPa	27	4		H	
	>202kPa					-light grey mottled orange brown
	>202kPa					
	UTP			MS		fine sandy SILT, non plastic, wet, brown
		26		ML		SILT, non plastic, wet, light grey mottled orange brown
	>202kPa		5	ML		SILT, friable, moist to wet, light grey with rusty bands, difficult to auger
	UTP			MS		sandy SILT, non plastic, wet, brown
	>202kPa	25				
				ML		SILT, non plastic, wet, dark grey (siltstone)
	UTP		6			**END OF BOREHOLE 6m (very difficult to auger)**
		24	7			Scala (blows per 50mm):15,12,37 for 45mm; then nil penetration

Water level after 2 hours

Water in

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.

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA25
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931666.93 mN, 1751719.18 mE
R.L.: 36.70 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 28/11/14
HOLE FINISHED: 28/11/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
FILL/ REWORKED GROUND	*ENV				VSt	SILT, non plastic, wet, dark brown (topsoil)
	*ENV 139/42kPa			MC		SILT, non plastic, wet, yellowish brown and brown, with fine gravel (scoria)
TAURANGA GROUP	*ENV 88/14kPa	36			St	clayey SILT, medium plasticity, wet, yellowish brown; low to medium plasticity, light greyish white mottled yellowish and reddish brown from 0.3m
	111/32kPa		1		VSt	
	*ENV 133/43kPa					1
				ML		SILT, minor clay,trace fine sand, low plasticity, wet. light purplish grey mottled reddish brown
	>202kPa *ENV	35				
	139/26kPa			MC		clayey SILT, low plasticity, wet, light greyish white mottled yellowish and reddish brown
	*ENV 133/51kPa		2			2
	133/48kPa					
	200/82kPa	34		MS		sandy SILT, non plastic, wet, light greyish white mottled reddish and yellowish brown
				MC		
	159/72kPa		3	MCS		clayey SILT, medium plasticity, wet, light greyish white mottled yellowish brown
						3
	197/81kPa			MS		clayey SILT, sandy, low plasticity, wet, light greyish white mottled yellowish brown
					St	sandy SILT, minor clay, low to no plasticity, wet, light grey mottled yellowish brown
	85/17kPa	33		MC		
				Pt		clayey SILT, medium plasticity, wet, pink white and orange brown
				OH	VSt	PEAT, non plastic, amorphous, black
	127/17kPa		4	Pt		organic CLAY, high plasticity, wet, brown with black rootlets
					F	4
	42/14kPa			MC		silty PEAT, non plastic, amorphous, blackish dark brown
				ML		clayey SILT, medium plasticity, wet, brown
	36/06kPa			CL		SILT, some clay, low to no plasticity, wet, light grey mottled brown
		32			St	
	68/10kPa			MC		silty CLAY, medium plasticity, wet, light brown
			5			clayey SILT, medium plasticity, wet, light grey with minor organic inclusions; medium plasticity from 5.1m
	61/09kPa				VSt	5
	160/26kPa				St	
	52/13kPa	31				
			6		VSt	
	114/40kPa			CL		silty CLAY, medium plasticity, wet, light brown then light grey
	156/59kPa			MC		clayey SILT, medium plasticity, wet, light grey
		30	7			**END OF BOREHOLE 6.5m (target depth)** Scala 6.5-8.4m (blows per 100mm): 5,10,13,15,15,16,16,18,18, 17,17,18,18,20,16,20,18,19,22

Slight inflow. Hole dry on completion

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.

T+T_DATATEMPLATE.GDT prmm

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA26
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931702.87 mN, 1752597.04 mE
R.L.: 30.00 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 15/12/14
HOLE FINISHED: 15/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

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) / COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	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.
TOPSOIL AND ALLUVIUM		Water in water level on completion				*ENV					ML		VS			SILT, non plastic, wet, dark brown; brown from 0.2m
						09kPa					ML					SILT, some clay, low plasticity, saturated, grey
						*ENV 30kPa							F			
													S			
						16kPa										
						*ENV		29	1				F			1
						32/04kPa										
						*ENV 12kPa							VS			
								28	2							2
						*ENV 06kPa										
						12kPa										
TAURANGA GROUP						09kPa					MC		S			clayey SILT, medium plasticity, wet, light grey
						16/04kPa		27	3							3
						35/16kPa							F			
						52/06kPa					MSC		St			sandy SILT, clayey, low plasticity, wet, light brown
						16/04kPa		26	4		MC					clayey SILT, medium plasticity, wet, light grey 4
						145/64kPa					MCS		VSt			clayey SILT, sandy, medium plasticity, wet, light grey
						137/22kPa										
WEATHERED EAST COAST BAYS FORMATION											ML					SILT, non plastic, wet, grey
											MS					sandy SILT, non plastic, wet, dark grey
						132/06kPa					MS					sandy SILT, minor clay, non plastic, wet, grey, difficult to auger 5
								25	5		MS		H			sandy SILT, non plastic, wet, grey
						UTP										
																END OF BOREHOLE 5.2m (very hard to auger) Scala: 26 blows for 100mm 25 blows for 50mm
								24	6							6
									7							

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA27
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931547.07 mN, 1752790.27 mE
R.L.: 39.90 m
DATUM: AUCK1946

DRILL TYPE: 50mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 15/12/14
HOLE FINISHED: 15/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

GEOLOGICAL | ENGINEERING DESCRIPTION

GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION	TESTS	R.L. (m)	DEPTH (m)	CLASSIFICATION SYMBOL	STRENGTH/DENSITY CLASSIFICATION	SOIL DESCRIPTION / ROCK DESCRIPTION
TOPSOIL	*ENV			ML	St	SILT, non plastic, wet, dark brown (topsoil)
TAURANGA GROUP	77/19kPa			ML		SILT, non plastic, wet, yellowish brown
	*ENV 84/38kPa			MC		clayey SILT, medium plasticity, wet, yellowish brown -yellowish brown mottled light greyish white
	103/46kPa	39	1		VSt	
	*ENV 127/53kPa					1
	*ENV 139/67kPa					
	140/88kPa	38	2	CL		silty CLAY, medium plasticity, wet, grey mottled yellowish brown
	*ENV 121/65kPa					2
	117/74kPa					
Water level after 1hr20min				MC		clayey SILT, medium plasticity, wet, light greyish white mottled yellowish brown -low plasticity, light greyish white mottled reddish brown
	132/88kPa	37	3			3
	133/78kPa				F	
	46/25kPa			CL		silty CLAY, medium plasticity, wet, dark purplish brown
	53/32kPa				St	-blackish brown; then dark purplish brown from 3.6m
	52/20kPa	36	4	MC		clayey SILT, medium plasticity, wet, light brown with black mottles
	59/23kPa					4 -low to medium plasticity, with some sandy and clayey layers
Water in	74/43kPa					
	82/45kPa	35	5			
	43/26kPa				F	- minor black organic inclusions 5
	39/22kPa			CL		silty CLAY, medium plasticity, wet, light brown and light grey
	58/39kPa				St	
	74/52kPa	34	6	MC		clayey SILT, low to medium plasticity, wet, light grey
						6
		33	7			**END OF BOREHOLE 6.2m (target depth)** Scala 6.2-7.5m (blows per 100mm): 4,6,6,8,10,10,13,14,15,16,21,24,25

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.

SHEAR STRENGTH (kPa): 10, 25, 50, 100, 200
COMPRESSIVE STRENGTH (MPa): 1, 5, 20, 50, 100, 250
DEFECT SPACING (mm): 50, 250, 1000, 2000

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

TONKIN & TAYLOR LTD

BOREHOLE LOG

BOREHOLE No:HA28
Hole Location: Refer to site plan

SHEET 1 OF 1

PROJECT: Northern Interceptor | LOCATION: Hobsonville, Greenhithe, Albany | JOB No: 28773.210

CO-ORDINATES: 5931180.65 mN, 1750275.42 mE
R.L.: 26.20 m
DATUM: AUCK1946

DRILL TYPE: 70mm hand auger
DRILL METHOD: HA
DRILL FLUID:

HOLE STARTED: 15/12/14
HOLE FINISHED: 15/12/14
DRILLED BY: RBE
LOGGED BY: RBE CHECKED: PRMM

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)	COMPRESSIVE STRENGTH (MPa)	DEFECT SPACING (mm)	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.
FILL						*ENV		26					VSt				SILT, non plastic, wet, dark brown (topsoil)
						101/36kPa											clayey SILT, low plasticity, wet, yellowish brown mottled light greyish white and reddish brown, minor gravel and small inclusions of topsoil
						*ENV 155/84kPa			1								
						110/48kPa											
						*ENV											
BURIED TOPSOIL						>202kPa		25			ML		H				SILT, non plastic, wet, dark brown (topsoil)
						*ENV					ML						SILT, some clay, minor sand, non plastic, wet, light yellowish brown
WEATHERED EAST COAST BAYS FORMATION						*ENV >202kPa							VSt				
						162/74kPa			2				St				
						*ENV 94/33kPa		24			MS		H				sandy SILT, non plastic, wet, yellowish brown mottled light greyish white
						>202kPa											
						>202kPa											-orange brown
		Water level after 6.75 hours				>202kPa			3								
						>202kPa		23									
						>202kPa											-light greyish white mottled yellowish brown
						>202kPa			4								
						>202kPa		22									-light greyish white mottled light pinkish brown
						>202kPa											-light brown
		Water in				>202kPa			5								
						>202kPa		21									
						>202kPa											-light brown mottled yellowish brown
						UTP											
						UTP			6		MS						sandy SILT, non plastic, wet, grey
								20									**END OF BOREHOLE 6.1m (target depth)** Scala 6.1-6.7m (blows per 100mm): 8,12,13,16,20,24 **Piezometer installed: 0-2.4m flush toby, plain pipe and bentonite 2.4-6.1m sand; screen 2.4-6.2m**
									7								

T+T_DATATEMPLATE.GDT prmm

Log Scale 1:35

BORELOG 616454.GPJ 3-Feb-2015

Appendix D: Analytical Results

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data												
	Human Health		Environmental	Disposal														
Location						HA1	HA1	HA1	BH2	BH2	BH2	HA2	HA2	HA3	HA3	HA3	HA3	Site 1
Depth (m bgl)						Surface	1.2	2.0				0.5	2	Surface	0.5	1.0	2.0	
Description	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	Fill	Fill	Fill	Fill	Natural	Natural	Fill	Fill	Topsoil	Natural	Natural	Natural	Harbour Sediment
Lab number						1366780.1	1366780.4	1366780.6	1366788.1	1366788.2	1366788.4	1366780.8	1366780.11	1366780.12	1366780.13	1366780.14	1366780.16	1361009.1
Date Sampled						16-Dec-14	16-Dec-14	16-Dec-14	17-Dec-14	17-Dec-14	17-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	
Metals and Metaloids (totals)																		
Arsenic	70	80	100	12	38	6	< 2	3	2	< 2	< 2	2	< 2	9	3	< 2	< 2	**30**
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.46	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	16	6	7	18	15	9	14	9	16	10	8	5	16
Copper	>10,000 [3]	>10,000 [3]	325	45	66	8	3	6	35	15	12	13	5	20	5	2	< 2	12
Lead	3300	880	250	65	71	5.5	18.2	16.7	10.9	11	5.7	11	15.7	21	12	5	4.8	36
Nickel	6,000 [3]	600 [3]	320	35	79	16	2	5	7	10	4	11	4	8	5	< 2	< 2	6
Zinc	400,000 [3]	14,000 [3]	1160	180	139	37	12	15	22	21	85	32	9	56	7	< 4	< 4	139
Organochlorine Pesticides Screening in Soil																		
Aldrin				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
alpha-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
beta-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
delta-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
cis-Chlordane				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
trans-Chlordane				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	-	-	< 0.04	-	< 0.04	< 0.04	-	-	-
2,4'-DDD				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDD				< LOR	0.014	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
2,4'-DDE				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDE				< LOR	0.182	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
2,4'-DDT				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDT				< LOR	0.038	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Total DDT	1,000	400	0.7	< LOR	0.207							NC		NC	NC			-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan I				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan II				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin aldehyde				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin ketone				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Heptachlor				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Methoxychlor				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																		
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	**0.03**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Fluoranthene	-		-	< LOR	1.31	**0.04**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.13	< 0.16	< 0.15	< 0.16	< 0.16	< 0.14	< 0.15	< 0.15	< 0.16	< 0.14	-	< 0.13	< 0.5
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	**0.04**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	-	NC	NC
TPH																		
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	< 8	< 10	-	-	-	-	-	-	< 10	< 8	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	< 20	< 20	-	-	-	-	-	-	< 20	< 20	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	< 40	< 40	-	-	-	-	-	-	< 40	< 40	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data													
	Human Health		Environmental	Disposal															
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	Site 3	Site 5	Site 7	Site 9	BH3	BH3	BH3	BH6	BH6	BH6	BH6	HA6	HA6	HA7
Depth (m bgl)										0.3	1.0	2.0	0.1	0.3	0.5	1.5	Surface	0.5	Surface
Description						Harbour Sediment	Harbour Sediment	Harbour Sediment	Harbour Sediment	Topsoil	Fill	Fill	Topsoil	Fill	Natural	Natural	Topsoil	Natural	Topsoil
Lab number						1361009.2	1361009.3	1361009.4	1361009.4	1366739.2	1366739.4	1366739.6	1366740.1	1366740.2	1366740.3	1366740.5	1366780.17	1366780.18	1366780.65
Date Sampled										18-Dec-14	18-Dec-14	18-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	15-Dec-14	15-Dec-14	12-Dec-14
Metals and Metaloids (totals)																			
Arsenic	70	80	100	12	38	12	**17**	**38**	3	< 2	3	3	2	< 2	2	< 2	2	5	4
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.13
Chromium	6,300	2,700	400	55	31	19	14	14	7	10	9	13	12	11	10	9	6	20	31
Copper	>10,000 [3]	>10,000 [3]	325	45	66	17	9	11	7	6	15	8	11	9	4	3	3	7	31
Lead	3300	880	250	65	71	28	18.9	24	6.4	5.7	11.8	8	20	11.7	8.1	6.7	11.2	11.1	62
Nickel	6,000 [3]	600 [3]	320	35	79	8	8	12	< 2	4	5	4	13	16	4	< 2	2	5	**43**
Zinc	400,000 [3]	14,000 [3]	1160	180	139	108	100	88	23	9	24	15	29	16	5	< 4	14	12	68
Organochlorine Pesticides Screening in Soil																			
Aldrin				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	< 0.04	-					< 0.04	-	-
2,4'-DDD				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDD				< LOR	0.014	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
2,4'-DDE				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDE				< LOR	0.182	-	-	Pending	-	< 0.010	< 0.010	-					< 0.010	-	-
2,4'-DDT				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDT				< LOR	0.038	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	-		-	NC	NC	-					NC	-	-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010		
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																			
Acenaphthene	-		-	< LOR	0.04	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.04**	< 0.04	-	< 0.03	< 0.03	< 0.03
Acenaphthylene	-		-	< LOR	0.04	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	< 0.03
Anthracene	-		-	< LOR	0.18	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.18**	< 0.04	-	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.84**	< 0.04	-	**0.06**	< 0.03	**0.03**
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.82**	< 0.04	-	**0.08**	< 0.03	**0.05**
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.03**	**0.75**	< 0.04	-	**0.1**	< 0.03	**0.05**
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.39**	< 0.04	-	**0.12**	< 0.03	**0.05**
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.33**	< 0.04	-	**0.05**	< 0.03	**0.03**
Chrysene	-		-	< LOR	0.73	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.73**	< 0.04	-	**0.05**	< 0.03	**0.03**
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.12**	< 0.04	-	**0.04**	< 0.03	< 0.03
Fluoranthene	-		-	< LOR	1.31	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.04**	**1.31**	< 0.04	-	**0.08**	< 0.03	**0.05**
Fluorene	-		-	< LOR	0.03	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.03**	< 0.04	-	< 0.03	< 0.03	< 0.03
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.46**	< 0.04	-	**0.15**	< 0.03	**0.04**
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.5	< 0.4	< 0.17	< 0.15	< 0.15	< 0.15	-	< 0.13	< 0.14	< 0.16	-	< 0.13	< 0.14	< 0.14
Phenanthrene	-		-	< LOR	0.68	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.68**	< 0.04	-	< 0.03	< 0.03	< 0.03
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.04**	**1.52**	< 0.04	-	**0.09**	< 0.03	**0.06**
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	NC	NC	-	NC	**1.18**	NC	-	**0.16**	NC	**0.22**
TPH																			
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

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< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data												
	Human Health		Environmental	Disposal														
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	HA7	HA7	HA8	HA8	BH10	BH10	HA14	HA14	HA14	HA15	HA15	HA15	HA16
Depth (m bgl)						0.7	1.5	Surface	1.0	0.1	0.5	Surface	0.5	1.0	Surface	0.5	1.5	0.4
Description						Fill	Buried Topsoil	Topsoil	Natural	Topsoil	Natural	Topsoil	Natural	Natural	Topsoil	Natural	Natural	Fill
Lab number						1366780.67	1366780.68	1366780.7	1366780.72	1363077.1	1363077.2	1366780.5	1366780.51	1366780.52	1366780.55	1366780.56	1366780.58	1366780.61
Date Sampled						12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	9-Dec-14	9-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14
Metals and Metaloids (totals)																		
Arsenic	70	80	100	12	38	2	< 2	4	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	0.13	< 0.10	< 0.10	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	10	8	15	9	4	4	7	-	20	8	< 2	17	11
Copper	>10,000 [3]	>10,000 [3]	325	45	66	13	5	15	4	< 2	< 2	2	-	7	5	< 2	12	5
Lead	3300	880	250	65	71	15.4	6.4	32	7.3	5.1	2.7	3.8	-	5.2	7.2	1.8	6	4.6
Nickel	6,000 [3]	600 [3]	320	35	79	11	3	14	2	< 2	< 2	< 2	-	2	< 2	< 2	< 2	< 2
Zinc	400,000 [3]	14,000 [3]	1160	180	139	26	10	87	< 4	4	< 4	5	-	9	15	< 4	12	6
Organochlorine Pesticides Screening in Soil																		
Aldrin				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
alpha-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
beta-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
delta-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
cis-Chlordane				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
trans-Chlordane				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	< 0.04	-	-	< 0.04	-	-	-	-	-	-	-	< 0.04
2,4'-DDD				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDD				< LOR	0.014	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
2,4'-DDE				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDE				< LOR	0.182	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
2,4'-DDT				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDT				< LOR	0.038	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	NC	-	-	NC	-	-	-	-	-	-	-	NC
Dieldrin	160	70	339	< LOR	0.122	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan I				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan II				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan sulphate				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endrin				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-		-	< 0.010
Endrin aldehyde				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endrin ketone				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Heptachlor				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Heptachlor epoxide				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Hexachlorobenzene				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Methoxychlor				< LOR	ND		< 0.010			< 0.010	-		-	-	-	-	-	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																		
Acenaphthene	-		-	< LOR	0.04	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Acenaphthylene	-		-	< LOR	0.04	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Anthracene	-		-	< LOR	0.18	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Chrysene	-		-	< LOR	0.73	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Fluoranthene	-		-	< LOR	1.31	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Fluorene	-		-	< LOR	0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.14	-	< 0.15	-	-	-	< 0.14	< 0.17	-	< 0.15	< 0.13	-	< 0.15
Phenanthrene	-		-	< LOR	0.68	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
BAP equivalent	35	40	2.15	< LOR	1.18	NC	-	NC	-	NC	NC	NC	NC	-	NC	NC	-	NC
TPH																		
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data											
	Human Health		Environmental	Disposal													
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA16	HA16	HA28	HA28	HA28	HA28	HA17	HA17	HA17	HA17	HA18	HA18
Depth (m bgl)						1.0	2.0	Surface	0.5	1.2	2.0	0.4	0.5	1.0	2.0	0.3	1.0
Description						Natural	Natural	Topsoil	Fill	Buried Topsoil	Natural	Fill	Buried Topsoil	Natural	Natural	Fill	Fill
Lab number						1366780.62	1366780.64	1366780.44	1366780.45	1366780.47	1366780.49	1366780.23	1366780.24	1366780.25	1366780.27	1366780.29	1366780.3
Date Sampled						12-Dec-14	12-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14
Metals and Metaloids (totals)																	
Arsenic	70	80	100	12	38	< 2	3	2	< 2	< 2	< 2	< 2	< 2	< 2	3	3	3
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	10	16	6	6	7	17	11	11	18	13	18	18
Copper	>10,000 [3]	>10,000 [3]	325	45	66	9	13	5	2	< 2	5	5	2	4	6	10	10
Lead	3300	880	250	65	71	6.3	9.8	5.4	4.7	3.4	4.8	5.1	4.6	4.8	6.8	7.7	7.7
Nickel	6,000 [3]	600 [3]	320	35	79	< 2	6	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	9	7
Zinc	400,000 [3]	14,000 [3]	1160	180	139	9	25	13	< 4	5	9	7	6	9	12	22	19
Organochlorine Pesticides Screening in Soil																	
Aldrin				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	-	-	< 0.04	-	-	-	< 0.04
2,4'-DDD				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDD				< LOR	0.014	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
2,4'-DDE				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDE				< LOR	0.182	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
2,4'-DDT				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDT				< LOR	0.038	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	-	-	-	NC	-	-	NC	-	-	-	NC
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																	
Acenaphthene	-		-	< LOR	0.04	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Acenaphthylene	-		-	< LOR	0.04	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Anthracene	-		-	< LOR	0.18	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[a]anthracene	-		-	< LOR	0.84	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Chrysene	-		-	< LOR	0.73	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Fluoranthene	-		-	< LOR	1.31	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Fluorene	-		-	< LOR	0.03	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Naphthalene	-		0.78 [4]	< LOR	ND	-	-	-	< 0.15	< 0.13	-	< 0.15	-	-	-	< 0.14	-
Phenanthrene	-		-	< LOR	0.68	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
BAP equivalent	35	40	2.15	< LOR	1.18	-	-	-	NC	NC	-	NC	-	-	-	NC	-
TPH																	
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data										
	Human Health		Environmental	Disposal												
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA18	HA19	HA19	HA19	HA20	HA20	BH12	BH12	BH12	HA21	HA23
Depth (m bgl)						1.7	Surface	0.5	1	Surface	0.5	0.1	0.8	1.2	Surface	Surface
Description						Natural	Fill	Buried topsoil	Natural	Fill (reworked)	Fill (reworked)	Topsoil	Fill	Fill	Topsoil	Fill
Lab number						1366780.32	1360979.21	1360979.22	1360979.1	1360979.16	1360979.17	1363077.6	1363077.8	1363077.9	1360979.32	1360979.23
Date Sampled						15-Dec-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	9-Dec-14	9-Dec-14	9-Dec-14	24-Nov-14	24-Nov-14
Metals and Metaloids (totals)																
Arsenic	70	80	100	12	38	2	7	-	-	-	3	< 2	5	3	2	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	0.13	-	-	-	0.17	0.21	< 0.10	< 0.10	< 0.10	-
Chromium	6,300	2,700	400	55	31	21	7	-	-	-	27	8	21	15	8	-
Copper	>10,000 [3]	>10,000 [3]	325	45	66	6	31	-	-	-	18	8	16	12	2	5
Lead	3300	880	250	65	71	6.9	**71**	-	-	-	9.1	7.2	12.4	11.5	5.3	6.6
Nickel	6,000 [3]	600 [3]	320	35	79	2	4	-	-	-	**79**	3	9	6	< 2	-
Zinc	400,000 [3]	14,000 [3]	1160	180	139	14	66	-	-	-	38	14	23	10	5	-
Organochlorine Pesticides Screening in Soil																
Aldrin				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
alpha-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
beta-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
delta-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
cis-Chlordane				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
trans-Chlordane				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	< 0.04	< 0.04	-	< 0.04	-	< 0.04	< 0.04	-	< 0.04	< 0.04
2,4'-DDD				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDD				< LOR	0.014	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
2,4'-DDE				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDE				< LOR	0.182	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
2,4'-DDT				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDT				< LOR	0.038	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	NC	NC	-	NC	-	NC	NC	-	NC	NC
Dieldrin	160	70	339	< LOR	0.122	-	< 0.010	< 0.010	-	**0.012**	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan I				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan II				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan sulphate				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin aldehyde				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin ketone				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Heptachlor				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Heptachlor epoxide				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Hexachlorobenzene				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Methoxychlor				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	ND
Polycyclic aromatic hydrocarbons																
Acenaphthene	-		-	< LOR	0.04	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Acenaphthylene	-		-	< LOR	0.04	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Anthracene	-		-	< LOR	0.18	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[a]anthracene	-		-	< LOR	0.84	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Chrysene	-		-	< LOR	0.73	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Fluoranthene	-		-	< LOR	1.31	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Fluorene	-		-	< LOR	0.03	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Naphthalene	-		0.78 [4]	< LOR	ND	-	-	-	-	< 0.14	-	-	< 0.15	-	-	-
Phenanthrene	-		-	< LOR	0.68	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
BAP equivalent	35	40	2.15	< LOR	1.18	-	-	-	-	NC	-	-	NC	-	-	-
TPH																
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	< 9	-	-	-	-	-	< 9	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	< 20	-	-	-	-	-	< 20	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	< 40	-	-	-	-	-	< 40	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data											
	Human Health		Environmental	Disposal													
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA23	HA23	BH13	BH13	HA24	HA24	HA24	HA25	BH14	BH14	BH15	BH15
Depth (m bgl)						0.5	1.5	0.1	0.5	Surface	0.5	2	Surface	0.1	0.5	0.1	0.4
Description						Fill	Natural	Fill	Fill	Fill	Fill	Fill	Fill	Topsoil	Fill	Topsoil	Natural
Lab number						1360979.24	1360979.26	1359119.1	1359119.3	1360979.1	1360979.11	1360979.35	1360979.4	1355309.1	1355309.2	1355309.7	1355309.8
Date Sampled						24-Nov-14	24-Nov-14	2-Dec-14	2-Dec-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	21-Nov-14	21-Nov-14	21-Nov-14	21-Nov-14
Metals and Metaloids (totals)																	
Arsenic	70	80	100	12	38	3	< 2	12	3	5	3	< 2	6	4	2	5	5
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	0.59	< 0.10	-	< 0.10	< 0.10	0.14	-	< 0.10	0.13	< 0.10
Chromium	6,300	2,700	400	55	31	17	9	11	7	-	10	6	24	-	9	17	26
Copper	>10,000 [3]	>10,000 [3]	325	45	66	21	2	**66**	5	22	11	< 2	26	25	11	16	30
Lead	3300	880	250	65	71	7.9	3.4	28	9.8	15.4	11.7	4.7	42	41	8.9	22	11
Nickel	6,000 [3]	600 [3]	320	35	79	3	< 2	9	2	-	3	< 2	17	-	4	8	**56**
Zinc	400,000 [3]	14,000 [3]	1160	180	139	14	4	36	9	-	13	< 4	60	-	7	41	43
Organochlorine Pesticides Screening in Soil																	
Aldrin				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
alpha-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
beta-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
delta-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
cis-Chlordane				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
trans-Chlordane				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	< 0.04	-	< 0.04	-	-	< 0.04	< 0.04	-	-	-
2,4'-DDD				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDD				< LOR	0.014	-	-	< 0.010	-	**0.014**	< 0.005	-	< 0.010	< 0.010	**0.007**	-	-
2,4'-DDE				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDE				< LOR	0.182	-	-	< 0.010	-	**0.182**	< 0.005	-	**0.022**	**0.066**	**0.055**	-	-
2,4'-DDT				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDT				< LOR	0.038	-	-	< 0.010	-	**0.011**	< 0.005	-	< 0.010	0.018	**0.028**	-	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	-	NC	-	**0.207**	< 0.03	-	**0.022**	**0.084**	**0.09**	-	-
Dieldrin	160	70	339	< LOR	0.122	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan I				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan II				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan sulphate				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin aldehyde				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin ketone				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Heptachlor				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Heptachlor epoxide				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Hexachlorobenzene				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Methoxychlor				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
ONOP				< LOR	ND	-	-	ND	-	ND	-	-	ND	-	-	-	-
Polycyclic aromatic hydrocarbons																	
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.03**	-	< 0.03	< 0.04	-
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.04**	-	< 0.03	< 0.04	-
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.14**	-	< 0.03	< 0.04	-
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.33**	-	< 0.03	< 0.04	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.37**	-	< 0.03	< 0.04	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.45**	-	< 0.03	< 0.04	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.3**	-	< 0.03	< 0.04	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.2**	-	< 0.03	< 0.04	-
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.35**	-	< 0.03	< 0.04	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.06**	-	< 0.03	< 0.04	-
Fluoranthene	-		-	< LOR	1.31	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.86**	-	< 0.03	< 0.04	-
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.04	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.35**	-	< 0.03	< 0.04	-
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.15	< 0.15	< 0.14	< 0.16	-	< 0.14	< 0.15	< 0.16	-	< 0.15	< 0.18	-
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.57**	-	< 0.03	< 0.04	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.9**	-	< 0.03	< 0.04	-
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	-	NC	NC	**0.56**	-	NC	NC	-
TPH																	
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	< 9	< 9	-	< 10	-	< 11	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	< 20	< 20	-	< 20	-	< 30	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	< 40	< 40	-	< 40	-	< 50	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data								
	Human Health		Environmental	Disposal										
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		BH16	HA26	HA26	HA26	BH17	BH17	HA27	HA27	HA27
Depth (m bgl)						0.1	Surface	0.5	1.5	0.1	1.5	Surface	0.5	1.5
Description						Topsoil	Topsoil	Natural	Natural	Topsoil	Natural	Topsoil	Natural	Natural
Lab number						1357766.1	1366780.34	1366780.35	1366780.37	1364826.1	1364826.4	1366780.39	1366780.4	1366780.42
Date Sampled						27-Nov-14	15-Dec-14	15-Dec-14	15-Dec-14	12-Dec-14	12-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14
Metals and Metaloids (totals)														
Arsenic	70	80	100	12	38	3	3	< 2	< 2	< 2	< 2	4	3	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	< 0.10
Chromium	6,300	2,700	400	55	31	17	9	5	10	5	8	-	-	15
Copper	>10,000 [3]	>10,000 [3]	325	45	66	21	10	4	6	4	3	12	3	4
Lead	3300	880	250	65	71	13	9.8	21	7.1	5.6	4.3	11.3	4.2	5
Nickel	6,000 [3]	600 [3]	320	35	79	10	6	< 2	5	< 2	< 2	-	-	< 2
Zinc	400,000 [3]	14,000 [3]	1160	180	139	35	49	18	20	7	< 4	-	-	6
Organochlorine Pesticides Screening in Soil														
Aldrin				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	-	< 0.04	< 0.04	-
2,4'-DDD				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDD				< LOR	0.014	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
2,4'-DDE				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDE				< LOR	0.182	-	< 0.005	**0.03**	-	< 0.010	-	**0.078**	< 0.010	-
2,4'-DDT				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDT				< LOR	0.038	-	< 0.005	< 0.005	-	< 0.010	-	**0.038**	< 0.010	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	< 0.03	< 0.03	-	NC	-	**0.116**	NC	-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	-	**0.122**	< 0.010	-
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons														
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	**0.03**	-	-	< 0.03	-	< 0.04	-	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Fluoranthene	-		-	< LOR	1.31	< 0.03	**0.05**	-	-	< 0.03	-	< 0.04	-	-
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.15	< 0.16	-	-	< 0.13	-	< 0.16	-	-
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	**0.04**	-	-	< 0.03	-	< 0.04	-	-
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	-	-	NC	-	NC	-	-
TPH														
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

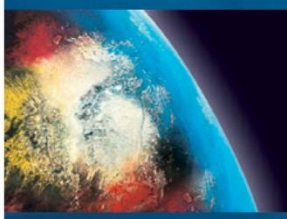
< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria



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ENVIRONMENTAL AND ENGINEERING CONSULTANTS

REPORT

Northern Interceptor - Phase 1

Ground Contamination Site Management Plan

Prepared for:

Watercare Services Limited

June 2015

Job No: 28773.34.v3

Tonkin & Taylor

ENVIRONMENTAL AND ENGINEERING CONSULTANTS

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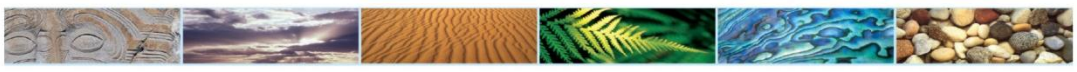

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Report Date	Version	Prepared by:
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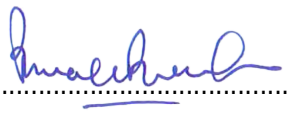
Report certified by a suitably qualified and experienced practitioner as prescribed under the NES (Soil).



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Senior Environmental Engineer

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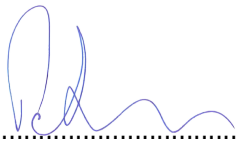

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Peter Roan

Project Director

CRSS

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Table of contents

Appendix A : Figures

Appendix B : Contractor Checklist

Appendix C : Soil testing information

Appendix D : MfE cleanfill guidelines – acceptable materials

Table of terms and abbreviations

Abbreviation	Definition
AC	Auckland Council
ACM	Asbestos containing material
AEE	Assessment of Effects on the Environment
ALW Plan	Auckland Council Regional Plan: Air, Land and Water
B(a)P eq.	Benzo(a)pyrene equivalent
DSI	Detailed Site Investigation
ECBF	East Coast Bays Formation
GIS	Geographic Information System
HAIL	Hazardous Activities and Industries List
HDD	Horizontal directional drilling
HDPE	High Density Polyethylene
MfE	Ministry for the Environment
NES Soil	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health
OCP	Organochlorine pesticides
ONOP	Organonitrogen and organophosphorus pesticides
PA	Permitted activity
PAH	Polycyclic Aromatic Hydrocarbon
PAUP	Proposed Auckland Unitary Plan
PE	Polyethelene
Phase 1	To be completed in 2020, Phase 1 transfers the existing Hobsonville Pump Station flows to Rosedale WWTP through a 600mm ID rising main crossing the Upper Harbour, and through Greenhithe, The North Shore Memorial Park, the North Shore Golf Club and Rosedale Industrial areas. The majority of the construction will be open trenched.
PSI	Preliminary Site Investigation
RMA	Resource Management Act 1991
SMP	Site Management Plan / Remedial Action Plan
TPH	Total Petroleum Hydrocarbon
T&T	Tonkin & Taylor Ltd
WWTP	Wastewater Treatment Plant
UCL	Upper confidence limit

1 Introduction

Tonkin & Taylor Ltd (T&T) has been commissioned Watercare Services Limited (Watercare) to prepare this Ground Contamination Site Management Plan (SMP) for earthworks associated with the Northern Interceptor Phase 1 project. The proposed alignment (referred to in this document as the site, shown on Figure 1 provided in Appendix A) runs from the Hobsonville Pump Station through to the Rosedale Waste Water Treatment Plant (WWTP)

The proposed work requires various resource consents under the Resource Management Act 1991 ("RMA"). This technical report provides specialist input relating to ground contamination for the Northern Interceptor Phase 1 – Assessment of Effects on the Environment report ("the main AEE") prepared by MWH New Zealand Limited, which supports the resource consent application.

1.1 Background

The proposed Northern Interceptor Phase 1 (refer Figure 1) will transfer existing flows from the Hobsonville Pump Station to the Rosedale WWTP. The proposed route is from the existing Hobsonville Pump Station, under the State Highway 18 motorway, along the northern side of the motorway causeway, and then under the Upper Waitemata Harbour, through Greenhithe and then the commercial area of Rosedale.

Key elements of the project include:

- Upgrading of the existing Hobsonville Pump Station;
- Micro-tunnelling under the State Highway 18 Motorway at Hobsonville;
- Installation of dual pipelines across the Upper Waitemata Harbour to Greenhithe via marine trenching or horizontal directional drilling ("HDD");
- Installation of pipelines under Lucas Creek via HDD;
- Construction of a pipe bridge between Witton Place and North Shore Golf Course, and across streams at Wainoni Park;
- Trench construction for pipeline installation in roads, open space and other land; and
- Associated infrastructure including chambers, air valves and scour valves, connections to existing infrastructure and air treatment facilities.

The Phase 1 works will require significant earthworks. T&T has undertaken a ground contamination investigation of the alignment[1]. The investigations, comprising a site historical review and soil testing at selected locations along the alignment, were undertaken to confirm if the proposed works would encounter contamination. Soil testing indicates that relatively short sections of the alignment contain levels of metals, organochlorine pesticides (OCPs) or hydrocarbons above published background concentrations but below the NES Soil[2] standards. In one section of the alignment (Wainoni Park), existing testing information indicates that near surface soils could contain DDT concentrations above the Auckland Regional Plan: Air Land and Water (ALW Plan)/Proposed Auckland Unitary Plan (PAUP) criteria for discharges. Further ground contamination testing is currently underway in Wainoni Park (to be reported separately when results become available).

The results and potential implications of the investigations undertaken to date are discussed in detail in Section 3.5 below.

[1] T&T 2015, *Ground contamination assessment, Northern Interceptor Phase 1;* prepared for Watercare
[2] National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health Regulations 2011

1.2 Scope of the report

This SMP sets out ground contamination related procedures for the Northern Interceptor Phase 1 earthworks, based on current knowledge of conditions that are likely to be encountered along the alignment, for:

- Establishing site and associated management structures/systems;
- Works procedures and responsibilities for the contactor and the contaminated land specialist;
- Health and safety requirements to augment the nominated Contractor's health and safety plans; and
- Requirements to verify the works.

1.3 Regulatory compliance

This report has been prepared in general accordance with Ministry for the Environment (MfE) Contamination Land Management Guidelines No.1 – *Guidelines for Consultants Reporting on Contaminated Sites in New Zealand*. Sampling procedures provided in the plan generally comply with the MfE Contamination Land Management Guidelines No.5 – *Site Investigation and Analysis of Soils*.

The plan meets the requirements of a SMP under the NES Soil. The persons preparing and certifying this SMP are suitably qualified and experienced practitioners as required by the NES Soil and defined in the NES Soil Users' Guide (April 2012).

Council approvals will be required to carry out the proposed works. This version has been prepared to support applications for those approvals. Additional Council requirements may need to be incorporated in this SMP when those approvals are obtained.

1.4 Applicability

This SMP provides a framework for managing contamination hazards onsite by identifying potential hazards and suggesting mitigation measures relevant to site conditions at the time of writing. This SMP provides information and recommendations to augment this process but is not intended to relieve the controller of the place of work of either their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment.

The provisions of this SMP are mandatory for all persons (employees, contractor and sub-contractors) who will be involved in undertaking any of the proposed ground disturbance works.

It is recommended that any persons undertaking the works develop a site-specific health and safety plan (SSHSP) to complement this SMP and to address other health and safety requirements that may be applicable to their particular works. This document should also be modified to address any specific health, safety or environmental issues that may arise during the works.

From time to time, statutory requirements, site ownership or occupation, operating procedures or site conditions may vary and will require that this plan be amended or updated.

This report has been prepared for the benefit of the Watercare Services Ltd with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

2 Roles and responsibilities

2.1 Distribution

A copy of the SMP shall be kept onsite at all times. It is Watercare's responsibility to distribute the most up to date plan to the Contractor, including Auckland Council.

It is the Contractor's responsibility to distribute the SMP to any other sub-contractors or parties carrying out the earthworks.

2.2 Implementation

Responsibility for the implementation of the SMP lies with Watercare. Watercare may delegate this responsibility to an appropriate on-site project manager/representative. Watercare will appoint a Contractor/s to carry out the earthworks and implement the procedures detailed in this document. The term "Contractor" used in this SMP refers to Watercare until such time as the Contractor is appointed by Watercare.

Watercare shall engage contaminated land specialist staff to carry out inspections, provide advice and carry out any sampling and testing as required during the works (refer Sections 5.4, 5.7 and 6.3). The contaminated land specialist staff shall be sufficiently experienced to comply with the "suitably experienced practitioner" as required by the NES Soil Regulation (2011).

2.3 Review and update

A review of the SMP shall be undertaken prior to commencing works. The review will be undertaken to confirm if the procedures in this SMP are relevant and/or requires updating.

Any variations to the SMP by the Contractor must be approved by the contaminated land specialist and Watercare.

It is the responsibility of the Watercare or the nominated Contractor to distribute any changes to the plan to the relevant parties involved in the works and to update the site copy.

2.4 Personnel contact details

The following are contact details for key staff involved in the earthworks and ground improvement at the site. These contact details shall also be provided on the site hazard board as per Sections 5 and 7.

Person/ organisation	Role	Contact number
TBA	Watercare/ Watercare nominated Project Manager	TBA
TBA	Contractor Site Manager	TBA
TBA	Contaminated Land Specialist	TBA
TBA	Auckland Council Earthworks and Contaminated Land, Natural Resources and Specialist Input, Auckland Council	301 0101

3 Site Condition

3.1 Location

The alignment extends from the Hobsonville Pump Station to the Rosedale WWTP located on the western and northern sides of the Auckland Isthmus respectively, as shown on Figure 1 in Appendix A.

The alignment generally takes a path within road reserves, with a number of relatively large sections through parkland. The following summarises significant sections of the alignment that are not within road reserves:

- Crosses the harbour between Hobsonville and Greenhithe;
- Within Wainoni Park;
- Crosses Te Wharau Creek between Wainoni Park and Memorial Park;
- Within Memorial and Rosedale Parks; and
- Within the North Shore Golf Club.
- Private land between Albany Highway and William Pickering Drive

3.2 Surrounding land use

The land use surrounding the alignment is variable, a summary provided below:

- Hobsonville section (refer Figure 3) – the land use adjacent to the alignment is the Upper-Harbour Motorway to the south and appears to be a lifestyle farm to the north.
- Greenhithe (refer Figures 4-5) – Surrounding land use is largely low density residential with the exception of Wainoni Park.
- Schnapper Rock (refer Figure 6) – The alignment passes through the Memorial Park, the North Shore Golf Club and minor low density residential development.
- Rosedale (refer Figures 7-8) – Land use consists the North Shore Golf Course and commercial/industrial use associated with the Rosedale industrial area.

3.2.1 Site geological information

The published geology beneath the alignment is described by Edbrooke (2001) as generally consisting Puketoka Formation and East Coast Bays Formation (ECBF). The alignment overlain on a map of the published geology is provided as Figure 2 in Appendix A.

The soil profile and hydrogeological information obtained from the geotechnical investigation conducted concurrently with this ground contamination investigation show the following:

- Fill material was generally encountered underlying topsoil to a depth of up to 2 m in many of the hand auger and machine boreholes on the alignment. This material typically comprised re-worked soft to stiff, clay/silt mixtures derived from natural Tauranga Group or ECBF soils. The fill material is often underlain by a thin layer of buried topsoil at the contact with natural underlying material.
- Locally around the Hobsonville Pump Station (BH01), fill was encountered to depths of up to 3 m and comprises a mixture of construction debris (concrete, steel, timber) and silt/clay soils.
- Natural Tauranga group or East Cost Bays Formation (ECBF) soils were encountered below topsoil or fill material.

Table 3.1 below summarises the geology encountered during geotechnical investigations along the alignment.

Table 3.1: Summary of site geological information

Depth below ground level to top of layer (m)	Unit thickness (m)	Geological unit	Description
0	0.2m	Topsoil	Dark brown organic silt
0.2m	0 - 1.6m	Fill	Re-worked soft to stiff, clay/silt mixtures derived from natural Tauranga Group or ECBF soils
Were present – directly underlying fill material	0 - 0.2m	Buried topsoil	Dark brown organic silt
0.2 – 1.8	> 2m	Natural soil (ECBF or Tauranga Group)	Silts and sands

3.3 Hydrogeology and hydrology

Groundwater depth within the alignment tends to be generally within a few metres of the ground surface in the alluvial sediments. Groundwater flow direction generally follows the surface topography and discharges to the nearest surface water body.

The alignment is located in various surface water catchments that generally discharge into the Upper Waitemata Harbour.

3.4 Potential contamination sources

Based on the site history review, potential HAIL activities identified on the land of the proposed alignment were:

- Use of persistent pesticides at former and existing horticultural land and sports turfs; and
- Intentional or accidental release of hazardous substances which could migrate onto the land from:
  - Discharges of sludge into land down-gradient (east) of the former NZDF WWTP;
  - a former air strip near Hobsonville;
  - former and existing horticultural activities;
  - electric equipment storage facility in Rosedale; and
- Intentional or accidental release of hazardous substances as a result of placement of contaminated fill during construction of roads along the alignment.

3.5 Contamination condition

Targeted soil and sediment analysis was undertaken along the alignment for metals, PAH, OCPs, organonitrogen pesticides (ONOPs) and total petroleum hydrocarbons (TPHs). Analytical results of the soil samples indicated no exceedances of the NES Soil commercial or recreational landuse SCS. Sampling locations and results are provided in Appendix A and C respectively.

Key findings are discussed below:

- Analytical results of soil samples collected along the alignment indicated no exceedances of the NES Soil commercial or recreational landuse SCS. In only 1 section of the alignment (Wainoni Park), available soil testing information indicated that contaminant

concentrations above the ALW Plan/PAUP criteria for discharges could be present. Further soil testing is currently underway to confirm the actual contaminant levels along the alignment within Wainoni Park. Results from these investigations will be incorporated into this SMP once finalised;

- The investigations indicated that contaminant levels were largely below published background concentrations. However, in sections of the alignment, contaminants slightly above published background concentrations have been identified in the near surface soils (less than 1 m depth).
- Sediment samples collected from the proposed alignment of the Upper Waitemata Harbour Crossing indicated that it could contain arsenic concentrations above the anticipated published background concentrations which has been adopted by Auckland Council as the default cleanfill criteria. This means that any sediment, if it requires disposal at a landfill (unlikely), may not be able to be disposed to cleanfill.
- Due to a change in the alignment, no soil testing data are available for the John Glen Avenue section of the alignment (refer Figure 7, Area 3). Concentrations are likely to be similar to handaugers south of the alignment (HA22, HA24 and HA25). Soil investigations are proposed in this area during construction work to confirm that soil disposal locations prior to commencing work within this section of the alignment.

An assessment of effects of the proposed works based on the results of the testing is shown on the conceptual site model below.

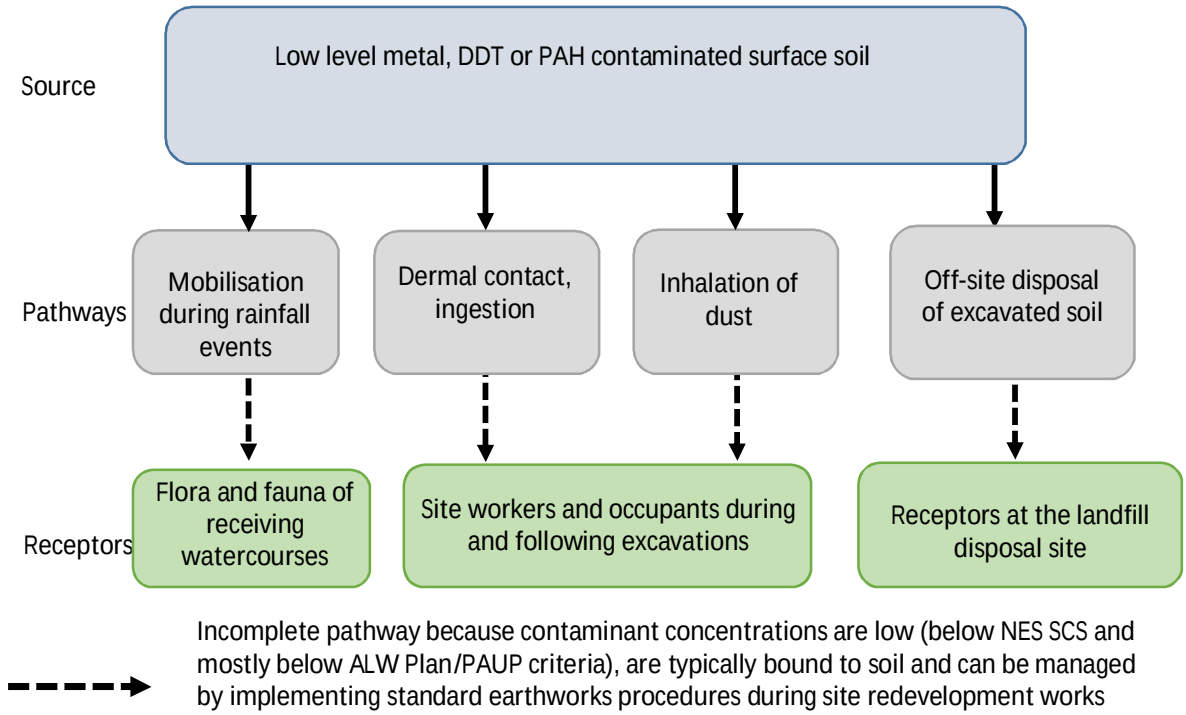


Diagram 1: Site conceptual Model

The results of the testing indicate that contaminant concentrations are not at levels that would pose a human health risk to construction workers and the general public. However, the presence of low level contamination in near surface soils has implications for the work as set out in this document.

4 Proposed Works

Earthworks are required to install the pipeline along the route. The proposed works are described in detail in the main AEE. Key drawings showing the proposed works and construction methodology are copied in Appendix A of this document.

Watercare intends to carry out the development works based on the following principles with respect to ground contamination:

- Limit discharges from the site during and following the proposed earthworks; and
- Ensure appropriate protection of on-site workers and the general public in the vicinity of the site when undertaking earthworks on the site

It is envisaged that the works will generally follow the steps outlined below:

- Provide site establishment facilities;
- Carry out earthworks following procedures outlined in the following sections of this SMP;
- Install the pipeline;
- Backfill the trench with on-site excavated material where possible and/or quarry sourced hardfill; and
- Reinstate surface to pre-earthworks condition (paved if in road carriageway or top-soiled and grassed if within parkland).

The construction method for works relating to the installation of pipelines within the Upper Waitemata Harbour Crossing has not yet been confirmed. The methodology could include HDD or marine trenching and may or may not require disposal of spoil.

5 Site management procedures

Procedures to manage the effects of soil disturbance are provided in this section of the plan.

A Contractor's check list is attached in Appendix B.

5.1 Preparatory works

The Contractor shall ensure the appropriate disposal permits, approvals for discharging accumulated water and contaminated land specialist engagements are in place prior to works commencement.

5.2 Establishment

The contractor shall emplace a number of structures to aid in the management of aspects of safety and environmental compliance. These include the following:

- Security fencing to prevent unauthorised access by non-project workers to the site;
- Signage, including site works information, key staff contact details and health and safety requirements;
- Health and safety facilities such as personal protection equipment (PPE) stores and first aid points;
- An environmental health and safety officer (HSO) shall be appointed by the Contractor for the duration of the works so that there is a person responsible for ensuring the contaminated land-related health and safety procedures are adhered to, alongside of those required under the Contractor Health and Safety Plan; and
- Erosion and sediment control measures.

All relevant staff shall be required to undergo a contaminated land safety induction before commencing work so that all workers are aware of the procedures in this SMP. The induction is required to make sure the worker is aware of the hazards related to the contaminated soil that is likely to be encountered in the area of work, what to look for when carrying out soil disturbance works, safe working procedures, safety equipment and requirements, and the action plan in case of an emergency.

5.3 Excavation and transportation procedure

Earthworks will typically be carried out using an excavator. Excavated material will generally be loaded to trucks alongside the excavation and removed from the working area.

The following shall be adhered to during excavation and transportation of excavated soils:

- Project-relevant earthworks controls shall be in place during excavation per Section 6;
- For any contaminated materials that require offsite disposal, a permit shall be obtained by the Contractor from the disposal destination prior to transportation and approval gained from the contaminated land specialist;
- Material will generally be loaded by the Contractor directly onto trucks to prevent contamination of areas where no contamination exists;
- Trucks shall be loaded within the site where runoff and possible spills during loading shall be controlled and contained;
- Trucks shall have their wheels either swept down or washed before they leave work area and there shall be no tracking of material onto public roads or footpaths.

- Each truck shall have a tracking document signed out onsite and collected at the landfill to track each load of material. For materials being disposed to cleanfill or managed fill, tracking with respect to load volumes shall be sufficient;
- Trucks shall have their loads covered by tarpaulins during transport of material to landfill; and
- Weighbridge dockets, if applicable, shall be retained by the Contractor and provided to the contaminated land specialist.

5.4 Disposal procedures

Where possible, excavated material will be re-used on site.

If off-site disposal is required, then the Contractor shall follow the disposal procedures outlined in Table 5.1 below. Locations of Areas 1 – 5 are shown on Figure 3 – 8 in Appendix A.

Table 5.1: Disposal procedures for excavated materials

Material Characteristics	Testing requirements	Possible Off-site Disposal Destination
Asphalt and Concrete: Surface coverings across the site	Nil*	Cleanfill, subject to approval by the operator
<u>All soil to be disposed from Area 1:</u> Topsoil, fill material or natural underlying soils	Nil*	Landfill or Managed fill
<u>Top 0.5m depth of soil within Areas 2 - 4</u>: Topsoil or fill material	Nil* Metals, PAH and OCPs	Landfill or Managed fill Cleanfill subject to further testing
<u>Below 0.5 m depth within Areas 2 - 4:</u> Natural underlying soils	Nil*	Cleanfill
<u>Fill within Area 5 up to 1 m depth:</u> Topsoil and silty clay fill material	Nil* Metals, PAH and OCPs	Landfill or Managed fill Cleanfill subject to further testing
<u>Below 1 m depth and natural soils in Area 5:</u> Orange brown clayey silt	Nil*	Cleanfill, subject to approval by the operator
<u>All soils from outside areas 1-5:</u> Topsoil Fill material (reworked ECBF) Natural underlying soils	Nil*	Cleanfill, subject to approval by the operator
<u>Upper Waitemata Harbour Crossing Sediment:</u> Marine sediment	Nil* Metals and OCPs	Landfill or Managed fill Cleanfill subject to further testing

Material Characteristics	Testing requirements	Possible Off-site Disposal Destination
Clean hardfill: Quarry rock and gravels containing minimal fines and less than 5% deleterious materials (concrete, brick, etc.)	Nil*	Cleanfill
Odorous or unsuitable materials These may include materials more heavily contaminated than expected, or materials associated with underground structures that held contaminants.	To be advised by contaminated land consultant	Landfill: (e.g. Hampton Downs or Redvale)
* subject to approval by the receiving facility following review of the data from T&T March 2015 *Ground contamination assessment Northern Interceptor - Phase 1*, Ref. 28773.340 or additional testing if requested		

The Contractor shall obtain the necessary permits from the disposal destination prior to transportation. Weighbridge dockets and/or a summary sheet from the landfill shall be retained by the Contractor and provided to the contaminated land specialist for inclusion in the Works Verification Report (refer Section 9).

Material testing if required to determine suitability of the natural soils for disposal to cleanfill shall be undertaken by a contaminated land specialist according to the procedure and testing programme provided in Section 5.7.

5.5 Imported material procedures

Hardfill imported for backfill, if sourced directly from a quarry or supplier, does not require testing.

Imported soil is unlikely to be required for this project. In the event that soil is required to be imported, it shall be sampled by a contaminated land specialist at a rate of 1 sample for every 500 m^3 and tested for metals and PAH. Depending on the land use at the material's source, testing for OCPs and asbestos content may also be required. It is preferable that the fill is tested at its source prior to its use at the site. However, if not, then the Contractor shall stockpile the fill on site until test results are available.

The imported soil shall have concentrations below the acceptance criteria provided in Table 5.2.

Table 5.2: Imported soil criteria

Contaminant	Imported fill acceptance criteria (mg/kg)[1]
Arsenic	12
Cadmium	0.65
Chromium	125
Copper	90
Nickel	320
Lead	65
Zinc	1160
All other contaminants	Below laboratory detection limit
Notes: [1] Background concentrations for volcanic soils as published in Auckland Regional Council Technical Publication 153	

5.6 Surface water and groundwater procedure

Stormwater runoff from up gradient of the site shall be diverted away from excavations. Groundwater may be encountered during earthworks, but is unlikely to be contaminated based on the type of contaminating activities which have been identified along the alignment and the depth to groundwater. Any water that requires dewatering within the Wainoni Park section of works (Area 2 in Figure 5) should be tested to ensure compliance with Table 5.3. The testing shall not be required if further investigation show that the contaminants are confined to near surface soils (above water table).

If visual evidence of contamination (e.g. sheen and/or odorous) is encountered during the works in any portion of the alignment, then the water shall not be allowed to be disposed to stormwater. The water shall be allowed to infiltrate into the ground or be pumped out to a sewer. If disposal of this water to stormwater is required, then confirmatory testing shall be undertaken to show that it meets the criteria set out in Table 5.3 below.

Table 5.3: Stormwater disposal acceptance criteria

Parameter	Water concentration [1] (mg/L)
Arsenic	0.013
Cadmium	0.0002
Chromium	0.001
Copper	0.0014
Nickel	0.011
Lead	0.0034
Zinc	0.008
Hydrocarbons	No sheen
Notes: [1] Guideline for the protection of freshwater species, 95% trigger level from *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, ANZECC, 2000	

5.7 Soil testing procedure

Validation testing of the excavation trench is not proposed.

As discussed in Section 5.4, additional testing of excavated soils for disposal purposes and/or imported soil and/or unexpected contamination may be required over the course of the works. If so, sampling shall be undertaken in accordance with the procedures below.

5.7.1 Soil sampling methodology

All soil sampling shall be undertaken by the contaminated land specialist according to the requirements of the NES Soil and the MfE Contaminated Land Management Guidelines No.5[3]. Soil samples shall be collected according to the following procedure:

- The materials encountered shall be described in accordance with the NZ Geotechnical Society "Guidelines for the classification and field description of soils and rocks for engineering purposes";
- Freshly gloved hands shall be used to collect soil samples and shall be placed immediately into 300ml glass jars;

[3] MfE, revised 2011: Contaminated Land Management Guideline No. 5 – *Site Investigation and Sampling*.

- Any equipment used to collect the samples shall be decontaminated between sample locations using clean water and Decon 90 (a phosphate-free detergent) rinses; and
- Samples shall be shipped in chilled container to an IANZ certified laboratory under chain of custody documentation.

5.7.2 Laboratory testing requirements

Testing scheduling will be based on known HAIL activities identified along the alignment during the T&T 2015 Ground Contamination Assessment, which may include metals, PAH, TPH, ONOPs or OCPs.

Any evidence of the presence of asbestos or volatile organics (solvents and petroleum fuel) shall trigger testing for asbestos content or VOCs in soil, respectively. The contaminated land specialist shall identify additional analytes on the basis of visual and olfactory observations.

5.7.3 Reporting and data evaluation

The contaminated land specialist shall report the results of any testing to Watercare and Auckland Council. The results will be evaluated with respect to published background concentrations for volcanic soils in Auckland[4] to establish if the material is suitable for disposal to cleanfill and/or other relevant landfill acceptance criteria.

[4] Auckland Regional Council Technical Publication 153 – *Background concentrations of Inorganic Elements in Soils from the Auckland Region*

6 Earthworks controls

The earthworks contractor shall carry out regular inspections of the earthwork areas for:

- Sediment control and compliance with this plan;
- Water accumulation;
- Dust generation; and
- Evidence of olfactory and/or visual contamination (refer Section 8).

Earthworks shall be undertaken in accordance with the following controls.

6.1 Dust control

From a human health perspective, there will be some situations (e.g. during excavation, truck loading, stockpiling and containment) where generated dust may have the potential to contain contamination. If not suppressed during windy conditions or during vehicular movement over contaminated soil, discharge of airborne contaminants may occur.

To avoid dust generation, should dry conditions prevail, and to mitigate against dust generation associated with vehicular movement, the following control and monitoring systems shall be put in place by the Contractor:

- Frequent spraying of water over the excavation and truck loading area to ensure the working surfaces remain damp;
- Wetting of the loaded material once placed on the truck;
- Use of a water truck or portable water sprays in trafficked areas to dampen dust;
- Stockpiling of material shall be avoided. However, if required, stockpiles shall be either dampened during formation and/or covered with polythene.

When using water to control dust, the Contractor shall ensure that:

- The volume of water used for dust suppression does not exceed soil field capacity of the wetted areas;
- The application does not cause surface runoff that would discharge into natural water bodies; and
- The application of water does not induce soil erosion or soil pugging.

6.2 Erosion and sediment control

Erosion and sediment control during construction shall be in accordance with the Auckland Council Technical Publication 90 (TP90) "*Erosion and sediment control guidelines for land disturbing activities in the Auckland Region*". Erosion and sediment control measures shall include:

- Avoid work in heavy rain;
- Keeping the site clean;
- Containing all runoff and entrained sediment during rainfall events within the excavation by utilising silt fences and runoff diversion bunds;
- Stockpiles are generally avoided, however where they are required they shall be covered if left overnight. Any stockpiles will not be placed in an area where runoff cannot be controlled;
- Limiting the duration of exposure of contaminated ground as much as possible;

- If disposal of surface water or groundwater is required refer to procedures in Section 5.6;
- Excavations will be backfilled as soon as practicable; and
- A stabilised entry/exit point, shall be established so sediment is not tracked on and off the site. This will be made of aggregate and will be removed off site once work has been completed.

To ensure good practice:

- The entry/exit point shall be reapplied with aggregate if excessive sediment build up occurs.
- Erosion and sediment control measures shall be upgraded/ modified where necessary. Sediment fences shall be replaced if the fabric is ripped or otherwise damaged. Fences shall be retrenched if needed.
- The weather conditions along with the performance of the erosion and sediment control measures shall be monitored by the Site Manager.

Erosion and sediment control measures shall remain in place until surface reinstatement and, where used, vegetated cover is established.

6.3 Odour and volatile contaminant controls

Odorous and volatile organic components are unlikely to be encountered during site works. However, if such material is encountered, the following procedures shall be followed by the contractor to minimise effects on site and surrounding workers:

- All work in the immediate vicinity of odorous material shall cease and the exposed material shall be covered, for example with tarpaulin, polyethylene sheeting or a layer of clean soil to prevent further discharge of odour. The Contractor shall then seek advice from the contaminated land specialist.
- The contaminated land specialist shall assess the potential for volatile compounds and advise on health and safety requirements. Assessment of volatility may include use of a Photoionization Detector (PID) and soil sampling and testing;
- Wind conditions shall be assessed and if necessary work shall cease until conditions are more favourable for minimising discharge of odour;
- A mitigation system, for example odour suppression backpack/spray, shall be established if natural dispersion is not adequate; and
- Health & safety procedures as set out in Section 7 shall be employed.

7 Health & Safety Procedures

These procedures have been developed to provide a framework for managing contaminated soils that could pose a human health risk. For the purposes of this SMP, soils that exceed the NES Soil SCS for commercial land use are defined as soils that could present a human health risk and would trigger the requirement to follow the health and safety procedures set out in this section of the SMP. As none of the existing soil testing results show contaminant levels above the relevant NES Soil SCS, these procedures would only apply in the event of unexpected contamination discovery.

The protocols set out below are not intended to relieve the owner or controller of the place of work of either their responsibility for the health and safety of their workers, contractors and the public, or their responsibility for protection of the environment. General health & safety procedures based on the requirements of the *Health and Safety in Employment Act*, 1992 shall be covered by the Contractor's Health and Safety Plan. The health and safety procedures described in this section of the SMP shall be implemented by the Contractor when contaminated soils exceeding the NES Soil SCS for commercial land use is encountered, in addition to its own plan.

7.1 Site control

If unexpected contamination is discovered, the following shall be put in place by the contractor:

- The area will be fenced to restrict entry to authorised workers and prevent access by the general public. Appropriate warning signs (e.g. "*Contaminated soils*") shall be erected around the fenced site;
- Any additional health and safety facilities as required by the hazard management procedures, such as wash facilities, personal protection equipment stores and first aid points shall be provided.

7.2 Identification of hazards

Potential pathways of exposure of the contamination during site redevelopment work are as follows:

- Dermal contact with the contaminated soil;
- Inhalation and ingestion of generated dust.

7.3 Identification of new hazards

Due to the nature of the works being undertaken, there is a risk of unspecified further hazards occurring during the course of the works.

The Contractor on site is responsible for reviewing any new work element and assessing whether there are any new associated hazards, and whether these can be eliminated, isolated or minimised. If these hazards are related to ground contamination, the Contractor shall seek advice from the contaminated land specialist. The Contractor shall then instruct all staff on the health and safety procedures associated with the new hazard.

Workers on contaminated sites can be subject to unusual stresses, for example, manual work while wearing dust masks or respirators, or exposure to elevated concentrations of contaminants. It would be prudent to check that staff working on this project do not have any pre-existing health condition which might place them at risk as a result of such stresses.

7.4 Hazard minimisation procedures

The Contractor shall ensure that the procedures and PPE requirements set out below are followed to minimise general site hazards.

7.4.1 Dermal contact with potentially contaminated material

Site workers shall avoid unnecessary contact with contaminated soil or suspected contaminated soil. If required, workers who could come into contact with contaminated soils shall wear disposable chemical resistant gloves, cloth coveralls and eye protection at all times of possible soil contact. The purpose of the coveralls and gloves is to reduce dermal contact during potential contact with contaminated materials.

All workers shall wear suitable footwear that will prevent exposure to contaminated soil/liquids. In some cases this will require gumboots to be worn, especially for those working in excavations were groundwater may be encountered.

To avoid the ingestion of contaminants, all workers shall adhere to the personal hygiene measures outlined in Section 7.4.3.

7.4.2 Inhalation of dust

During dry conditions, it is possible that dust may be generated during earthworks and materials transport. The Contractor shall apply the dust control procedures outlined in Section 6.1 during these situations.

Respiratory protection (P2 dust mask is the minimum protection) shall be worn if materials have been identified where there is a risk that contaminants could be mobilised by dust or asbestos containing materials could be exposed. The Contractor shall ensure that this is assessed daily by the HSO. Half face respirators with asbestos fibre filters shall also be made available for workers where required if deemed necessary by the HSO/ contaminated land specialist.

7.4.3 Personal hygiene

All workers entering this area of the site shall be further briefed on the requirements for personal hygiene. The following shall be observed for all workers and visitors to this area of the site:

- Eating, drinking or smoking is only permitted in the designated clean areas of the site. Eating, drinking and smoking shall only be permitted after thorough washing of hands and face has occurred;
- Fresh protective gloves, dust masks and coveralls shall be used daily; and
- Hand to mouth and hand to face contact shall be avoided onsite.

8 Contingency Measures

8.1 Unexpected Contamination

Unexpected contamination could be encountered during the works. Typical visual and olfactory indicators of contamination include:

- Odour (petroleum hydrocarbons, oil);
- Green/yellow discoloured soil may indicate high levels of copper and chromium;
- Black staining coupled with an odour may indicate heavy oil/hydrocarbon contamination;
- Asbestos-containing materials (ACM), as fragments or free fibre;
- Inclusions of deleterious materials including, but not limited to, those set out in Table 4.1 of the MfE Cleanfill Guidelines (Appendix C)[5].

The following is a "first response" checklist for the Contractor to follow should visual or olfactory evidence of contamination be encountered during the works onsite.

The presence of other contaminants in high levels may dictate further controls be implemented and additional or difference containment/disposal be required. The first response procedures are to ensure contamination is appropriately contained while decisions about its management are being undertaken.

Unexpected Contamination First Response Checklist:	
Stop work in the immediate vicinity of the contamination discovery and isolate the area by taping, coning or fencing off.	☐
Advise the Site Manager (appointed by the nominated contractor) and Watercare.	☐
Implement contaminated soil Health and Safety procedures as per Section 7.	☐
Update the site Hazard Board and prevent access to the area by unnecessary personnel.	☐
If ACM is observed provide P2 dust masks to all staff entering the isolated area.	☐
If odours are present cover the material over with non-odorous soil or hay/straw and lime to prevent nuisance odour.	☐
The Site Manager and/or Watercare must advise the contaminated land specialist to inspect and advise of specific controls if appropriate.	☐
Implement contaminated material handling procedures as directed by the contaminated land specialist.	☐

[5] Ministry for the Environment, 2002: A Guide to Management of Cleanfills.

8.2 Uncontrolled discharge of contaminants

In the event of an uncontrolled discharge of contaminants or contaminated soil or water to the environment, the following shall be implemented.

Uncontrolled Discharge Response Checklist:	
Stop work immediately and take all practical steps to contain the discharge and prevent further discharge.	☐
Advise the Site Manager (appointed by the nominated contractor) and Watercare.	☐
The Site Manager and/or Watercare must advise the contaminated land specialist to inspect and advise of specific controls if appropriate.	☐
Contaminated land specialist shall notify Auckland Council.	☐
A strategy to remedy the situation is to be determined by the contaminated land specialist and Auckland Council, and implemented by Watercare and their nominated contractor.	☐
All details of the discharge (volume, type, location) and procedures taken to remedy the situation are to be recorded and included with the Works Verification Report (refer Section 9) to be submitted to Auckland Council at the completion of works.	☐

9 Works Verification Procedures

Verification/ validation is the process of confirming the objectives of the works have been achieved, confirming works were undertaken according to agreed procedures, and reporting on any incidents.

Verification observations shall be conducted by the contaminated land specialist. A works verification report shall be prepared by the contaminated land specialist on completion of the earthworks and upon receipt of all necessary documentation.

9.1 Information required from the Contractor

In order for the contaminated land specialist to complete the works verification procedure, the Contractor must provide the following to the contaminated land specialist:

- Copies of weigh bridge summaries for the disposal destination for contaminated soil;
- Disposal volumes for materials removed and disposed of to cleanfill;
- Records of visits from contaminated land related council representatives;
- Details of any complaints; and
- Details of any contaminated land related health & safety incidents and how they were resolved.

The Contractor shall provide the required information within 1 month of completion of the earthworks.

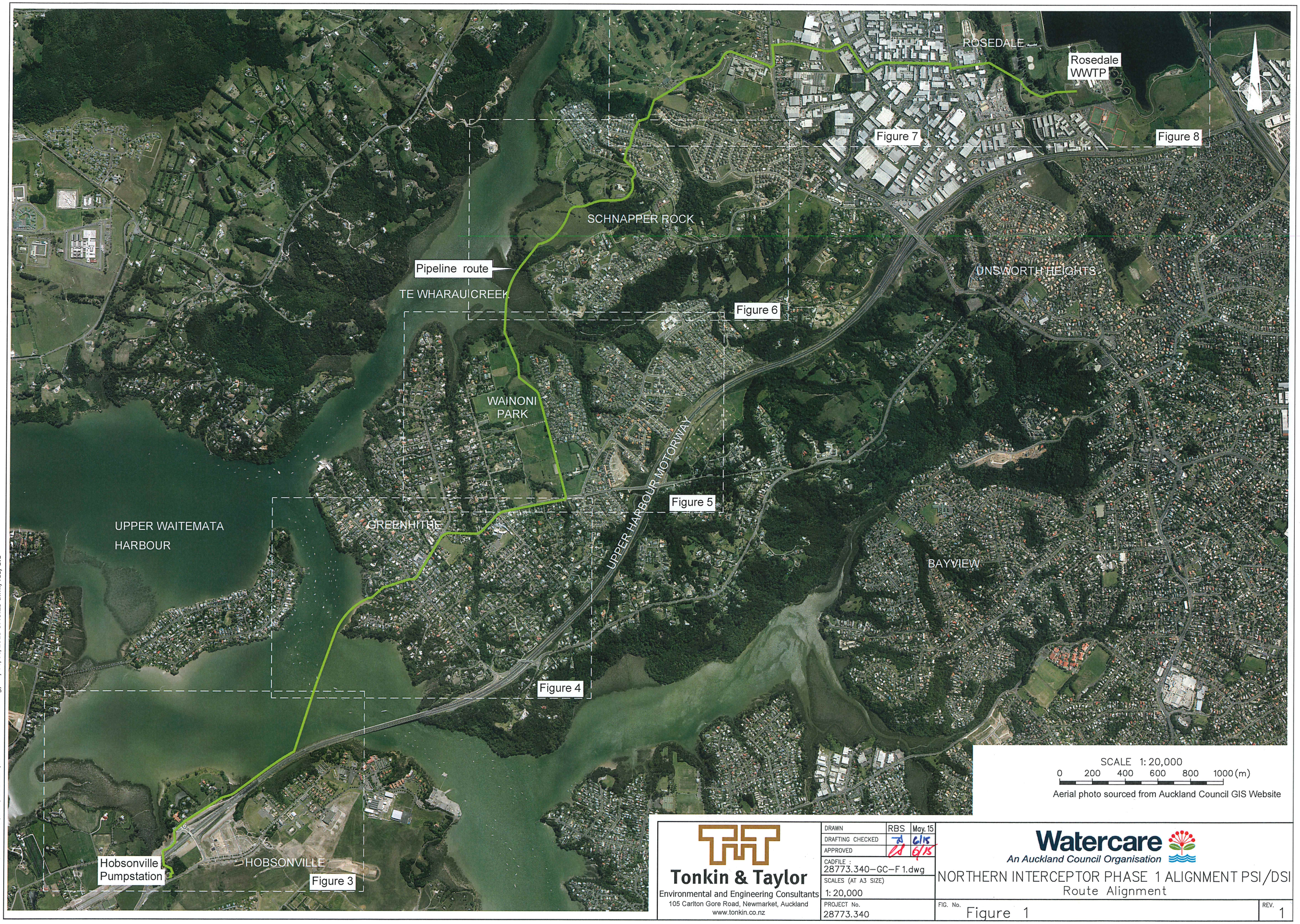
9.2 Reporting

A works verification report shall be prepared and submitted to Auckland Council for approval within 3 months of completion of the excavation works. The report shall document variations from the strategies outlined in this SMP and the reasons why variations were necessary. The report shall also include, as a minimum:

- A summary of information from the contractor, as detailed in Section 9.1;
- Volumes of soil removed from the site and associated chemical test results and waste disposal acceptance receipts;
- Details of any variations to the management plan; and
- Results of soil and water samples.

The report shall be submitted to the Auckland Council and shall comply with the Ministry for the Environment *Guidelines for Reporting on Contaminated Sites in New Zealand* (June 2001).

Appendix A: Figures



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Watercare
An Auckland Council Organisation

NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Route Alignment

FIG. No. Figure 1

REV. 1

Pipeline route

LEGEND

Symbol	Description
hf	Construction Fill
ht	Tauranga Group: Stream Alluvium
tp	Tauranga Group: Pumiceous Deposits (Alluvium)
re	East Coast Bays Formation: Alternating muddy Sandstone and Mudstone
rr	Paremoremo Formation: Mudstone and graded Sandstone

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Geological map sourced from Institute of Geological and Nuclear Sciences (Crown Copyright Reserved)

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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Route Geology

FIG. No. Figure 2

REV. 0

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UPPER WAITEMATA HARBOUR

UPPER HARBOUR MOTORWAY

BUCKLEY AVENUE

HOBSONVILLE

A10
Former Horticultural

F1
Airstrip

HA-3

HA-2

BH-2

BH-1

HA-1

Area 1

G6 - Former NZDF Sludge Disposal bed and WWTP

Watercare Pump Station

1

2

3

N

LEGEND

BH-1	Borehole location (T&T, Dec. 2014)
HA-1	Handauger location (T&T, Dec. 2014)
1	Sediment sample location
	Minor surface contamination Refer Section 7.3 of PSI/DSI Report.
G6	MfE HAIL ID reference

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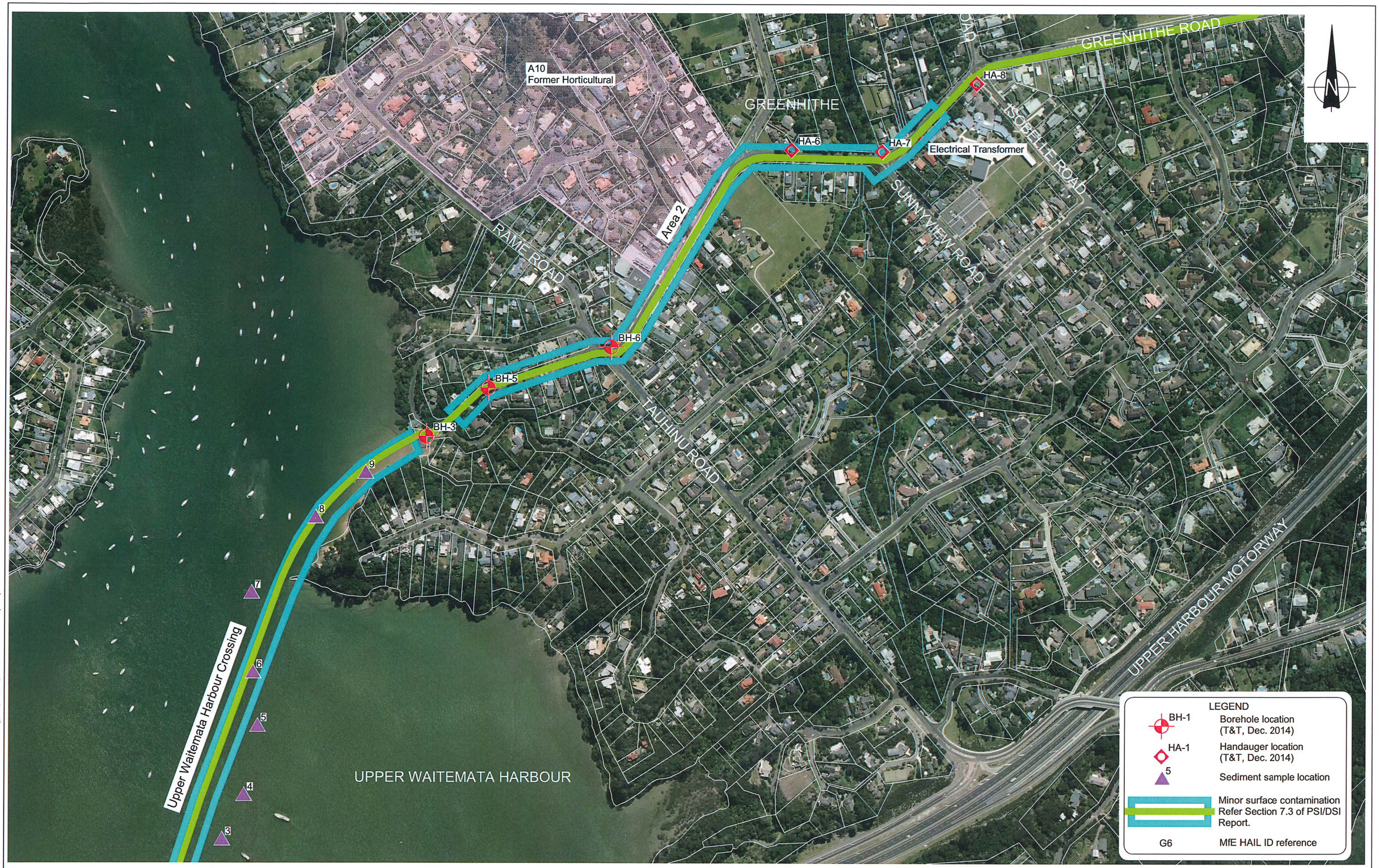
NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Hobsonville

FIG. No. Figure 3

REV. 2



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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI

Potential HAIL Activities – Greenhithe

FIG. No. Figure 4

REV. 1

TE WHARAU CREEK

A10
FormerHorticultural

Discharge Consent
(Residual DDT)

Area 3

A10
Sports Turf

Wainoni Park

GREENHITHE

ROLAND ROAD

CHURCHOUSE ROAD

GREENHITHE ROAD

UPPER HARBOUR MOTORWAY

N

LEGEND

BH-1	Borehole location (T&T, Dec. 2014)
HA-1	Handauger location (T&T, Dec. 2014)
	Minor surface contamination Refer Section 7.3 of PSI/DSI Report.
G6	MfE HAIL ID reference

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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Greenhithe–Schnapper Rock

FIG. No. Figure 5

REV. 1

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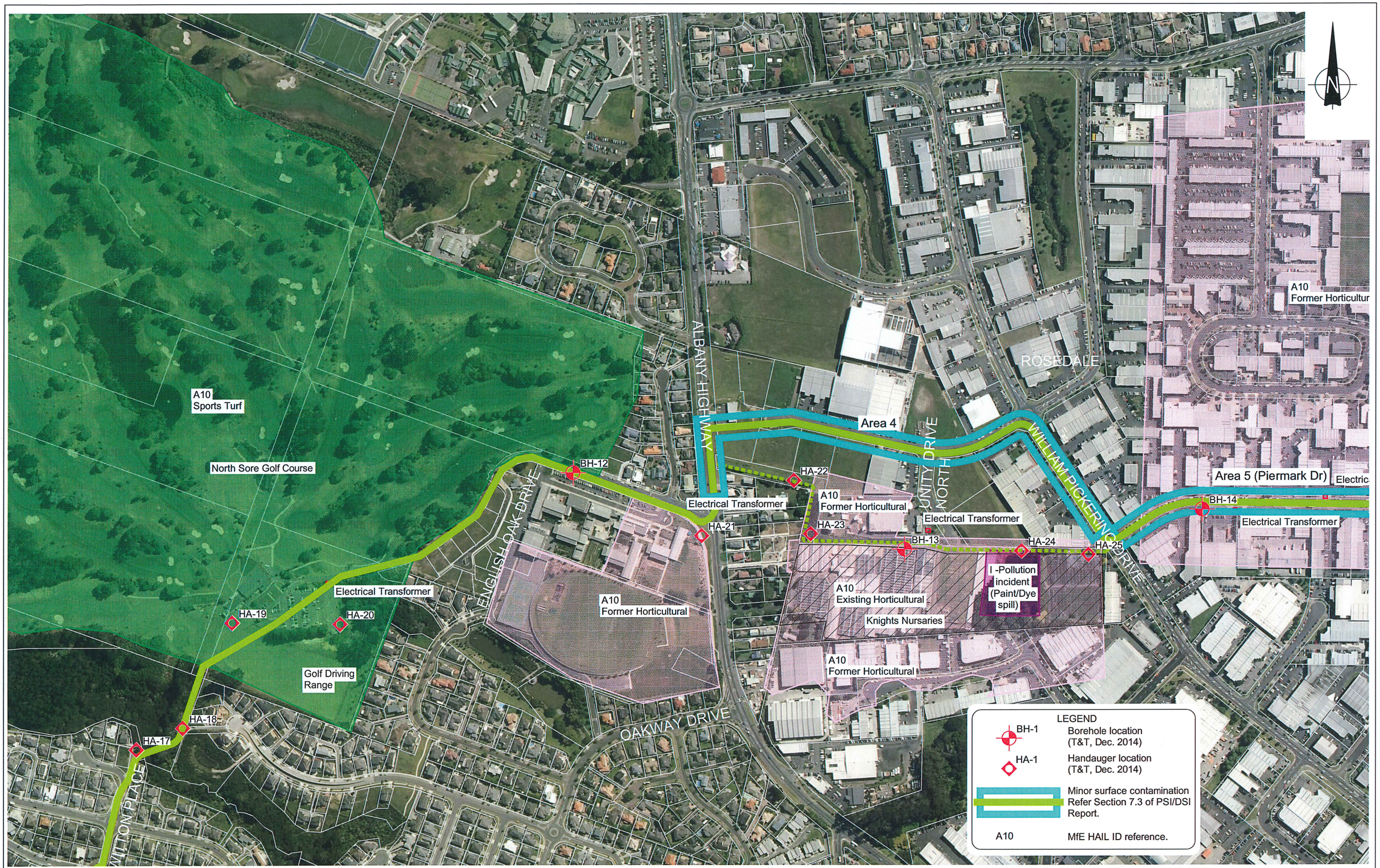
NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI

Potential HAIL Activities – Schnapper Rock

FIG. No. Figure 6

REV. 1



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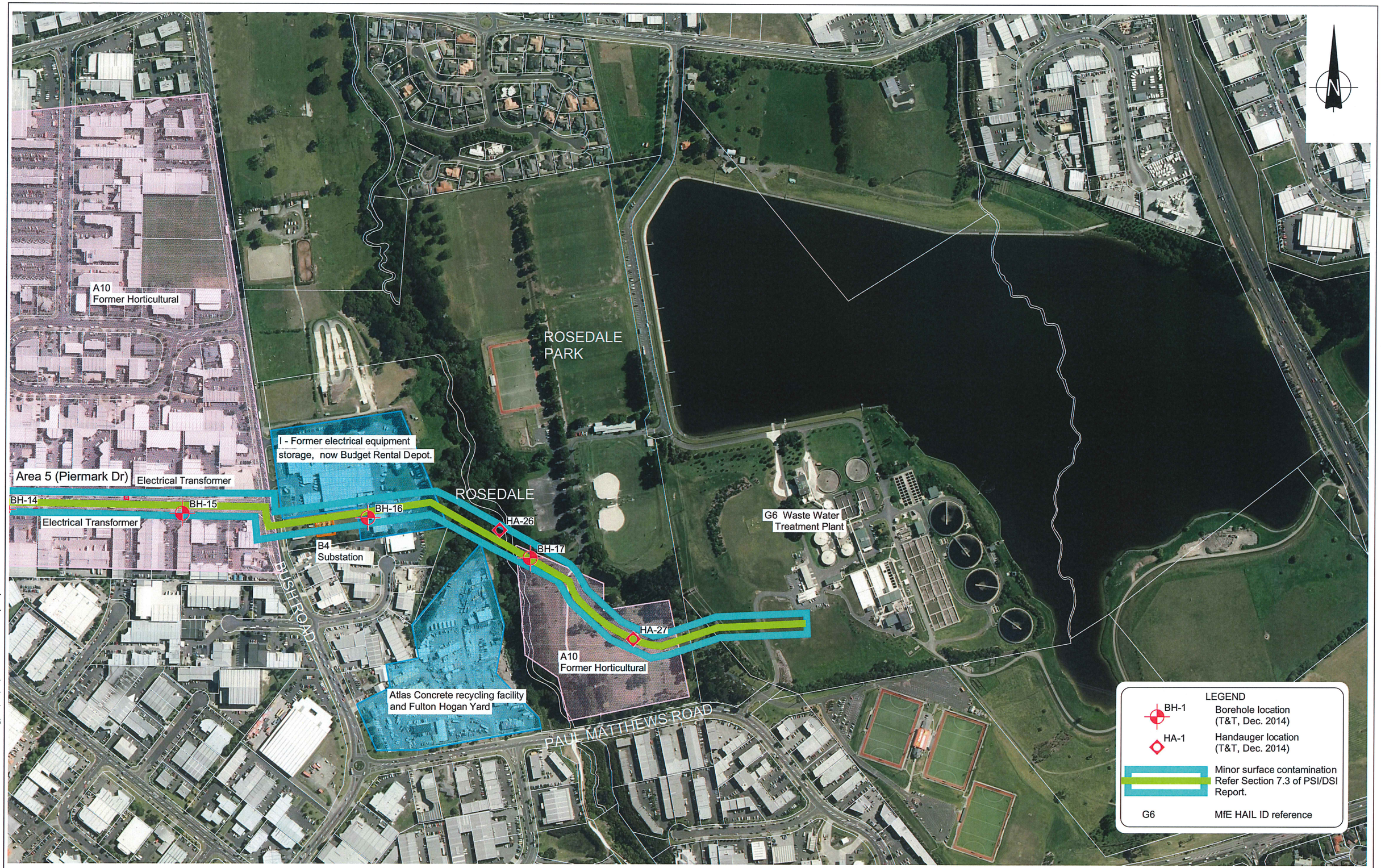
NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Rosedale

FIG. No. Figure 7 REV. 1



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NORTHERN INTERCEPTOR PHASE 1 ALIGNMENT PSI/DSI
Potential HAIL Activities – Rosedale

FIG. No. Figure 8

REV. 2

Appendix B: Contractor Checklist

Contractor Checklist:

Northern Interceptor Phase **1**

Summary of key SMP requirements

The Contractor shall undertake the following during earthworks for the Westney Road Watermain

Timing	Key task	Details
Prior to ground works commencing	Site set up	• Establish the areas on site where earthworks (dust, erosion, sediment, stormwater, odour) controls as per SMP Section 5 and 6 are required; • Hazard board to state contaminated soil may be present and indicating health and safety requirements for workers; • Obtain PPE: disposal gloves and P2 dust masks; • Arrange disposal permits.
During the works	General SMP compliance	• Maintain earthworks (dust, erosion, sediment, stormwater, odour) controls as per SMP Sections 5 and 6; • Implement health and safety procedures in Section 7 if contaminated soil/groundwater is encountered; • Retain all weighbridge and disposal dockets and provide to Contractor;
	Alert Contaminated Land Specialist	• If any of the following situations arise: – Contaminated soil is encountered that includes: o Odours (petroleum, oil) o Discolouration (black, green/blue staining most common) o Waste material o Asbestos containing materials (ACM). – Groundwater with an oil sheen, odour or discolouration is encountered; • If soil is to be disposed offsite, follow procedures in Table 5.1 Section 5. Additional soil samples may need to be collected and tested.
Within one month of completion of the relevant works	Provide contaminated land-related Information to Contaminated Land Specialist	• Details of any complaints relating to odour or dust made during the works; • Details of unexpected encounters/events and the action taken; • Details of visits made by Council representatives; • Summary of weighbridge information for disposal verification.

Appendix C: Soil testing information

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data												
	Human Health		Environmental	Disposal														
Location						HA1	HA1	HA1	BH2	BH2	BH2	HA2	HA2	HA3	HA3	HA3	HA3	Site 1
Depth (m bgl)						Surface	1.2	2.0				0.5	2	Surface	0.5	1.0	2.0	
Description	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	Fill	Fill	Fill	Fill	Natural	Natural	Fill	Fill	Topsoil	Natural	Natural	Natural	Harbour Sediment
Lab number						1366780.1	1366780.4	1366780.6	1366788.1	1366788.2	1366788.4	1366780.8	1366780.11	1366780.12	1366780.13	1366780.14	1366780.16	1361009.1
Date Sampled						16-Dec-14	16-Dec-14	16-Dec-14	17-Dec-14	17-Dec-14	17-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	
Metals and Metaloids (totals)																		
Arsenic	70	80	100	12	38	6	< 2	3	2	< 2	< 2	2	< 2	9	3	< 2	< 2	**30**
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.46	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	16	6	7	18	15	9	14	9	16	10	8	5	16
Copper	>10,000 [3]	>10,000 [3]	325	45	66	8	3	6	35	15	12	13	5	20	5	2	< 2	12
Lead	3300	880	250	65	71	5.5	18.2	16.7	10.9	11	5.7	11	15.7	21	12	5	4.8	36
Nickel	6,000 [3]	600 [3]	320	35	79	16	2	5	7	10	4	11	4	8	5	< 2	< 2	6
Zinc	400,000 [3]	14,000 [3]	1160	180	139	37	12	15	22	21	85	32	9	56	7	< 4	< 4	139
Organochlorine Pesticides Screening in Soil																		
Aldrin				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
alpha-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
beta-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
delta-BHC				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
cis-Chlordane				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
trans-Chlordane				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	-	-	< 0.04	-	< 0.04	< 0.04	-	-	-
2,4'-DDD				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDD				< LOR	0.014	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
2,4'-DDE				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDE				< LOR	0.182	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
2,4'-DDT				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
4,4'-DDT				< LOR	0.038	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Total DDT	1,000	400	0.7	< LOR	0.207							NC		NC	NC			-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan I				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan II				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin aldehyde				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Endrin ketone				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Heptachlor				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
Methoxychlor				< LOR	ND	-	-	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-	-	-
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																		
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	**0.03**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Fluoranthene	-		-	< LOR	1.31	**0.04**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.13	< 0.16	< 0.15	< 0.16	< 0.16	< 0.14	< 0.15	< 0.15	< 0.16	< 0.14	-	< 0.13	< 0.5
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	**0.04**	< 0.04	< 0.03	< 0.04	< 0.04	< 0.03	< 0.03	< 0.03	< 0.04	< 0.03	-	< 0.03	< 0.09
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	-	NC	NC
TPH																		
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	< 8	< 10	-	-	-	-	-	-	< 10	< 8	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	< 20	< 20	-	-	-	-	-	-	< 20	< 20	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	< 40	< 40	-	-	-	-	-	-	< 40	< 40	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data													
	Human Health		Environmental	Disposal															
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	Site 3	Site 5	Site 7	Site 9	BH3	BH3	BH3	BH6	BH6	BH6	BH6	HA6	HA6	HA7
Depth (m bgl)										0.3	1.0	2.0	0.1	0.3	0.5	1.5	Surface	0.5	Surface
Description						Harbour Sediment	Harbour Sediment	Harbour Sediment	Harbour Sediment	Topsoil	Fill	Fill	Topsoil	Fill	Natural	Natural	Topsoil	Natural	Topsoil
Lab number						1361009.2	1361009.3	1361009.4	1361009.4	1366739.2	1366739.4	1366739.6	1366740.1	1366740.2	1366740.3	1366740.5	1366780.17	1366780.18	1366780.65
Date Sampled										18-Dec-14	18-Dec-14	18-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	16-Dec-14	15-Dec-14	15-Dec-14	12-Dec-14
Metals and Metaloids (totals)																			
Arsenic	70	80	100	12	38	12	**17**	**38**	3	< 2	3	3	2	< 2	2	< 2	2	5	4
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.13
Chromium	6,300	2,700	400	55	31	19	14	14	7	10	9	13	12	11	10	9	6	20	31
Copper	>10,000 [3]	>10,000 [3]	325	45	66	17	9	11	7	6	15	8	11	9	4	3	3	7	31
Lead	3300	880	250	65	71	28	18.9	24	6.4	5.7	11.8	8	20	11.7	8.1	6.7	11.2	11.1	62
Nickel	6,000 [3]	600 [3]	320	35	79	8	8	12	< 2	4	5	4	13	16	4	< 2	2	5	**43**
Zinc	400,000 [3]	14,000 [3]	1160	180	139	108	100	88	23	9	24	15	29	16	5	< 4	14	12	68
Organochlorine Pesticides Screening in Soil																			
Aldrin				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	< 0.04	-					< 0.04	-	-
2,4'-DDD				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDD				< LOR	0.014	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
2,4'-DDE				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDE				< LOR	0.182	-	-	Pending	-	< 0.010	< 0.010	-					< 0.010	-	-
2,4'-DDT				< LOR	ND	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
4,4'-DDT				< LOR	0.038	-	-		-	< 0.010	< 0.010	-					< 0.010	-	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	-		-	NC	NC	-					NC	-	-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010	-	-
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	< 0.010	-					< 0.010		
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																			
Acenaphthene	-		-	< LOR	0.04	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.04**	< 0.04	-	< 0.03	< 0.03	< 0.03
Acenaphthylene	-		-	< LOR	0.04	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	< 0.03
Anthracene	-		-	< LOR	0.18	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.18**	< 0.04	-	< 0.03	< 0.03	< 0.03
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.84**	< 0.04	-	**0.06**	< 0.03	**0.03**
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.82**	< 0.04	-	**0.08**	< 0.03	**0.05**
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.03**	**0.75**	< 0.04	-	**0.1**	< 0.03	**0.05**
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.39**	< 0.04	-	**0.12**	< 0.03	**0.05**
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.33**	< 0.04	-	**0.05**	< 0.03	**0.03**
Chrysene	-		-	< LOR	0.73	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.73**	< 0.04	-	**0.05**	< 0.03	**0.03**
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.12**	< 0.04	-	**0.04**	< 0.03	< 0.03
Fluoranthene	-		-	< LOR	1.31	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.04**	**1.31**	< 0.04	-	**0.08**	< 0.03	**0.05**
Fluorene	-		-	< LOR	0.03	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.03**	< 0.04	-	< 0.03	< 0.03	< 0.03
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.46**	< 0.04	-	**0.15**	< 0.03	**0.04**
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.5	< 0.4	< 0.17	< 0.15	< 0.15	< 0.15	-	< 0.13	< 0.14	< 0.16	-	< 0.13	< 0.14	< 0.14
Phenanthrene	-		-	< LOR	0.68	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	< 0.03	**0.68**	< 0.04	-	< 0.03	< 0.03	< 0.03
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.10	< 0.08	< 0.04	< 0.03	< 0.03	< 0.03	-	**0.04**	**1.52**	< 0.04	-	**0.09**	< 0.03	**0.06**
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	NC	NC	-	NC	**1.18**	NC	-	**0.16**	NC	**0.22**
TPH																			
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

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< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria					Analytical Data												
	Human Health		Environmental	Disposal														
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria	Maximum	HA7	HA7	HA8	HA8	BH10	BH10	HA14	HA14	HA14	HA15	HA15	HA15	HA16
Depth (m bgl)						0.7	1.5	Surface	1.0	0.1	0.5	Surface	0.5	1.0	Surface	0.5	1.5	0.4
Description						Fill	Buried Topsoil	Topsoil	Natural	Topsoil	Natural	Topsoil	Natural	Natural	Topsoil	Natural	Natural	Fill
Lab number						1366780.67	1366780.68	1366780.7	1366780.72	1363077.1	1363077.2	1366780.5	1366780.51	1366780.52	1366780.55	1366780.56	1366780.58	1366780.61
Date Sampled						12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	9-Dec-14	9-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14	12-Dec-14
Metals and Metaloids (totals)																		
Arsenic	70	80	100	12	38	2	< 2	4	< 2	< 2	< 2	< 2	-	< 2	< 2	< 2	< 2	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	0.13	< 0.10	< 0.10	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	10	8	15	9	4	4	7	-	20	8	< 2	17	11
Copper	>10,000 [3]	>10,000 [3]	325	45	66	13	5	15	4	< 2	< 2	2	-	7	5	< 2	12	5
Lead	3300	880	250	65	71	15.4	6.4	32	7.3	5.1	2.7	3.8	-	5.2	7.2	1.8	6	4.6
Nickel	6,000 [3]	600 [3]	320	35	79	11	3	14	2	< 2	< 2	< 2	-	2	< 2	< 2	< 2	< 2
Zinc	400,000 [3]	14,000 [3]	1160	180	139	26	10	87	< 4	4	< 4	5	-	9	15	< 4	12	6
Organochlorine Pesticides Screening in Soil																		
Aldrin				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
alpha-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
beta-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
delta-BHC				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
cis-Chlordane				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
trans-Chlordane				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	< 0.04	-	-	< 0.04	-	-	-	-	-	-	-	< 0.04
2,4'-DDD				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDD				< LOR	0.014	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
2,4'-DDE				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDE				< LOR	0.182	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
2,4'-DDT				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
4,4'-DDT				< LOR	0.038	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	NC	-	-	NC	-	-	-	-	-	-	-	NC
Dieldrin	160	70	339	< LOR	0.122	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan I				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan II				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endosulfan sulphate				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endrin				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-		-	< 0.010
Endrin aldehyde				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Endrin ketone				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Heptachlor				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Heptachlor epoxide				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Hexachlorobenzene				< LOR	ND	-	< 0.010	-	-	< 0.010	-	-	-	-	-	-	-	< 0.010
Methoxychlor				< LOR	ND		< 0.010			< 0.010	-		-	-	-	-	-	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																		
Acenaphthene	-		-	< LOR	0.04	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Acenaphthylene	-		-	< LOR	0.04	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Anthracene	-		-	< LOR	0.18	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Chrysene	-		-	< LOR	0.73	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Fluoranthene	-		-	< LOR	1.31	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Fluorene	-		-	< LOR	0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.14	-	< 0.15	-	-	-	< 0.14	< 0.17	-	< 0.15	< 0.13	-	< 0.15
Phenanthrene	-		-	< LOR	0.68	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	-	< 0.03	-	-	-	< 0.03	< 0.04	-	< 0.03	< 0.03	-	< 0.03
BAP equivalent	35	40	2.15	< LOR	1.18	NC	-	NC	-	NC	NC	NC	NC	-	NC	NC	-	NC
TPH																		
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data											
	Human Health		Environmental	Disposal													
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA16	HA16	HA28	HA28	HA28	HA28	HA17	HA17	HA17	HA17	HA18	HA18
Depth (m bgl)						1.0	2.0	Surface	0.5	1.2	2.0	0.4	0.5	1.0	2.0	0.3	1.0
Description						Natural	Natural	Topsoil	Fill	Buried Topsoil	Natural	Fill	Buried Topsoil	Natural	Natural	Fill	Fill
Lab number						1366780.62	1366780.64	1366780.44	1366780.45	1366780.47	1366780.49	1366780.23	1366780.24	1366780.25	1366780.27	1366780.29	1366780.3
Date Sampled						12-Dec-14	12-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14
Metals and Metaloids (totals)																	
Arsenic	70	80	100	12	38	< 2	3	2	< 2	< 2	< 2	< 2	< 2	< 2	3	3	3
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chromium	6,300	2,700	400	55	31	10	16	6	6	7	17	11	11	18	13	18	18
Copper	>10,000 [3]	>10,000 [3]	325	45	66	9	13	5	2	< 2	5	5	2	4	6	10	10
Lead	3300	880	250	65	71	6.3	9.8	5.4	4.7	3.4	4.8	5.1	4.6	4.8	6.8	7.7	7.7
Nickel	6,000 [3]	600 [3]	320	35	79	< 2	6	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2	9	7
Zinc	400,000 [3]	14,000 [3]	1160	180	139	9	25	13	< 4	5	9	7	6	9	12	22	19
Organochlorine Pesticides Screening in Soil																	
Aldrin				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	-	-	< 0.04	-	-	-	< 0.04
2,4'-DDD				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDD				< LOR	0.014	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
2,4'-DDE				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDE				< LOR	0.182	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
2,4'-DDT				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
4,4'-DDT				< LOR	0.038	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	-	-	-	NC	-	-	NC	-	-	-	NC
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	-	-	< 0.010	-	-	-	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons																	
Acenaphthene	-		-	< LOR	0.04	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Acenaphthylene	-		-	< LOR	0.04	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Anthracene	-		-	< LOR	0.18	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[a]anthracene	-		-	< LOR	0.84	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Chrysene	-		-	< LOR	0.73	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Fluoranthene	-		-	< LOR	1.31	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Fluorene	-		-	< LOR	0.03	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Naphthalene	-		0.78 [4]	< LOR	ND	-	-	-	< 0.15	< 0.13	-	< 0.15	-	-	-	< 0.14	-
Phenanthrene	-		-	< LOR	0.68	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	-	-	-	< 0.03	< 0.03	-	< 0.03	-	-	-	< 0.03	-
BAP equivalent	35	40	2.15	< LOR	1.18	-	-	-	NC	NC	-	NC	-	-	-	NC	-
TPH																	
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-	-	-	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data										
	Human Health		Environmental	Disposal												
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA18	HA19	HA19	HA19	HA20	HA20	BH12	BH12	BH12	HA21	HA23
Depth (m bgl)						1.7	Surface	0.5	1	Surface	0.5	0.1	0.8	1.2	Surface	Surface
Description						Natural	Fill	Buried topsoil	Natural	Fill (reworked)	Fill (reworked)	Topsoil	Fill	Fill	Topsoil	Fill
Lab number						1366780.32	1360979.21	1360979.22	1360979.1	1360979.16	1360979.17	1363077.6	1363077.8	1363077.9	1360979.32	1360979.23
Date Sampled						15-Dec-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	9-Dec-14	9-Dec-14	9-Dec-14	24-Nov-14	24-Nov-14
Metals and Metaloids (totals)																
Arsenic	70	80	100	12	38	2	7	-	-	-	3	< 2	5	3	2	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	0.13	-	-	-	0.17	0.21	< 0.10	< 0.10	< 0.10	-
Chromium	6,300	2,700	400	55	31	21	7	-	-	-	27	8	21	15	8	-
Copper	>10,000 [3]	>10,000 [3]	325	45	66	6	31	-	-	-	18	8	16	12	2	5
Lead	3300	880	250	65	71	6.9	**71**	-	-	-	9.1	7.2	12.4	11.5	5.3	6.6
Nickel	6,000 [3]	600 [3]	320	35	79	2	4	-	-	-	**79**	3	9	6	< 2	-
Zinc	400,000 [3]	14,000 [3]	1160	180	139	14	66	-	-	-	38	14	23	10	5	-
Organochlorine Pesticides Screening in Soil																
Aldrin				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
alpha-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
beta-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
delta-BHC				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
cis-Chlordane				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
trans-Chlordane				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	< 0.04	< 0.04	-	< 0.04	-	< 0.04	< 0.04	-	< 0.04	< 0.04
2,4'-DDD				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDD				< LOR	0.014	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
2,4'-DDE				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDE				< LOR	0.182	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
2,4'-DDT				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
4,4'-DDT				< LOR	0.038	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Total DDT	1,000	400	0.7	< LOR	0.207	-	NC	NC	-	NC	-	NC	NC	-	NC	NC
Dieldrin	160	70	339	< LOR	0.122	-	< 0.010	< 0.010	-	**0.012**	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan I				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan II				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endosulfan sulphate				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin aldehyde				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Endrin ketone				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Heptachlor				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Heptachlor epoxide				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Hexachlorobenzene				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
Methoxychlor				< LOR	ND	-	< 0.010	< 0.010	-	< 0.010	-	< 0.010	< 0.010	-	< 0.010	< 0.010
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-	-	ND
Polycyclic aromatic hydrocarbons																
Acenaphthene	-		-	< LOR	0.04	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Acenaphthylene	-		-	< LOR	0.04	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Anthracene	-		-	< LOR	0.18	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[a]anthracene	-		-	< LOR	0.84	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Chrysene	-		-	< LOR	0.73	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Fluoranthene	-		-	< LOR	1.31	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Fluorene	-		-	< LOR	0.03	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Naphthalene	-		0.78 [4]	< LOR	ND	-	-	-	-	< 0.14	-	-	< 0.15	-	-	-
Phenanthrene	-		-	< LOR	0.68	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	-	-	-	-	< 0.03	-	-	< 0.03	-	-	-
BAP equivalent	35	40	2.15	< LOR	1.18	-	-	-	-	NC	-	-	NC	-	-	-
TPH																
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	< 9	-	-	-	-	-	< 9	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	< 20	-	-	-	-	-	< 20	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	< 40	-	-	-	-	-	< 40	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

2 - ARP:ALW Permitted Activity Soil Criteria Schedule 10 - discharges (unless otherwise stated).

3 - NEPC 2013. Guideline on the Investigation Levels for Soil and Groundwater

4 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt, GW Protection <1m m depth.

5- MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. Sandy Silt.

< LOR indicates acceptance criteria is less than the laboratory level of reporting

ND indicates that the value was below laboratory detection limits

NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data											
	Human Health		Environmental	Disposal													
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		HA23	HA23	BH13	BH13	HA24	HA24	HA24	HA25	BH14	BH14	BH15	BH15
Depth (m bgl)						0.5	1.5	0.1	0.5	Surface	0.5	2	Surface	0.1	0.5	0.1	0.4
Description						Fill	Natural	Fill	Fill	Fill	Fill	Fill	Fill	Topsoil	Fill	Topsoil	Natural
Lab number						1360979.24	1360979.26	1359119.1	1359119.3	1360979.1	1360979.11	1360979.35	1360979.4	1355309.1	1355309.2	1355309.7	1355309.8
Date Sampled						24-Nov-14	24-Nov-14	2-Dec-14	2-Dec-14	24-Nov-14	24-Nov-14	24-Nov-14	24-Nov-14	21-Nov-14	21-Nov-14	21-Nov-14	21-Nov-14
Metals and Metaloids (totals)																	
Arsenic	70	80	100	12	38	3	< 2	12	3	5	3	< 2	6	4	2	5	5
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	0.59	< 0.10	-	< 0.10	< 0.10	0.14	-	< 0.10	0.13	< 0.10
Chromium	6,300	2,700	400	55	31	17	9	11	7	-	10	6	24	-	9	17	26
Copper	>10,000 [3]	>10,000 [3]	325	45	66	21	2	**66**	5	22	11	< 2	26	25	11	16	30
Lead	3300	880	250	65	71	7.9	3.4	28	9.8	15.4	11.7	4.7	42	41	8.9	22	11
Nickel	6,000 [3]	600 [3]	320	35	79	3	< 2	9	2	-	3	< 2	17	-	4	8	**56**
Zinc	400,000 [3]	14,000 [3]	1160	180	139	14	4	36	9	-	13	< 4	60	-	7	41	43
Organochlorine Pesticides Screening in Soil																	
Aldrin				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
alpha-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
beta-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
delta-BHC				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
cis-Chlordane				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
trans-Chlordane				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	< 0.04	-	< 0.04	-	-	< 0.04	< 0.04	-	-	-
2,4'-DDD				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDD				< LOR	0.014	-	-	< 0.010	-	**0.014**	< 0.005	-	< 0.010	< 0.010	**0.007**	-	-
2,4'-DDE				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDE				< LOR	0.182	-	-	< 0.010	-	**0.182**	< 0.005	-	**0.022**	**0.066**	**0.055**	-	-
2,4'-DDT				< LOR	ND	-	-	< 0.010	-	< 0.010	< 0.005	-	< 0.010	< 0.010	< 0.005	-	-
4,4'-DDT				< LOR	0.038	-	-	< 0.010	-	**0.011**	< 0.005	-	< 0.010	0.018	**0.028**	-	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	-	NC	-	**0.207**	< 0.03	-	**0.022**	**0.084**	**0.09**	-	-
Dieldrin	160	70	339	< LOR	0.122	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan I				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan II				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endosulfan sulphate				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin aldehyde				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Endrin ketone				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Heptachlor				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Heptachlor epoxide				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Hexachlorobenzene				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
Methoxychlor				< LOR	ND	-	-	< 0.010	-	< 0.010	-	-	< 0.010	< 0.010	-	-	-
ONOP				< LOR	ND	-	-	ND	-	ND	-	-	ND	-	-	-	-
Polycyclic aromatic hydrocarbons																	
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.03**	-	< 0.03	< 0.04	-
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.04**	-	< 0.03	< 0.04	-
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.14**	-	< 0.03	< 0.04	-
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.33**	-	< 0.03	< 0.04	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.37**	-	< 0.03	< 0.04	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.45**	-	< 0.03	< 0.04	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.3**	-	< 0.03	< 0.04	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.2**	-	< 0.03	< 0.04	-
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.35**	-	< 0.03	< 0.04	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.06**	-	< 0.03	< 0.04	-
Fluoranthene	-		-	< LOR	1.31	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.86**	-	< 0.03	< 0.04	-
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.04	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.35**	-	< 0.03	< 0.04	-
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.15	< 0.15	< 0.14	< 0.16	-	< 0.14	< 0.15	< 0.16	-	< 0.15	< 0.18	-
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.57**	-	< 0.03	< 0.04	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	< 0.03	< 0.03	< 0.04	-	< 0.03	< 0.03	**0.9**	-	< 0.03	< 0.04	-
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	NC	NC	-	NC	NC	**0.56**	-	NC	NC	-
TPH																	
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	< 9	< 9	-	< 10	-	< 11	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	< 20	< 20	-	< 20	-	< 30	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	< 40	< 40	-	< 40	-	< 50	-

All values in mg/kg

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health (unless otherwise stated).

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NA indicates contaminant not limiting as estimated criteria is significantly higher than that likely to be encountered on site (20,000 mg/kg for TPH and 10,000 mg/kg for other contaminants)

BOLD indicates that the value exceeds background concentrations

Note: No results exceed human health or discharge criteria

Table D1: Comparison of laboratory results against relevant acceptance criteria

	Acceptance Criteria				Maximum	Analytical Data								
	Human Health		Environmental	Disposal										
Location	NES Soil SCS - Commercial [1]	NES Soil SCS - Recreational [2]	PAUP / ALW Plan Criteria (Discharge) [2]	Published background (non volcanic) / Default cleanfill criteria		BH16	HA26	HA26	HA26	BH17	BH17	HA27	HA27	HA27
Depth (m bgl)						0.1	Surface	0.5	1.5	0.1	1.5	Surface	0.5	1.5
Description						Topsoil	Topsoil	Natural	Natural	Topsoil	Natural	Topsoil	Natural	Natural
Lab number						1357766.1	1366780.34	1366780.35	1366780.37	1364826.1	1364826.4	1366780.39	1366780.4	1366780.42
Date Sampled						27-Nov-14	15-Dec-14	15-Dec-14	15-Dec-14	12-Dec-14	12-Dec-14	15-Dec-14	15-Dec-14	15-Dec-14
Metals and Metaloids (totals)														
Arsenic	70	80	100	12	38	3	3	< 2	< 2	< 2	< 2	4	3	< 2
Cadmium	1300	400	7.5	0.65	0.59	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	-	< 0.10
Chromium	6,300	2,700	400	55	31	17	9	5	10	5	8	-	-	15
Copper	>10,000 [3]	>10,000 [3]	325	45	66	21	10	4	6	4	3	12	3	4
Lead	3300	880	250	65	71	13	9.8	21	7.1	5.6	4.3	11.3	4.2	5
Nickel	6,000 [3]	600 [3]	320	35	79	10	6	< 2	5	< 2	< 2	-	-	< 2
Zinc	400,000 [3]	14,000 [3]	1160	180	139	35	49	18	20	7	< 4	-	-	6
Organochlorine Pesticides Screening in Soil														
Aldrin				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
alpha-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
beta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
delta-BHC				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
gamma-BHC (Lindane)			>20,000	< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
cis-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
trans-Chlordane				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Total Chlordane [(cis+trans)*100/42]				< LOR	ND	-	-	-	-	< 0.04	-	< 0.04	< 0.04	-
2,4'-DDD				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDD				< LOR	0.014	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
2,4'-DDE				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDE				< LOR	0.182	-	< 0.005	**0.03**	-	< 0.010	-	**0.078**	< 0.010	-
2,4'-DDT				< LOR	ND	-	< 0.005	< 0.005	-	< 0.010	-	< 0.010	< 0.010	-
4,4'-DDT				< LOR	0.038	-	< 0.005	< 0.005	-	< 0.010	-	**0.038**	< 0.010	-
Total DDT	1,000	400	0.7	< LOR	0.207	-	< 0.03	< 0.03	-	NC	-	**0.116**	NC	-
Dieldrin	160	70	339	< LOR	0.122	-	-	-	-	< 0.010	-	**0.122**	< 0.010	-
Endosulfan I				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endosulfan II				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endosulfan sulphate				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin aldehyde				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Endrin ketone				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Heptachlor				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Heptachlor epoxide				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Hexachlorobenzene				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
Methoxychlor				< LOR	ND	-	-	-	-	< 0.010	-	< 0.010	< 0.010	-
ONOP				< LOR	ND	-	-	-	-	-	-	-	-	-
Polycyclic aromatic hydrocarbons														
Acenaphthene	-		-	< LOR	0.04	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Acenaphthylene	-		-	< LOR	0.04	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Anthracene	-		-	< LOR	0.18	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[a]anthracene	-		-	< LOR	0.84	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[a]pyrene (BAP)	-		-	< LOR	0.82	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	-		-	< LOR	0.75	< 0.03	**0.03**	-	-	< 0.03	-	< 0.04	-	-
Benzo[g,h,i]perylene	-		-	< LOR	0.39	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Benzo[k]fluoranthene	-		-	< LOR	0.33	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Chrysene	-		-	< LOR	0.73	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Dibenzo[a,h]anthracene	-		-	< LOR	0.12	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Fluoranthene	-		-	< LOR	1.31	< 0.03	**0.05**	-	-	< 0.03	-	< 0.04	-	-
Fluorene	-		-	< LOR	0.03	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Indeno[1,2,3-c,d]pyrene	-		-	< LOR	0.46	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Naphthalene	-		0.78 [4]	< LOR	ND	< 0.15	< 0.16	-	-	< 0.13	-	< 0.16	-	-
Phenanthrene	-		-	< LOR	0.68	< 0.03	< 0.04	-	-	< 0.03	-	< 0.04	-	-
Pyrene	NA	NA	7.9 [4]	< LOR	1.52	< 0.03	**0.04**	-	-	< 0.03	-	< 0.04	-	-
BAP equivalent	35	40	2.15	< LOR	1.18	NC	NC	-	-	NC	-	NC	-	-
TPH														
C7 – C9	700 [5]	500 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-
C10 – C14	1700 [5]	510 [5]	-	< LOR	ND	-	-	-	-	-	-	-	-	-
C15 – C36	NA	NA	-	< LOR	ND	-	-	-	-	-	-	-	-	-

All values in mg/kg

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BOLD indicates that the value exceeds background concentrations

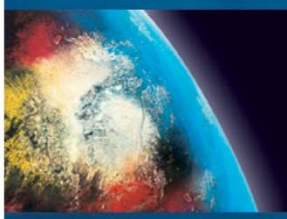
Note: No results exceed human health or discharge criteria

Appendix D: MfE cleanfill guidelines – acceptable materials

Table D1: Acceptable materials[6]

Material	Discussion
Asphalt (cured)	Weathered (cured) asphalt is acceptable: After asphalt has been exposed to the elements for some time, the initial oily surface will have gone and the asphalt is considered inert.
Bricks	Inert – will undergo no degradation.
Ceramics	Inert.
Concrete – un-reinforced	Inert material. Ensure that other attached material is removed.
Concrete – reinforced	Steel reinforcing bars will degrade. However, bars fully encased in intact concrete will be protected from corrosion by the concrete. Reinforced concrete is thus acceptable provided protruding reinforcing steel is cut off at the concrete face.
Fibre cement building products	Inert material comprising cellulose fibre, Portland cement and sand. Care needs to be taken that the product does not contain asbestos, which is unacceptable.
Glass	Inert, and poses little threat to the environment. May pose a safety risk if placed near the surface in public areas, or if later excavated. The safety risk on excavation should become immediately apparent, so glass is considered acceptable provided it is not placed immediately adjacent to the finished surface.
Tiles (clay, concrete or ceramic)	Inert.

[6] Ministry for the Environment, 2002: A Guide to Management of Cleanfills – Table 4.1



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