Contamination Site Management Plan (CSMP) for the proposed Whenuapai-Redhills section of the Northern Interceptor 2 (NI2)

Title: Contamination Site Management Plan				
Date	**Issue No**	**Description**	**Prepared by:**	**Approved by SQEP:**
May 2023	1	CSMP to support consent application.	S Myers-Hutchings	L. Hine
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1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Watercare Services Limited (Watercare) to prepare this CSMP. The CSMP has been prepared to manage potential effects of ground contamination during earthworks for the proposed Whenuapai to Redhills section of the NI2 infrastructure improvement work. The NI2 infrastructure improvement work area is shown in **Figure 1** overleaf and is herein referred to as 'the site'.

The persons preparing this CSMP are suitably qualified and experienced practitioners (SQEP) as required by the National Environmental Standards for managing and assessing contaminants in soil (NESCS)[1] and defined in the NESCS Users' Guide[2]. This CSMP has been prepared in accordance with our proposal dated the 17 May 2021.

2 Background and proposed earthworks

Watercare is proposing to upgrade its Wastewater Servicing Scheme to promote growth in the North-West region of Auckland. The overall servicing project will enable Watercare to efficiently service Whenuapai and Redhill's for the next 10 to 15 years by providing capacity in the order of 13,000 dwellings or 39,000 people.

Soil disturbance for the project can be divided into three distinct sections:

- **Section 1- Massey Connector**: The Massey Connector gravity sewer main (chainage 0 to 1200 m), extending from 8 Spedding Road to Shaft LS8 (State Highway 18 (SH18)). This will be constructed using an Earth Pressure Balance (EPB) Tunnel Boring Machine (TBM). A Break Pressure Tank (BPT) will be constructed at 8 Spedding Road (approximately 1,500 m^2). A Construction Area Hub (CAH) is planned at 32 Mamari Road with an approximate area of 7,500 m^2.
- **Section 2- the Main Tunnel**: The DN2100 gravity sewer main (chainage 0 to 2631 m), extending adjacent to SH18 between Shaft LS8 and Shaft RS17, is to be constructed using an EPB TBM.
- **Section 3- Hobsonville pumpstation**: Proposed between Shaft RS17 and the inlet chamber wetwall of the Hobsonville wastewater pumpstation (chainage 0 to 106.20). Trench excavation is proposed for the two manholes (MH1 and MH2) between RS17 and the wetwall on the pumpstation property.

Assessment of soil and groundwater conditions **for the BPT, CAH and Alignment Section 3** was not included in the DSI intrusive investigation program completed in 2021. Additional intrusive investigations are proposed to support works in these areas. Such investigations will be reported as pre-works soil investigation or an addendum to the DSI, and this CSMP updated prior to construction.

The proposed investigation works will be completed by a SQEP in accordance with the sampling plan (appended to this CSMP).

3 Contamination Conditions and Basis for Procedures – Alignment Sections 1 and 2

The site history as documented by the Detailed Site Investigation (DSI)[3] identified several potentially contaminating activities occurring on the proposed NI2 infrastructure improvement work alignment and on adjacent properties.

In 2021, T+T completed soil and groundwater sampling along the Sections 1 and 2 of the proposed alignment of the NI2 infrastructure improvement work and evaluated the testing results in the context of the proposed development. In summary:

Sections 1 and 2 Soil condition:

- Low concentrations of contaminants were recorded in soils when compared to background concentrations. However, these are not levels which may pose a risk to human health and/or the environment.
- Asbestos was not detected in the nine surface samples tested.

Sections 1 and 2 Groundwater condition:

- The ANZECC Guidelines for the protection of 95% of freshwater species and/or background groundwater concentrations were also exceeded in shallow groundwater at these locations (BH122 shallow, BH115 shallow and BH132 shallow).
- Samples of deeper groundwater (screened at 11-27 m) contained contaminant concentrations below background concentrations and the ANZECC Guidelines for the protection of 95% of freshwater species.

BPT and CAH

- BPT: No soil testing has been completed in the area of the proposed BPT. Soil testing is proposed in this area and the CSMP will be revised in the once results are available.
- CAH: No soil testing has been completed in this area. Topsoil will be stripped and retained onsite, and no soil is proposed to be taken offsite from this area. On this basis no soil testing is proposed and generic H&S and environmental controls will be put in place.

The soil and groundwater testing locations are shown below in **Figure 1.** The soil and groundwater results table are presented in **Table 1**.

Based on the site data, the **earthworks controls** overpage are required to be implemented by the contractor to manage ground contamination related health and safety issues and environmental discharges during the works.

4 Contamination Conditions and Basis for Procedures – Alignment Section 3

No soil testing has been completed to date in the Hobsonville Pumpstation. Section 4 will be updated in the revised CSMP once soil sampling has been completed.

5 Roles and responsbiltites

Role	Responsibility
Watercare and/or their appointed project manager	Responsible for ensuring compliance with resource consent conditions including the requirements of the CSMP and ensuring a SQEP is retained during the works.
Main Contractor (Contractor).	Responsible for implementation of CSMP during earthworks, including monitoring compliance of all sub-contractors with the requirements for the CSMP. The Main Contractor is responsible for ensuring the site and works complies with resource consents, environmental management systems and requirements of Site Management Plans not just related to contaminated land.
Any subcontractor(s) undertaking soil disturbance work.	Responsible for undertaking works applicable to their profession in accordance with the requirements of this CSMP.
Contaminated Land Specialist (SQEP)	Responsible for provision of ground contamination advice during the works and completion reporting. The SQEP shall also complete any additional soil and/or water sampling as required. The SQEP must meet the requirements of a SQEP as per the NESCS User's Guide.

6 Site Management Procedures

The **table overleaf** provides the controls and procedures to manage the ground contamination risk during the proposed development.

7 Applicability

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

This CSMP provides a framework for managing contamination hazards on site by identifying potential hazards and suggesting mitigation measures relevant to site conditions and works proposed at the time of writing. This CSMP provides information and recommendations to augment this process but is not intended to relieve the person conducting a business or undertaking (PCBU), previously referred to as 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.

Any persons undertaking ground disturbance works on the site must develop a site-specific risk assessment (such as a job safety analysis (JSA), or similar) to complement this CSMP and to address other health and safety requirements that may be applicable to their particular works. The site-specific risk assessment must 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 requiring that this plan be amended or updated. The plan has been prepared on the basis of information available at the date of preparation. The nature and continuity of soil conditions away from sample locations are inferred and it must be appreciated that actual conditions could vary from the assumed model. We understand and agree that this report will be used by Auckland Council in undertaking its regulatory functions in connection with the processing and monitoring of resource consents relating to this project.

References

1 Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

2 Ministry for the Environment, 2012. Users' Guide - National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.

3 T+T, *Detailed Site Investigation-Whenuapai to Redhills Wastewater Servicing Package 2.* dated May 2023. Prepared for Watercare, T+T reference: 1015506.v3.

4 Ministry for the Environment, revised 2021. Contaminated Land Management Guideline No. 5. Site Investigation and analysis of soils.

5 BRANZ, November 2017. New Zealand Guidelines for Assessing and Managing asbestos in soil.

The provisions of the contaminated site management plan are mandatory for all persons (employees, contractor and sub-contractors) who will be involved in undertaking ground disturbance works on the site.

Watercare – Proposed Whenuapai-Redhills section of the Northern Interceptor 2 (NI2)

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Key Contamination Risks	
 **Soil Risk**	• Data to date indicates other chemical constituents i.e. heavy metals, PAH and TPH in shallow and deeper soils are below relevant human health and environmental criteria and unlikely to represent a risk human health or the environment during works. • If gross contamination is encountered, further health and safety controls would be required to be implemented to protect human health e.g. site workers, nearby residents or commercial workers. Contingency Measures outlined below will be followed should gross contamination be discovered.
Health and Safety Procedures	
 **Induction and training**	• **<u>All site personnel</u>** shall be required to undergo a CSMP briefing by a SQEP before commencing work. • Specific training must be given on identifying unexpected contamination, asbestos control procedures controls and procedures to minimise discharges of contaminants to the environment and minimum requirements for Personal Protective Equipment (PPE) and its use. The purpose of the induction and training is to ensure that personnel are competent to undertake the requirements of this CSMP.
 **PPE**	• Standard PPE is expected to be sufficient to manage contamination from soil disturbance from the balance of the site. • If unexpected contamination is identified or suspected, the SQEP shall be contacted for advice on further required protective equipment.
 **Decontamination**	As part of good environmental practise, to avoid tracking soil outside of the works area the following controls should be implemented: • Bootwash with fresh water to clean boots of soil and/or debris. • Hand wash for workers to clean hands regularly at breaks and at the end of the day.
Site Management Procedures	
 **Site Establishment**	• Establish standard earthworks controls for dust, erosion, sediment, and stormwater. • Prior to works commencing the site shall be appropriately fenced to prevent access by the public. • Hazard board to state contaminated soil may be present and indicate health and safety requirements for workers. • Arrange disposal permits for excavated soil to be disposed to an appropriate waste disposal facility. • Watercare or their nominated contractor shall engage a SQEP to supervise the works and to contact if unexpected contamination is encountered.
 **Spoil Disposal procedures**	• Spoil must be disposed to a facility consented to take that material. Permits and acceptance must be received from disposal operator before transporting material. • Spoil onsite should be disposed of to the following locations: – **Managed fill** – Shallow soils from Shafts RS10, RS14, LS16 and RS17 (BH133) contained concentrations of TPH above cleanfill acceptance criteria. – **Cleanfill** – Shallow soils from Shaft LS8 and Shaft LS12 and underlying deeper natural soils. – **BPT/CAH/Hobsonville Pumpstation (Alignment Section 3)** – no soil to be taken offsite without testing by a SQEP to confirm the appropriate disposal facility. From a contamination perspective, based on the soil data available to date soils can be reused onsite. From a ground contamination perspective, any constraints surrounding the reuse of soil should be confirmed with the SQEP. Reused soils may also be subject to engineering or other constraints e.g. settlement.
 **Spoil excavation, transport and management**	**<u>GENERAL SITE CONTROLS:</u>** • All soil being disposed offsite is transported in covered trucks. • Wheels of trucks transporting soil offsite shall be free of debris prior to leaving site, and there shall be no tracking of material onto roads or footpaths. • The disposal documentation/weighbridge dockets for each load shall be collected and provided to the SQEP one month after completion of works. • Spoil stockpiles shall only be placed in an area where runoff can be controlled, clear of any flooding or ponding areas and at an adequate distance away from receptors. Alternatively, appropriate sediment and erosion controls to be constructed around the stockpiles (cut off drains, silt fences and silt socks). • Maximum height of any stockpile is likely to be 3m, subject to confirmation by a geotechnical engineer. • The stockpiles will be covered with geotextile or mulched if not in use for more than 3 days to prevent rainfall induced erosion and dust. • Any stockpile that is inactive for longer than 1 week shall be stabilised (i.e., mulched).
 **Dust Control and Air Monitoring**	• Dust will be managed by maintaining damp conditions using water sprays in areas of ground disturbance/excavation. Dust controls shall comply with the applicable Council guidelines, regulations and other applicable legislation. • Consider stopping work if wind conditions are too high and dust cannot be mitigated.
 **Imported Material and material reuse Procedures**	• All soils imported to site must be either hardfill sourced direct from a consented quarry or the meet with the following: – Be derived from a source, which is previously verified in accordance with the methods described in the NESCS Regulations, as being a piece of land to which the NESCS Regulations do not apply; or – Have been adequately investigated in accordance with MfE Contamination Land Management Guidelines No.5 – Site Investigation and Analysis of Soils (Revised 2011) by a SQEP to meet the 'cleanfill' definition and comply with the published background concentrations for Auckland volcanic soils. • **In all cases the testing information shall be provided to the SQEP for approval prior to the materials being imported to site.**
 **Erosion and Sediment Control and Water Management**	**<u>Erosion and Sediment Control:</u>** • These effects will be managed by ensuring that no debris or spoil generated by the works is allowed to be discharged to the stormwater system. • Erosion and sediment control shall be installed prior to soil disturbance works and managed in accordance with the Council's guidelines (i.e. GD05) and other applicable legislation, including where necessary the use of silt fences and runoff diversion bunds (as appropriate) and filter cloths/mats installed over stormwater cesspits. Soil must be reinstated to an erosion-resistant state within one month of completion of the soil disturbance works. **<u>Stormwater (Ponding Water):</u>** • Clean water shall be diverted away from ground disturbance/excavation areas. Wherever possible water generated or encountered in areas of ground disturbance/excavation will be retained onsite to soak away. • Accumulated water, which does not soak away, the water shall be allowed to infiltrate into the ground or be pumped out to a sewer subject to securing any necessary consents and permits.

<u>The provisions of the contaminated site management plan are mandatory for all persons (employees, contractor and sub-contractors) who will be involved in undertaking ground disturbance works on the site.</u>

	• 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 subject to securing any necessary permits. **<u>Discharge of dewatering water – general requirements</u>** • The discharge of dewatering water to land where it may enter water, or to water, shall meet the relevant permitted activity criteria under the AUP including the removal of sediment, and associated performance monitoring (sediment removal, observations for any conspicuous oil or grease film, scrum or foam, pH, change in colour and temperature monitoring).

Contingency Measures

Unexpected Discoveries/Uncontrolled Discharges:

If unexpected contamination (such as fill, unusually coloured, odorous, or suspected asbestos containing material) is identified during earthworks on any part of the site, or uncontrolled discharges occur then the Contractor shall ensure the following (where appropriate):

- All works shall cease within 10 m of the suspected contamination.
- The Contractor shall contact the SQEP for advice as soon as the area is made safe. Where required, the SQEP shall visually inspect the material and provide additional advice regarding its safe handling.
- Works shall not recommence until the SQEP has given approval.
- Discharge of any ponded water or dewatering water to stormwater shall stop until approval to recommence discharge is obtained from the SQEP and the regulatory authority.
- No soil shall be taken offsite from the impacted area until the SQEP has given approval. All details of the discharge (volume, type, location), contamination encountered, and procedures taken to remedy the situation are to be recorded and included with the Works Verification Report to be submitted to Auckland Council at the completion of works.

Complaints procedures:

A written record of all complaints received shall be maintained. The Contractor's site supervisor shall initiate an investigation and notify Auckland Council as soon as practicable on receipt of a complaint, including providing details of any corrective actions taken. Appropriate feedback will be provided to the complainant, such as the response made and any corrective actions taken, in response to the complaint.

Notification requirements:

Watercare or the client appointed representative shall be notified immediately in the event that any contingency measures are required to be implemented.

Works Completion Reporting

- Verification observations shall be conducted by the SQEP. The verification programme recommended includes observation of the ground works and collection of soil and groundwater samples for unexpected discoveries, if encountered.
- Soil samples many be required if unexpected contamination conditions are encountered and remediated. Any validation sampling shall be undertaken by the SQEP, in general accordance with requirements of the MfE Contaminated Land Management Guideline No. 5[4] and Asbestos-in-Soil guidelines[5].
- A site validation report shall be prepared by the SQEP on completion of the earthworks and upon receipt of all necessary documentation.

Information required from the contractor, to be provided the SQEP within one month of works completion:

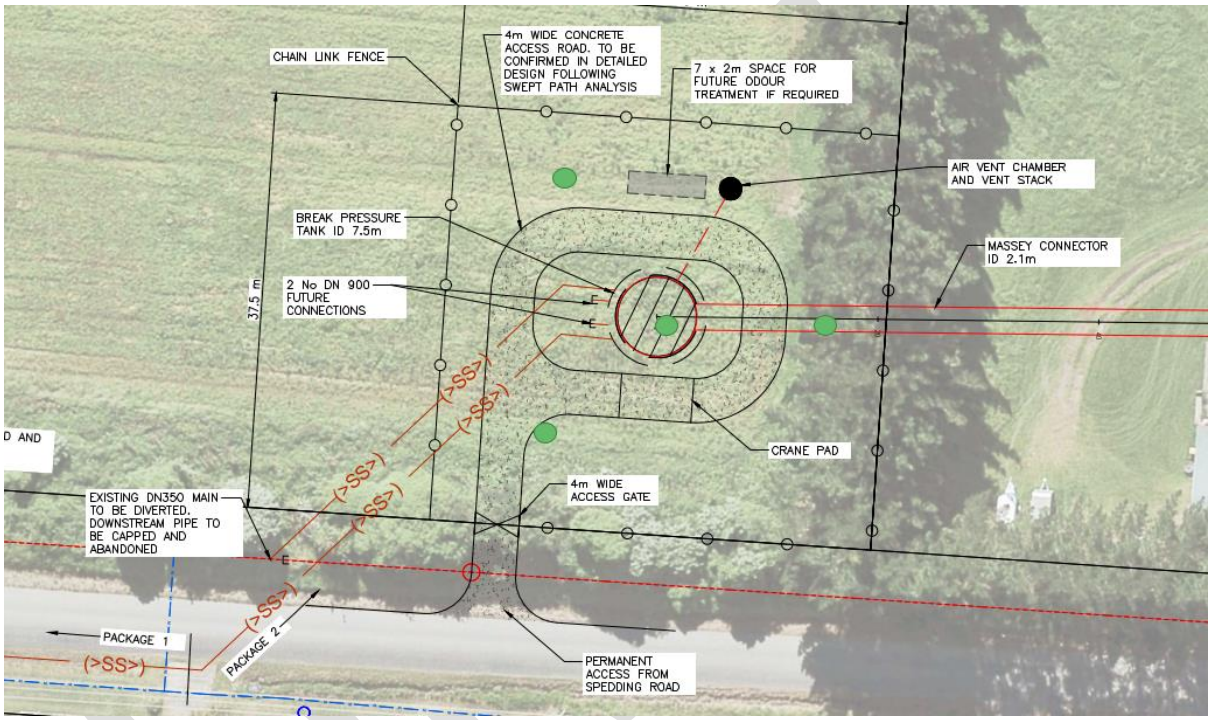
- Copies of weigh bridge summaries and disposal volumes for the disposal to cleanfill, managed fill and/or consented landfill.
- Documentation confirming the source, and where necessary testing, of any imported material during works.
- Records of visits from contaminated land related council representatives.
- Details of any complaints in relation to contamination.
- Details of any contaminated land related health & safety incidents and how they were resolved.
- Details of unexpected discoveries and the contingency action undertaken.

Sampling plan and methodology

Sampling plan and methodology for proposed investigation works to support earthworks at the Break Pressure Tank and trenching works between Shaft 17 and the Hobsonville Pumpstation is under preparation.

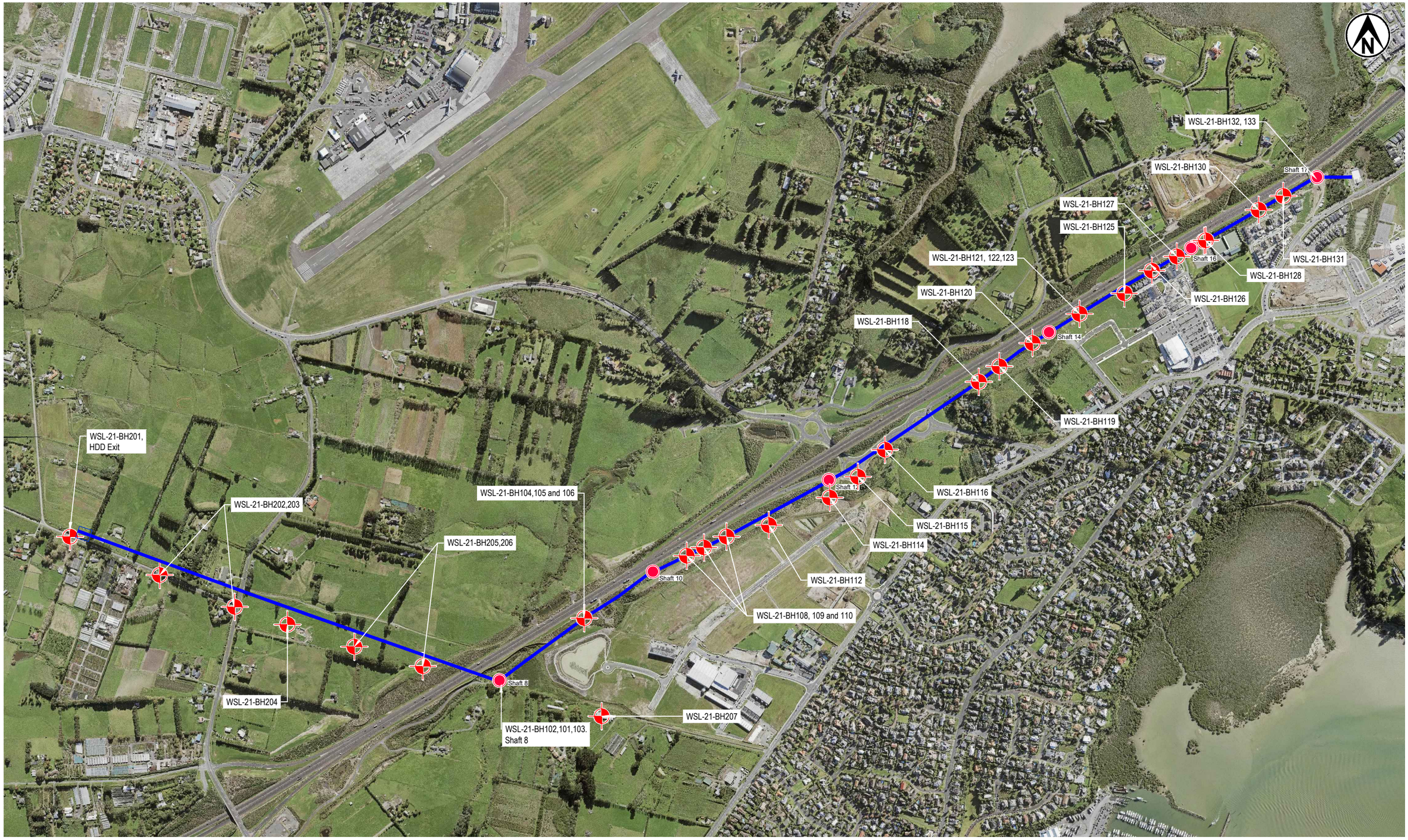
Draft sampling layout plan shown below for each location – green circles represent proposed sampling locations:

Break Pressure Tank area



Shaft 17 to Hobsonville Pumpstation

P:\1015506\WorkingMaterial\CAD\1015506-F2.2.dwg 2023-May-02 8:54:13 am Plotted By: TERESA FAYE CORPUZ



A3 SCALE 1:10000

0 0.1 0.2 0.3 0.4 0.5 (km)

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PROJECT No.	1015506.000	
DESIGNED	RVDK	May.23
DRAWN	RBS	May.23
CHECKED		

BUILDING CONSENT APPROVAL

APPROVED DATE

CLIENT **WATERCARE SERVICES LIMITED**

PROJECT **GROUND CONTAMINATION DETAILED SITE INVESTIGATION**

TITLE WHENUAPAI REDHILLS WASTEWATER SERVICING SCHEME PACKAGE 2
Site Features

UNDER REVISION 1

SCALE (A3) 1:10,000 FIG No. 1015506.000-F4.1 REV 1

Table E.9: Summary table of groundwater testing Whenuapai Package 2

				14		16		10	12		17	
Sample Name	ANZECC Guidelines for the Protection of 95% of Freshwater Species [1]	**Background groundwater concentrations - Waitemata Bores [2]**	Maximum	BH122 Deep A	BH122 Shallow A	BH127 Deep B	BH127 Shallow A	BH110 A	BH115 shallow A	BH115 deep A	BH132 shallow A	BH132 deep A
Depth to groundwater (mbgl)				6.166	3.844	7.214	5.832	7.76	3.464	3.078	3.524	6.273
Screen depth (top-bottom)				11-15m	5-9m	21-24m	6.7-9.7m	21-27m	5-8m	16-19m	4-7m	13-16m
Soil profile				Fill material to 2.80m, Tauranga Group to 8.85m, East Coast Bays 8.85-30m		Fill material to 1.5m, Tauranga Group to 21.4m, East Coast Bays 21.4-25.5m		Fill material to 3.45m, Tauranga Group to 17.52m, East Coast Bays from 17.52-33m	Fill material to 3.0m, Tauranga Group to 9.4m, East Coast Bays from 9.4-19.5m		Fill material to 0.6m, Tauranga Group to 23.70m, East Coast Bays 23.70-33.13m	
Sample Date				8/07/2021	09/07/2021	8/07/2021	09/07/2021	18/11/2021	18/11/2021	18/11/2021	18/11/2021	18/11/2021
QC Type				Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
Testing suite				Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC	Metal, TPH, SVOC
Laboratory ID				21-30964	21-30964	21-30964	21-30964	21-48482-1	21-48482-5	21-48482-3	21-48482-7	21-48482-9
Metals												
Dissolved Arsenic	0.013	**0.0101**	0.0046	0.0013	0.0043	0.00085	0.0012	<0.00050	0.00059	<0.00050	0.0046	0.002
Dissolved Cadmium	0.0002	-	0.0002	<0.00002	0.0002	0.000021	0.000022	<0.000020	0.000083	<0.000020	0.000025	<0.000020
Dissolved Chromium	0.001	**<0.0005**	**0.0042**	**0.0011**	**0.0042**	<0.0002	<0.0002	<0.00020	0.00028	<0.00020	**0.0014**	**0.0009**
Dissolved Copper	0.0014	**0.001**	**0.011**	0.00024	**0.011**	<0.0002	<0.0002	<0.00020	**0.0047**	0.00058	**0.0087**	0.00061
Dissolved Lead	0.0034	**0.0008**	**0.0022**	<0.00005	**0.0017**	0.000055	<0.00005	<0.000050	<0.000050	<0.000050	**0.0022**	0.00029
Dissolved Mercury	0.0006	-	<LOR	<0.00008	<0.00008	<0.00008	<0.00008	<0.000080	<0.000080	<0.000080	<0.000080	<0.000080
Dissolved Nickel	0.011	**0.03**	**0.0415**	0.0018	**0.0415**	0.0053	0.0051	0.0046	0.011	0.0011	0.0075	0.0027
Dissolved Zinc	0.008	**0.055**	**0.351**	0.016	**0.351**	0.011	0.031	0.021	**0.134**	0.022	**0.066**	0.0047
Total Petroleum Hydrocarbons (TPH)			<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
Semi-volatile organic compounds (SVOC)			<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
4-Methylphenol	-	-	**0.001**	<0.0003	**0.001**	<0.0003	<0.0003	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030
Butyl benzyl phthalate	-	-	**0.0012**	<0.001	**0.0012**	<0.001	<0.001	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Benzyl alcohol	-	-	**0.0016**	<0.0003	**0.0016**	<0.0003	**0.00043**	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030

Notes:

All concentrations in g/m^3 (ppm)

ID = Insufficent data to derive a reliable trigger value.

Red values indicate results above the ANZECC Guidelines for the Protection of 95% of Freshwater Species

Bold values indicate results above background groundwater concentrations

Shaded values indicate results above both background concnetrations and ANZECC 95% Freshwater trigger values

1 - ANZG 2000, Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

2 - Auckland Regional Council (2007). State of the Environment Monitoring: Groundwater Quality Data Report 1998-2005. ARC Technical Publication 352. Auckland. 86 Pages

Table E.1: Summary table of analytical results of shallow soil testing for Whenuapai Package 2

Sample Name						HDD Exit 0.00-0.10m	HDD Exit 0.40-1.00m	Shaft 8 0.00-0.1m	Shaft 8 0.30-1.00m	Shaft 10 BH108 - 0.0m	Shaft 10 BH108 - 0.5m	Shaft 12 BH114 - 0.1m	Shaft 12 BH114 - 0.5m	Shaft 14 BH121 - 0.0m
Sample Date						19/04/2021	19/04/2021	19/04/2021	19/04/2021	17/06/2021	17/06/2021	7/10/2021	7/10/2021	3/05/2021
QC Type						Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
Depth						0.0-0.10m	0.4-1.00m	0.00-0.10m	0.3-1.00m	0.0m	0.5m	0.0m	0.5m	0.0m
Testing suite	NES Commercial / Industrial [1]	AUP Permitted Activity Criteria [2]	Published Auckland Background Levels (non-volcanic) [3]	Ridge Road managed fill accpetance criteria [9]	Maximum	Metals (10), PAH, TPH, OCP, ONOP and asbestos	Metals (10), PAH, TPH, OCP	Metals (10), PAH, TPH, OCP, ONOP and asbestos	Metals (10), PAH, TPH, OCP	Metals (10), PAH, TPH, OCP and asbestos	Metals (10), PAH and TPH	Metals (10), PAH, TPH, OCP, ONOP and asbestos	Metals (10), PAH, TPH and OCP	Metals (10), PAH, TPH, OCP and asbestos
Laboratory ID						21-17935-3 / 2590821.3	21-17935-4	21-17935-5 / 2590821.5	21-17935-7	21-27853-1/ 21-27865-1	21-27853-2	21-43665-1/ 21-43661-1	21-43661-2	21-20712-1/ 21-31541-1
PID screening (field PPM)						0.4	0.7	0.6	0.6	Not collected	Not collected	Not collected	Not collected	0.3
pH screening (field)						-	-	-	-	-	-	-	-	-
Asbestos as ACM (w/w%)	0.05%	-	ND	1% w/w (AF/FA)	Asbestos NOT detected.	Asbestos NOT detected.	-	Asbestos NOT detected.	-	Asbestos NOT detected.	-	Asbestos NOT detected.	-	Asbestos NOT detected.
Asbestos Fibres/Fines (w/w%)	0.001%													
Metals														
Arsenic	70	100	**12**	70	10	1.7	4	5	4.1	0.91	0.91	1.3	0.99	3.3
Beryllium	220000 [4]	-	**-**	-	0.64	0.06	0.082	0.24	0.18	0.64	0.47	0.2	0.23	0.32
Boron	>10,000	-	**45**	-	4.1	2.1	<1.25	4.1	<1.25	<1.3	<1.3	1.4	<1.3	1.9
Cadmium	1300	7.5	**0.65**	7.5	0.38	0.38	0.028	0.061	0.016	0.056	0.071	0.026	0.019	0.047
Chromium	6300	400	**55**	400	23.2	4.7	6	12	14.7	7.5	8.3	8.9	9.2	13.3
Copper	>10,000	325	**45**	325	26.9	6.4	4.8	19.6	8.08	2.7	5.4	4.2	3.9	26.9
Lead	3300	250	**65**	250	24.7	6.19	6.93	6.83	6.35	11.6	7.09	13	9.64	9.87
Mercury	4200	0.75	**0.45**	0.75	0.21	0.06	0.12	<0.025	0.11	0.085	0.067	0.11	0.1	0.086
Nickel	6000 [6]	105	**35**	320	16.5	2.2	3	16.5	0.98	2.3	2.5	4.2	3	12.2
Zinc	400000 [6]	400	**180**	400	50.4	30	5.48	50	7.33	10.5	8.92	12.1	7.5	29.4
OCPs						<LOR	<LOR	<LOR	<LOR	<LOR	-	<LOR	<LOR	<LOR
4,4'-DDE	-	-	**<LOR**	-	**0.0076**	<0.005	<0.005	<0.005	<0.005	**0.0076**	-	<0.0050	<0.0050	<0.0050
TPHs						<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
C15-C36	NL [7]	NL [8]	**<LOR**	5600	**107**	**29**	<25	<25	<25	**67**	**46**	<25	<25	**56**
C7-C36 (Total)	-	-	**<LOR**	-	**107**	<50	<50	<50	<50	**67**	<50	<50	<50	**56**
PAHS						<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR	<LOR
ONOPS						<LOR	-	<LOR	-	-	-	<LOR	-	-
PFAS						-	-	-	-	-	-	-	-	-
SVOC						-	-	-	-	-	-	-	-	-

Notes:
All values in mg/kg unless otherwise indicated
'-' indicates not analysed or no relevant assessment criteria
<LOR = less than the laboratory limit of reporting
Asbestos NOT detected = asbestos not identified to be present by the laboratory method.
NL = Not limiting (i.e. >20,000 mg/kg)

Red vaues indicate that the results exceed NES Soil criteria: commercial/ industrial criteria
Underlined values indicates that the results exceed the AUP Permitted Activity Criteria
Bold values indicate that results exceed the public background concentrations for non-volcanic soils in the Auckland Region
Shaded values indicate that the results exceed typical managed fill criteria

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7 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011. Module 4 Tier 1 Soil acceptance criteria - Silty Clay - Surface (<1 m)
8 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011. Soil acceptance criteria for protection of groundwater quality, Surface (<1 m) Silty Clay, GW 4 m
9 - Ridge Road Managed Fill Acceptance Criteria

Table E.1: Summary table of analytical results of shallow soil testing for Whenuapai Package 2

Sample Name						Shaft 14 BH121- 0.5m	Shaft 16 BH128 - 0.0m	Shaft 16 BH128 - 0.5m	WSL-21-BH133-0.0m	WSL-21-BH133-0.5m
Sample Date						3/05/2021	18/05/2021	18/05/25021	28/05/2021	28/05/2021
QC Type						Regular	Regular	Regular	Regular	Regular
Depth						0.5m	0.0m	0.5m	0.0m	0.5m
Testing suite	NES Commercial / Industrial [1]	AUP Permitted Activity Criteria [2]	Published Auckland Background Levels (non-volcanic) [3]	Ridge Road managed fill accpetance criteria [9]	Maximum	Metals (10), PAH and TPH	Metals (10), PAH, TPH, OCP, ONOP and Asbestos	Metals (10), PAH, TPH and OCP	Metals (10), TPH, OCP, Asbestos, SVOC and PFAS	Metals (10), TPH, Asbestos and SVOC
Laboratory ID						21-20712-2	21-22644-1/ 21-22655-1	21-22644-2	21-24630-1/ 21-24627-1	21-24630-2/ 21-24627-2
PID screening (field PPM)						0.1	0.6	3.3	1.3	0.9
pH screening (field)						-	-	-	-	-
Asbestos as ACM (w/w%)	0.05%	-	ND	1% w/w (AF/FA)	Asbestos NOT detected.	-	Asbestos NOT detected.	-	Asbestos NOT detected.	Asbestos NOT detected.
Asbestos Fibres/Fines (w/w%)	0.001%									
Metals										
Arsenic	70	100	**12**	70	10	2.1	10	3.9	1.8	2.2
Beryllium	220000 [4]	-	-	-	0.64	0.19	0.3	0.15	0.23	0.18
Boron	>10,000	-	**45**	-	4.1	2.2	4.1	2.4	2.1	1.7
Cadmium	1300	7.5	**0.65**	7.5	0.38	0.048	0.19	0.048	0.048	0.045
Chromium	6300	400	**55**	400	23.2	11	23.2	16.4	8.9	8.8
Copper	>10,000	325	**45**	325	26.9	12.2	18.4	16.6	7.2	8.83
Lead	3300	250	**65**	250	24.7	8.94	24.7	19.1	9.17	15.3
Mercury	4200	0.75	**0.45**	0.75	0.21	0.086	0.17	0.18	0.08	0.087
Nickel	6000 [6]	105	**35**	320	16.5	6.02	13.4	13.8	6.71	6.23
Zinc	400000 [6]	400	**180**	400	50.4	24	50.4	20.1	16	23.1
OCPs						-	<LOR	<LOR	<LOR	-
4,4'-DDE	-	-	**<LOR**	-	**0.0076**	-	<0.0050	<0.0050	<0.005	-
TPHs						<LOR	<LOR	<LOR	<LOR	<LOR
C15-C36	NL [7]	NL [8]	**<LOR**	5600	**107**	**107**	**55**	<25	**37**	**29**
C7-C36 (Total)	-	-	**<LOR**	-	**107**	**107**	**55**	<50	<50	<50
PAHS						<LOR	<LOR	<LOR	<LOR	<LOR
ONOPS						-	<LOR	-	-	-
PFAS						-	-	-	<LOR	-
SVOC						-	-	-	<LOR	<LOR

Notes:
All values in mg/kg unless otherwise indicated
'-' indicates not analysed or no relevant assessment criteria
<LOR = less than the laboratory limit of reporting
Asbestos NOT detected = asbestos not identified to be present by the laboratory method.
NL = Not limiting (i.e. >20,000 mg/kg)

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9 - Ridge Road Managed Fill Acceptance Criteria

Table E7: Summary table of analytical results of deep soil testing for Whenuapai Package 2

						Main Tunnel - pH testing and testing of natural soils					Main Tunnel - pH testing and testing of natural soils				
Sample Name						WSL-21-BH101	WSL-21-BH101	WSL-21-BH104	WSL-21-BH106	WSL-21-BH110	WSL-21-BH112	WSL-21-BH116	WSL-21-BH118	WSL-21-BH120	WSL-21-BH121
Sample Date						-	7/04/2021	3/06/2021	14/06/2021	23/06/2021	18/06/2021	09/11/2021	10/06/2021	10/05/2021	4/05/2021
QC Type						Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
Depth	**NES Commercial / Industrial** [1]	**AUP Permitted Activity Criteria** [2]	**Published Auckland Background Levels (non-volcanic)** [3]	**Ridge Road managed fill accpetance criteria** [7]	**Maximum**	10-10.4m	28-28.7m	12m	21m	20m	24m	13m	22m	20m	10m
Testing suite						Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite
Laboratory ID						21-16211-1	21-16211-1	21-25541-1	21-26998-2	21-31081-1	21-29124-2	21-47139-1	21-26998-4	21-31081-2	21-21579-1
PID screening (field PPM)						-	-	-	-	-	-	-	-	-	-
pH screening (field)						7	7	7	No reading taken	7	7	7	7	7	7
pH*	-	-	-	-	7.6	7.5	7.6	4.8	5.1	4.1	3.2	4.2	4.4	3.9	3.9
Chloride*	-	-	-	-	20.4	9.8	3.8	3.4	<3.0	10.9	5.5	<3.0	3.8	6.1	<3
Sulfate-S*	-	-	-	-	107.4	67.5	78.8	9.1	25.5	29.2	<3.0	2,588.0	11.2	107.4	16.4
Arsenic	70	100	**12**	70	5.7	5.3	5.7	0.3	1.4	1.9	<0.13	5.8	2	4.1	2.8
Barium	2000 [5]	-	**350**	-	**939**	138	**357**	41.7	**729**	117	41.1	315	275	101	109
Beryllium	220000 [4]	-	-	-	1.87	0.3	0.44	0.62	0.31	0.88	0.74	0.37	0.32	0.46	0.59
Boron	>10,000	-	**45**	-	5.8	3.7	5.5	2.2	2	2.2	1.9	3.5	2.8	2	2.6
Cadmium	1300	7.5	**0.65**	7.5	0.14	0.033	0.073	0.015	0.054	0.047	<0.0050	0.17	0.044	0.015	0.048
Chromium	6300	400	**55**	400	24.4	24.3	20.1	14.2	17.2	14	12	17.5	14.9	13.1	13.1
Cobalt	350 [4]	-	**35**	-	20.3	8.32	9.88	0.71	9.41	13.2	2.1	21.7	6.22	10.5	8.05
Copper	>10,000	325	**45**	325	32.6	13.1	22.1	32.6	14.1	16.9	11.0	17.6	12.5	13.4	18.5
Lead	3300	250	**65**	250	14	4.8	8.99	6.19	4.3	4.7	4.5	5.0	4.6	6.37	5.88
Manganese	26000 [4]	-	**2500**	-	1070	180	423	23.8	146	96.3	55	192	777	100	99.9
Mercury	4,200	1	**0.45**	-	0.42	0.032	0.05	0.032	<0.025	<0.025	<0.025	0.061	<0.025	0.028	0.044
Nickel	6000 [6]	105	**35**	320	**37.9**	15.9	19.4	1.6	15.9	21.9	4.4	**36.5**	11.2	19.7	14.9
Selenium	5800 [4]	-	-	-	2.4	0.88	1.5	1.2	0.41	0.72	2.1	0.79	0.42	0.65	0.88
Tin	700000 [4]	-	**4**	-	2.2	0.43	0.57	0.43	0.39	0.65	0.33	0.38	0.32	0.43	0.46
Vanadium	5800 [4]	-	**160**	-	60.9	44.4	49	34.6	56.4	24.7	23.7	36.2	26.2	17.1	17.8
Zinc	400000 [5]	400	**180**	400	91.1	40.2	55.6	13.7	34.8	50.6	23.5	79.6	38.3	22.5	54
Sulfur*	6000000 [4]	-	**2300**	-	**4100**	1800	**3300**	<250	1,700	1,200	<250	**18,000**	1,500	**2,900**	1900
Fluoride*	47000 [4]	-	-	-	280	170	230	110	99.0	100	120	170	170	110	130
Total Organic Carbon	-	-	**0.6-14%**	-	**26.1**	12.1	0.99	0.13	0.23	0.22	<0.10	1.3	0.58	0.25	0.23
Allophane Indicator*	-	-	-	-	Moderate	Very Weak	Moderate	Weak	Moderate	Very Weak	Very Weak	Non - Reactive	Moderate	Non - Reactive	Non- Reactive

Notes:
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7 - Ridge Road Quarry Managed Fill Acceptance Criteria

Table E7: Summary table of analytical results of deep soil testing for Whenuapai Package 2

						Main Tunnel - pH testing and testing of natural soils						Main Tunnel - pH testing and testing of natural soils		
Sample Name						WSL-21-BH121	WSL-21-BH125	WSL-21-BH126	WSL-21-BH130	WSL-21-BH131	WSL-21-BH132	WSL-21-BH132	WSL-21-BH133	WSL-21-BH133
Sample Date						5/05/2021	20/10/21	20/10/21	1/06/2021	27/05/2021	25/05/2021	25/05/2021	31/05/2021	31/05/2021
QC Type						Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
Depth	**NES Commercial / Industrial [1]**	**AUP Permitted Activity Criteria [2]**	**Published Auckland Background Levels (non-volcanic) [3]**	**Ridge Road managed fill accpetance criteria [7]**	**Maximum**	25m	23m	17m	16m	10m	10m	15m	10m	15m
Testing suite						Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite
Laboratory ID						21-21579-1	21-45159-2	21-45159-3	21-25082-2	not collected yet	21-24443-1	21-24443-2	21-25085-1	21-25085-2
PID screening (field PPM)						-	-	-	-	-	-	-	-	-
pH screening (field)						7	7	7	7	7	7	7	7	7
pH*	-	-	-	-	7.6	5.9	3.8	4	3.7	4.3	4.8	4.3	4.3	3.8
Chloride*	-	-	-	-	20.4	14.5	5.3	19.1	<3.0	14.6	16.6	5.3	11.1	5.4
Sulfate-S*	-	-	-	-	107.4	34.5	6.7	<3.0	16.3	12.1	3.5	<3.1	4.3	<3
Arsenic	70	100	**12**	70	5.7	2.8	2.4	0.54	2.4	0.77	0.98	0.39	1.3	0.36
Barium	2000 [5]	-	**350**	-	**939**	**427**	90.4	31.9	30.1	206	181	40.2	124	52.5
Beryllium	220000 [4]	-	**-**	-	1.87	0.43	1.87	0.3	0.48	0.62	0.95	0.28	0.8	0.17
Boron	>10,000	-	**45**	-	5.8	5.8	3	1.5	2.3	1.5	2.9	<1.25	1.6	<1.25
Cadmium	1300	7.5	**0.65**	7.5	0.14	0.048	0.022	<0.0050	0.091	0.039	0.038	0.011	0.14	0.016
Chromium	6300	400	**55**	400	24.4	20.8	13.2	13.3	7.1	7.6	12	18.8	6.1	16.4
Cobalt	350 [4]	-	**35**	-	20.3	10	8.59	0.88	7.64	0.89	1.8	0.37	0.55	0.4
Copper	>10,000	325	**45**	325	32.6	17.9	31.1	19.8	11.7	6.7	2.8	5.3	1.4	6.3
Lead	3300	250	**65**	250	14	5.56	7.2	4.7	5	8.97	4.3	10.2	12.3	14
Manganese	26000 [4]	-	**2500**	-	1070	395	108	5.5	61.6	64.4	117	49.8	47.5	47.3
Mercury	4,200	1	**0.45**	-	0.42	0.037	0.036	<0.025	0.025	0.42	0.15	0.28	0.14	0.19
Nickel	6000 [6]	105	**35**	320	**37.9**	16.9	15	1.9	11.8	4.4	2.1	1.8	1.6	1.4
Selenium	5800 [4]	-	**-**	-	2.4	0.65	1.3	0.66	0.69	2.4	1.6	0.66	1.3	0.47
Tin	700000 [4]	-	**4**	-	2.2	0.56	0.62	0.44	0.28	1.8	0.71	0.76	1.5	0.82
Vanadium	5800 [4]	-	**160**	-	60.9	35.1	37.4	27.9	11	8.9	15.1	58.9	10	60.9
Zinc	400000 [5]	400	**180**	400	91.1	52.6	46.6	21.1	91.1	7.47	4.2	21.4	9.44	47.7
Sulfur*	6000000 [4]	-	**2300**	-	**4100**	1600	**3,800**	<250	1,800	1700	**4100**	<250	720	<250
Fluoride*	47000 [4]	-	**-**	-	280	250	210	130	99	140	75	120	170	130
Total Organic Carbon	-	-	**0.6-14%**	-	**26.1**	0.23	0.48	<0.10	0.21	12	**26.1**	0.71	9.1	0.49
Allophane Indicator*	-	-	-	-	Moderate	Non- Reactive	Very Weak	Very Weak	Non - Reactive	Non - Reactive	Non - Reactive	Non - Reactive	Non - Reactive	Non - Reactive

Notes:
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7 - Ridge Road Quarry Managed Fill Acceptance Criteria

Table E7: Summary table of analytical results of deep soil testing for Whenuapai Package 2

						Massey Connector - pH testing and testing of natural soils					Massey Connector - pH testing and testing of natural soils			
Sample Name						WSL-21-BH201	WSL-21-BH202	WSL-21-BH202	WSL-21-BH203	WSL-21-BH204	WSL-21-BH204	WSL-21-BH205	WSL-21-BH206	WSL-21-BH206
Sample Date						30/03/2021	30/03/2021	30/03/2021	16/03/2021	16/03/2021	16/03/2021	16/03/2021	16/03/2021	16/03/2021
QC Type						Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular	Regular
Depth	**NES Commercial / Industrial [1]**	**AUP Permitted Activity Criteria [2]**	**Published Auckland Background Levels (non-volcanic) [3]**	**Ridge Road managed fill accpetance criteria [7]**	**Maximum**	4-4.2m	14-14.2m	32-32.2m	25-25.2m	26-26.2m	36-36.2	22-22.2m	16-16.2m	24-24.2m
Testing suite						Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite	Full suite
Laboratory ID						21-14934-1	21-14934-2	21-14934-3	21-12125-1	21-12125-2	21-12125-3	21-12125-4	21-12125-5	21-12125-6
PID screening (field PPM)						-	-	-	-	-	-	-	-	-
pH screening (field)						7	7	7	7	7	7	7	7	7
pH*	-	-	-	-	7.6	4.1	4.1	5.2	5.9	6.2	7	4.4	4.1	5.5
Chloride*	-	-	-	-	20.4	8.7	4.5	20.4	6.1	3.3	4.9	<3	<3	<3.1
Sulfate-S*	-	-	-	-	107.4	<3.0	21.8	25.1	18.4	64.6	106.1	34	16	83.4
Arsenic	70	100	**12**	70	5.7	0.95	2.5	2.5	2.6	4.7	2.6	2.5	2.2	2.2
Barium	2000 [5]	-	**350**	-	**939**	29	**939**	266	**736**	117	211	133	**671**	**534**
Beryllium	220000 [4]	-	-	-	1.87	0.2	0.4	0.5	0.45	0.47	0.36	1.2	0.41	0.31
Boron	>10,000	-	**45**	-	5.8	4.5	5.7	5.5	4.8	4.4	3.9	2.8	3	2.9
Cadmium	1300	7.5	**0.65**	7.5	0.14	<0.0050	0.056	0.061	0.058	0.064	0.055	0.048	0.038	0.051
Chromium	6300	400	**55**	400	24.4	7.7	12.8	16.3	16	19.2	24.4	15.5	14.1	15.2
Cobalt	350 [4]	-	**35**	-	20.3	0.24	10.2	8.25	13.6	11	9.14	20.3	11.4	8.6
Copper	>10,000	325	**45**	325	32.6	8.96	15.9	24	26.9	32.5	19.9	20.5	16.4	18.5
Lead	3300	250	**65**	250	14	7.43	5.2	7.03	6.21	8.17	5.05	4.9	4.5	4.4
Manganese	26000 [4]	-	**2500**	-	1070	9.1	459	171	1070	186	493	132	294	1060
Mercury	4,200	1	**0.45**	-	0.42	<0.025	0.027	0.028	0.034	0.05	0.03	<0.025	<0.025	<0.025
Nickel	6000 [6]	105	**35**	320	**37.9**	0.8	15.9	14.8	21.9	19.7	16.3	**37.9**	19.2	14.7
Selenium	5800 [4]	-	-	-	2.4	<0.25	0.72	1.1	1.1	1.1	0.94	1.6	0.95	0.83
Tin	700000 [4]	-	**4**	-	2.2	2.2	0.75	0.68	0.48	0.53	0.4	0.41	0.33	0.33
Vanadium	5800 [4]	-	**160**	-	60.9	15.3	25.9	31.6	33.4	38.8	51	26.2	25.3	33.9
Zinc	400000 [5]	400	**180**	400	91.1	4.8	50.5	54.5	60.6	67.4	46.7	52.2	55.2	47.4
Sulfur*	6000000 [4]	-	**2300**	-	**4100**	<250	1400	1700	2100	**2700**	**3800**	1400	1600	1300
Fluoride*	47000 [4]	-	-	-	280	98	150	280	210	260	190	120	140	230
Total Organic Carbon	-	-	**0.6-14%**	-	**26.1**	0.08	0.19	0.27	0.26	0.36	0.14	0.15	0.14	0.29
Allophane Indicator*	-	-	-	-	Moderate	Very Weak	Non - Reactive	Non - Reactive	Non - Reactive	Non - Reactive	Moderate	Non - Reactive	Non - Reactive	Non - Reactive

Notes:
All values in mg/kg unless otherwise indicated
'-' indicates not analysed or no relevant assessment criteria
<LOR = less than the laboratory limit of reporting

Red vaues indicate that the results exceed NES Soil criteria: commercial/ industrial criteria
Underlined values indicates that the results exceed the AUP Permitted Activity Criteria
Bold values indicate that results exceed the public background concentrations for non-volcanic soils in the Auckland Region
Shaded values indicate that the results exceed typical managed fill criteria

1 - MfE, April 2012. Users Guide: National Environmental Standard for assessing and managing contaminants in soil to protect Human Health: Commercial/Industrial use (adopted for the protection of construction workers during the proposed works).
2 - Auckland Unitary Plan: Operative in Part Version (AUP). Permitted Activity Soil Criteria Table E30.6.1.4.1 (unless otherwise stated).
3 - Auckland Regional Council, Technical Publication 153, October 2001. Background concentrations of inorganic elements in soils from the Auckland Region: non-volcanic soils.
4 - USEPA Regional Screening Levels - Summary Table TR=1E-06, HQ=1 (https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables)
5 - Canadian Environmental Quality Guidelines (CCME, 2002) (http://st-ts.ccme.ca/)
6 - Assessment of Site Contamination National Environment Protection Measures (ASC NEPM) Toolbox – http://www.nepc.gov.au/nepms/assessment-site-contamination/toolbox.
7 - Ridge Road Quarry Managed Fill Acceptance Criteria