



Watercare Services Limited

Whenuapai-Redhills Wastewater Servicing Package 1 Environmental Assessment: Detailed Site Investigation - Summary Report

June 2021

Executive summary

GHD Limited (GHD) has been engaged by Watercare Services Limited (Watercare) to prepare a contaminated land Detailed Site Investigation (DSI) report to support consenting requirements for construction of the proposed Whenuapai-Redhills Package 1 wastewater rising main/gravity main and interim pump station (the alignment).

The proposed method of construction for the alignment is a combination of open-cut trench, which will be opened and closed progressively as the construction moves along the alignment, and horizontal directional drilling (HDD). Open cut excavations will be required for construction of the interim pump station.

The purpose of this report is to provide information on the potential for soil and groundwater contamination along the proposed alignment, and to assess compliance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations, 2011(NES CS) and Auckland Unitary Plan Operative in Part (AUP (OP)) rules for discharges to the environment.

Contamination investigations were carried out by Tonkin & Taylor Ltd (T+T) in conjunction with the geotechnical investigations along the alignment from 2 November 2020 to 18 December 2020. The investigations were undertaken in accordance with the environmental investigation specifications prepared by GHD in October 2020 titled "*Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Ground Investigation Scope (Package 1)*" (GHD Ground Investigation Scope).

The findings of the DSI identified soil concentrations in the vicinity of the alignment reported below the adopted human health criteria under the NES CS Regulations, the permitted activity discharge criteria under the AUP (OP) E.30, and background where soil will be disturbed during construction.

The NES CS Regulations are considered to no longer apply to soil disturbance and removal activities during construction works as the DSI demonstrates concentrations of select inorganic and organic contaminants are below naturally occurring background levels. Therefore, resource consent is not required in accordance with Regulation 5(9) of the NES CS.

The discharge of groundwater onto or into land and/or into water for the purpose of dewatering trenches or other excavations during construction of the watermain (where dewatering is required) along the alignment is a **Permitted Activity** under the AUP (OP) Rule E4.4.1 (A5).

The maximum reported concentrations of copper, nickel, and zinc were found to exceed the respective ANZECC Guidelines for the protection of 80% and 95% freshwater species, which applies to discharge of groundwater to surface water receptors along the alignment. Testing of groundwater during dewatering activities is recommended prior to discharge and testing and treatment procedures are to be outlined in a SMP.

Based on the results of the DSI, soil is considered suitable for reuse as backfill (if geotechnically suitable) or disposal offsite to a licenced managed landfill facility i.e., Redvale Landfill. It is recommended that licenced landfill operators be provided a copy of the laboratory reports and consulted to confirm acceptance requirements prior to delivery of the material to respective facilities.

It is recommended that Site Management Plan (SMP) be prepared, and the controls implemented to manage discharges into the environment from construction dewatering, and soil disposal during construction. Any groundwater encountered during construction would be

managed onsite using appropriate management controls as provided in the SMP and by the implementation of appropriate sediment control measures.

Soil and groundwater management procedures outlined in a SMP are recommended to be adhered to during the construction and that contamination discovery protocols be adopted. This relates to situations encountering any unexpected contamination, to manage any potential risks to human health and the environment during construction. The contaminant discovery protocols provided in a SMP should be followed and if further contamination is discovered, soils should be tested and disposed of to an appropriately licensed facility as required.

This report is subject to, and must be read in conjunction with, the limitations set out in this report and the assumptions and qualifications contained throughout the Report.

Limitations

This report: has been prepared by GHD for Watercare Services Limited and may only be used and relied on by Watercare Services Limited for the purpose agreed between GHD and the Watercare Services Limited as set out in section 1.3 of this report.

GHD otherwise disclaims responsibility to any person other than Watercare Services Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section 1.6 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Watercare Services Limited and others (Tonkin & Taylor Ltd) who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

Table of contents

1.	Introduction.....	1
1.1	General project background	1
1.2	Construction methodology	2
1.3	Purpose of this report.....	2
1.4	Objectives	2
1.5	Scope of work	3
1.6	Assumptions	3
2.	Preliminary Site Investigation – Summary	4
2.1	PSI Overview	4
2.2	Further Investigation Requirements.....	5
3.	Statutory Context	5
3.1	The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011	5
3.2	The Auckland Unitary Plan – Operative in Part	6
3.3	Contaminated Land Management Guidelines	7
4.	Detailed Site Investigation.....	7
4.1	Field investigations	7
4.2	Analytical testing suites.....	7
4.3	Summary of observed field conditions.....	10
5.	Assessment of soil and groundwater contamination	12
5.1	Soil Screening Criteria	12
5.2	Groundwater Screening Criteria	16
5.3	Soil and Groundwater Analytical Results.....	16
5.4	Field Quality Assurance and Quality Control Procedures	18
6.	Conceptual Site Model.....	20
6.1	Refinement of the Conceptual Site Model	20
6.2	Conceptual Site Model Summary	21
7.	Conclusions and Recommendations	22
7.1	Statutory Requirements	22
7.2	Recommendations.....	22

Table index

Table 4-1: PID Field Readings	11
Table 6-1: AUP (OP) Permitted Activity Criteria.....	14
Table 6-2: Background Concentrations in the Auckland Region	14

Figure index

Figure 1-1: Indicative location and extent of the proposed alignment.....	1
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Appendices

Appendix A – Tonkin & Taylor Ground Contamination Factual Report

Appendix B – Tonkin & Taylor Geotechnical Logs

Appendix C – Soil and Groundwater Analytical Results – Summary Tables

1. Introduction

1.1 General project background

GHD Limited (GHD) has been engaged by Watercare Services Limited (Watercare) to prepare a contaminated land Detailed Site Investigation (DSI) report to support resource consenting requirements for the proposed Whenuapai-Redhills Package 1 wastewater rising main/gravity main and interim pump station (the proposed alignment) as shown in Figure 1-1.

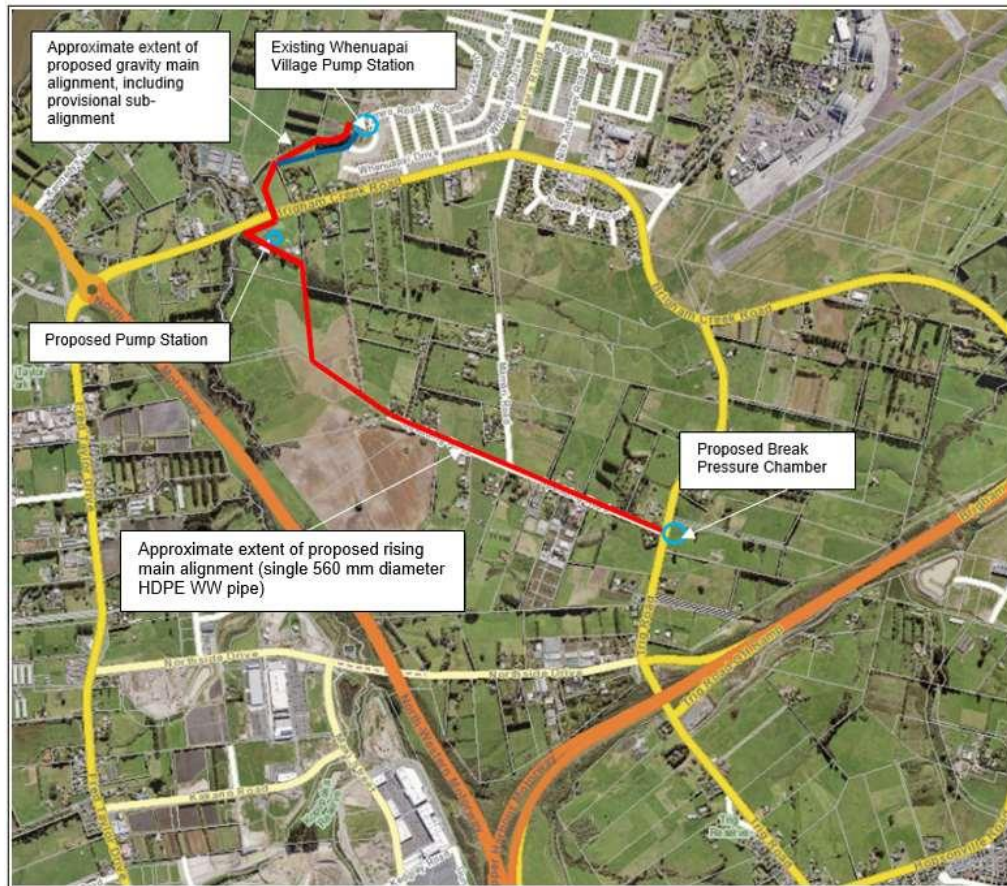


Figure 1-1: Indicative location and extent of the proposed alignment

1.1.1 Previous site investigations

A Preliminary Site Investigation (PSI) was completed by GHD in October 2020 (GHD, 2020a)¹ for the proposed alignment. The PSI report assessed potential risks to human health where potential activities listed on the Ministry for the Environment (MfE) Hazardous Activities and Industries List (HAIL)² were identified as having ‘more likely than not occurred’ along the proposed alignment.

A detailed summary of the PSI findings and risk assessment related to the proposed construction along the alignment is provided in section 2 of this report. The PSI report has not been appended to this report; however, it is available upon request.

Watercare engaged Tonkin and Taylor Ltd (T+T) to undertake geotechnical and contaminated land field investigations. The geotechnical and contaminated land field investigations were

¹ GHD Limited. (2020a). Whenuapai-Redhills Wastewater Servicing Environmental Assessment: Preliminary Site Investigation. Report prepared for Watercare Services Limited dated June 2020.

² Ministry for the Environment. (2011). Hazardous Activities and Industries List.

undertaken in accordance with the “Whenuapai-Redhills Wastewater Servicing Rising Main /Gravity Main and Interim Pump Station Investigation Scope” (GHD Investigation Scope) prepared by GHD in October 2020 (GHD, 2020b)³. This report summarises the ground contamination findings of the T+T contaminated land investigation undertaken for the proposed alignment.

1.2 Construction methodology

The overall development comprises approximately 3 km of pipeline upgrade, an interim pump-station and a new break-pressure chamber.

The construction methodology along the proposed alignment for the proposed rising and gravity main sections will be a combination of trenching and horizontal directional drilling (HDD) to a depth of 3 to 7 metres below ground level (mbgl), except for the crossing of the Sinton Stream which could see depths extending to approximately 15.0 mbgl. The maximum depth of soil disturbance at the proposed pump station is anticipated to be at 15 mbgl. The maximum depth of soil disturbance at the new break pressure chamber will be approximately 5 mbgl.

The excavation volumes along the proposed alignment are anticipated to exceed Ministry for the Environment (MfE) National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, 2011(NES CS)⁴ permitted activity criteria of 25 m³ per 500 m² for soil disturbance and 5 m³ per 500 m² for soil removal.

1.3 Purpose of this report

The purpose of this report is to provide information on the potential for soil and groundwater contamination along the proposed alignment and to assess compliance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health), Regulations 2011(NES CS) ⁵ and Auckland Unitary Plan Operative in Part (AUP (OP))⁶.

1.4 Objectives

The objectives of this DSI are to:

- Assess the contamination status of soil along the alignment to evaluate whether the proposed construction poses a risk to human health and the environment; during soil disturbance activities;
- Identify the consent requirements under the NES CS Regulations and AUP (OP);and
- Identify any extra considerations or management that may need to be addressed during construction and design due to possible contamination along the alignment.

³ GHD Limited. (2020b). Whenuapai-Redhills Wastewater Servicing Rising Main /Gravity Main and Interim Pump Station Investigation Scope (Package 1). Prepared for Watercare Services Limited dated October 2020 (Revision 2).

⁴ Ministry for the Environment Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. In. Ministry for the Environment. (2012). Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

⁵ Ministry for the Environment Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.

⁶ The Auckland Unitary Plan Operative in Part 2016 (updated 09 April 2021).

1.5 Scope of work

The scope of work for this DSI included the following:

- A review of the reported ground conditions and contamination results from the soil and groundwater investigations undertaken by T+T for the purpose of chemical characterisation to inform disposal and resource consent requirements;
- Preparation of this DSI report to summarise the investigation findings undertaken and the assessment of the soil and groundwater analytical results in accordance with the MfE *Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand (Revised 2011)*; and
- Recommendations on off-site disposal and on-site reuse options for soil excavated during the proposed works, including any contaminated land management controls that may be required based on the reported findings.

1.6 Assumptions

This report was developed with consideration given to the following assumptions:

- The ground contamination investigations that were scoped as part of the DSI are based on the proposed alignment design as described in the GHD Investigation Scope (Revision 2) dated October 2020 (GHD, 2020b). Reassessment of the soil and groundwater analytical findings and an update of this DSI report will be required should any additional changes of the design occur.
- The level of environmental investigations scoped is considered sufficient to assess the contamination risk along the proposed alignment to inform resource consent status under the Resource Management National Environmental Standard Assessing and Managing Contaminants in Soil to Protect Human Health, 2011 (NES CS) and the Auckland Unitary Plan – Operative in Part (AUP (OP)) Chapter E.30 for discharges to the environment.
- The level of environmental investigations scoped is considered sufficient for the purpose of characterising the soil and groundwater risk along the proposed alignment for disposal purposes.
- It is assumed that the maximum depth of soil disturbance from open-cut excavations at the proposed pump station is 15 mbgl. As such, the proposed sampling locations and depths specified in the environmental investigation have been scoped to allow representative sampling of the soil profile.
- It is assumed that the construction methodology along the proposed alignment will be a combination of trenching and HDD to a depth of 3 to 7 mbgl, except for the crossing of the Sinton Stream which could see depths extending to approximately 15.0 mbgl. The soil disturbance and dewatering will occur along trench excavations and at drilling pit/shaft sites along the proposed alignment. As such, the sampling locations and depths outlined in this investigation were scoped to characterise both the deep and shallow soil profile and underlying aquifers.
- The analytical testing suites adopted as part of this investigation intended to assess the contamination risk to human health and the environment, and suitability for soil disposal and groundwater discharges.
- The information obtained from third parties including Watercare and T+T is complete and accurate and represents existing ground conditions.
- The observations made during the investigation are representative of the activities that have occurred onsite; and

- The observable and inferred site condition is representative of the actual site condition.

2. Preliminary Site Investigation – Summary

2.1 PSI Overview

The purpose of the PSI was to inform Watercare of the potential risks to human health and environment from identified potential or known HAIL sites and the likely resource consent requirements under the NES CS Regulations and AUP (OP).

The scope of work primarily involved a desktop-based review of historical aerial photographs and Auckland Council contaminated sites register searches.

The potential risk in relation to the presence of HAIL activities was also considered as part of the investigation and a qualitative risk rating, as per below, was allocated to sites where potential or known HAIL items were identified:

- **Low** – HAIL activities are within 500 m of a proposed alignment and are unlikely to impact the proposed works.
- **Medium** – HAIL activities identified with potential contaminating activities or industries occurring on land adjacent to a proposed alignment. There is some potential for contact during proposed works.
- **High** – HAIL activities have been identified and contamination is known to have occurred on land either adjacent to or beneath a proposed alignment.

The findings of the PSI indicated that there is the potential for contaminated land associated with historical and existing HAIL activities to be encountered along the proposed alignment.

The PSI identified six sites where HAIL activities associated with commercial/industrial wastewater treatment and disposal, storage and use of hazardous goods, and horticultural activities have 'more likely than not' occurred.

The findings of the PSI reported two high risk and nine medium risk category HAIL activities identified along the proposed alignment. Low risk HAIL activities were identified within a distance within 500 m; however, were considered unlikely to present a risk to the proposed works. The supplementary information provided by Auckland Council did not suggest any significant contaminant issues along the proposed alignment.

The potential soil contaminants of concern related to the HAIL activities identified were as follows:

- Heavy metals
- Organochlorine pesticides (OCPs)
- Total petroleum hydrocarbons (TPH)
- Benzene, ethylbenzene, toluene, xylene (BTEX)
- Volatile organic compounds (VOCs)

2.2 Further Investigation Requirements

Upon completion of the PSI, a DSI was recommended to be undertaken to confirm resource consent status under the NES CS and AUP (OP), to characterise the soil for off-site disposal, and inform appropriate management of soil in the event of contamination discovery during construction.

3. Statutory Context

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

3.1.1 Overview

The NES CS regulates activities undertaken on contaminated land and provides nationally consistent human health risk-based standards for management of such activities.

The NES CS does not include criteria for environmental risk assessment; however, this is covered by the AUP (OP) and is discussed in section 3.2.

The NES CS applies to 'pieces of land' on which any activity in the HAIL is 'more likely than not' to have occurred and for soil disturbance where the following permitted activity thresholds are exceeded:

- Soil disturbance greater than 25 m³ per 500 m² of the piece of land associated with the HAIL
- Soil removal greater than 5 m³ per 25 m² of the piece of land associated with the HAIL.

These permitted activity thresholds as well as other triggers are detailed in Regulation 8 (3) of the NES CS.

The NES CS also regulates:

- Site investigation and reporting
- The sampling of soils for contamination assessment
- Removing underground fuel storage systems
- Contamination investigations and health risk assessments when subdividing land and changing land use.

3.1.2 Applicability

The NES CS applies to areas ('pieces of land') on which a HAIL activity is 'more likely than not' to have occurred and restricts activities, such as soil disturbance, from being undertaken on the 'pieces of land'. The PSI undertaken by GHD (2020a) assessed the likelihood of contaminated soil and groundwater existing in the area(s) of proposed earthworks by means of a desktop review of available information pertaining to the location of the site. The term defined as the 'pieces of land' in the NES CS was applied to the linear section of the road carriageway and land parcels intersected by the proposed alignment where soil disturbance is proposed during construction.

Where a HAIL activity is identified as having 'more likely than not' occurred along the alignment, the NES CS will be considered to apply to the proposed works under Regulation 5(1)(a) of the NES CS. Soil disturbance of up to 25 m³ per 500 m² of the 'piece of land' is considered a permitted activity. However, only 5 m³ per 500 m² would be permitted for soil removal from the site. If these criteria, among others, are not met then resource consent will be required for the proposed works. If a resource consent is required, then the NES CS requires that a DSI be undertaken to assess whether the activity is a controlled or restricted discretionary activity. However, the NES CS would be deemed to no longer apply to the 'pieces of land' if the DSI demonstrates that any contaminants in, or on, the 'pieces of land' are at or below background concentrations under Regulation 5(9).

The applicability of the NES CS Regulations based on the DSI findings is discussed further in section 7.1.1 of this report.

3.2 The Auckland Unitary Plan – Operative in Part

3.2.1 Overview

Councils are required to manage both the use of land containing elevated levels of contaminants and the discharge of contaminants from land containing elevated levels of contaminants. Therefore, Councils may impose controls in addition to the NES CS for environmental protection.

The AUP (OP) includes the regulations associated with Contaminated Land (Chapter E30) and specifies rules that relate to the discharges of contaminants from disturbing soil on land and discharges of surface and groundwater containing elevated levels of contaminants.

3.2.2 Applicability

Soil disturbance

The AUP (OP) section E30 Contaminated Land applies to soil disturbance activities where the following thresholds are exceeded:

- Soil disturbance greater than 200 m³ (refer E30.6.1.2(1)(b)), on a site with contaminant concentrations above the permitted activity criteria as outlined in Table E30.6.1.4.1 of the AUP (OP)

Dewatering

The discharge of groundwater onto or into land and/or into water for the purpose of dewatering trenches or other excavations during construction of the interim pump station and rising main (where dewatering is required) is a Permitted Activity under the AUP (OP) Rule E4.4.1 (A5).

Therefore, groundwater testing is not required to further inform resource consent status for the purpose of dewatering under the AUP (OP) during construction. However, groundwater testing has been undertaken to assess concentrations of contaminants for disposal purposes during construction dewatering i.e., to inform whether dewatered groundwater can be discharged to surface water or requires further treatment and/or offsite disposal.

The applicability of the AUP(OP) based on the DSI findings is discussed further in section 7.1.2 of this report.

3.3 Contaminated Land Management Guidelines

The MfE has prepared a series of guideline documents on contaminated land management. These guidelines are intended to provide consistency of reporting on the investigation, assessment and remediation of contaminated sites in New Zealand. The NES CS Regulations incorporates MfE Contaminated Land Management Guidelines (CLMG) by reference and therefore gives them regulatory effect.

To achieve a uniform approach to reporting in New Zealand the first of the series, the CLMG No. 1 provides guidance and a checklist for the content of reports. This DSI has been prepared in general accordance with these guidelines.

4. Detailed Site Investigation

4.1 Field investigations

Contamination investigations were carried out by T+T in conjunction with the geotechnical investigations along the alignment from 2 November 2020 to 18 December 2020. The investigations were undertaken in accordance with the sampling scope prepared by GHD (2020b)⁷ *Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Ground Investigation Scope (Package 1) Revision 2* (GHD Ground Investigation Scope).

The soil and groundwater sampling methodology and testing schedule were completed by T+T in accordance with the GHD Ground Investigation Scope and the *Ministry for the Environment Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils*.

The soil and groundwater sampling locations are shown in Appendix A of the T+T (2021a) Ground Contamination Factual Report⁸ (refer **Appendix A**). The hand auger and machine drilled borehole logs have been documented in the T+T (2021b) Geotechnical Ground Investigation Factual Report (Appendix C and D)⁹ and copies are provided in **Appendix B** of this report.

The soil and groundwater sampling methodologies undertaken during the investigations are provided in section 4.2 of the T+T (2021a) Report in **Appendix A**.

4.2 Analytical testing suites

4.2.1 Soil suites

The soil testing schedule specification had been determined by the GHD Investigation Scope (GHD, 2020b) and implemented in the field by T+T.

⁷GHD Limited. (2020b). Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Ground Investigation Scope (Package 1). Prepared for Watercare Services Limited Revision 2 dated 13 October 2020.

⁸Tonkin & Taylor Ltd. (2021a). Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Ground Contamination Factual Report. Report prepared for Watercare Services Limited dated February 2021. Report number: 1014985.v2

⁹ Tonkin & Taylor Ltd. (2021a). Whenuapai-Redhills Wastewater Servicing Rising Main/Gravity Main and Interim Pump Station Geotechnical Ground Investigation Factual Report. Report prepared for Watercare Services Limited dated January 2021. Report number: 1014985.0000

The soil testing undertaken comprised the following analytical suites:

Soil Suite 1 – Commercial Wastewater Discharge Sites

A specific analytical suite to target where soil disturbance is proposed on Commercial Wastewater Discharge Sites (HAIL G5).

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).
- PAHs.
- Volatile organic compounds (VOCs) including BTEX¹⁰.
- Total petroleum hydrocarbons (TPH).

Soil Suite 2 – Horticultural / Agricultural Sites

A specific analytical suite to target where soil disturbance is proposed on Horticultural / Agricultural Sites (HAIL A8 and HAIL A10)

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).
- Semi Volatile Organic Compounds (SVOCs).

Soil Suite 3 – Soil Disposal

A general analytical suite for characterisation for soil waste disposal comprising:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc).
- TPH.
- Polycyclic aromatic hydrocarbons (PAH).
- Asbestos semi quantitative analysis.

Samples were tested for TPH to provide an initial screening to inform whether further assessment of polycyclic aromatic hydrocarbons (PAH) was required. It was intended that samples would be further analysed for PAH if the PAH surrogate assessment criteria for TPH was exceeded.

Semi-quantitative analysis of asbestos presence in soils was included in the testing schedule where required.

Collection of field duplicates were also included in the testing schedule part of the project QAQC procedures.

4.2.2 Groundwater suites

The groundwater testing schedule specification had been determined by the GHD Investigation Scope (GHD, 2020b) and implemented in the field by T+T. The analytical suites adopted for the groundwater testing are detailed in Section 5.2 (Table 5.2) of the T+T (2021a) Report (refer **Appendix A**). There was sampling and testing of groundwater from HAIL sites where analytical Suites 1 and 2 were required.

¹⁰ Benzene, toluene, ethylbenzene and xylene

Groundwater Suite 1 - Commercial Wastewater Discharge Sites

A specific analytical suite for characterisation of groundwater where construction dewatering is proposed on Commercial Wastewater Discharge Sites (HAIL G5).

- pH
- Dissolved metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
- PAH.
- BTEX
- Nutrient suite dissolved (nitrate, nitrite, ammonium, dissolved reactive phosphorous).

Groundwater Suite 2 - Horticultural / Agricultural Sites

A specific analytical suite for characterisation of groundwater where construction dewatering is proposed on Horticultural / Agricultural Sites (HAIL A8 and HAIL A10)

- pH
- Dissolved metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
- SVOCs.

Groundwater Suite 3 - General disposal

A general analytical suite for characterisation of groundwater for disposal during dewatering comprised:

- pH
- Dissolved metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
- PAH.
- TPH.

4.2.3 Additional testing

Relocation of ground investigation locations

The soil and groundwater sampling suites were revised by GHD prior to the investigation when sampling locations had to be removed or relocated. Scheduling at locations ENVR-HA03, ENVR-HA04, and ENVR-HA05 was adjusted by T+T as per GHDs request from the original Suite 2 testing to Suite 3 because the locations were moved from the southern side of the road to the northern side. OCP testing was added to the surface samples collected to assess for the potential migration of pesticide sprays used on the adjacent properties for horticultural purposes.

Unexpected ground contamination

The soil and groundwater sampling suites were revised by GHD during the investigations when unexpected, potential contamination in soils and/or groundwater were encountered (refer Section 4.3.1). The revised analytical tests were scheduled by T+T when the samples were submitted for laboratory analysis under the chain of custody process.

Suitability for landfill disposal

Further Toxicity Characteristic Leaching Procedure (TCLP) analysis of the cold hold samples submitted was not undertaken as part of this investigation. This was based on the initial concentrations of contaminants reporting below the adopted managed fill criteria.

4.3 Summary of observed field conditions

Field observations made by T+T field staff during the investigations are provided in section 4.3 of the T+T (2021a) Report in **Appendix A**.

4.3.1 Soil

The ground conditions T+T observed during sampling comprised fill material (reworked topsoil fill) to depths ranging between 0.1 mbgl and 3.4 mbgl. There was one location (HA112) where fill comprised a strong chemical odour was observed at 1.8 m bgl and a white/cream coloured powder present at 2.0 m bgl. The property where these samples were collected was not a potential or known HAIL site identified in GHD (2020a) PSI. The property at 23 Brigham Creek Road where these samples were collected appeared rural residential, comprising a house and a few outbuildings. There were no other contamination indicators encountered in the soil sampled. The soil testing suite for samples collected at location HA112 and the adjacent HA117 was revised by GHD. As a result, the testing schedule amended by T+T was adjusted as per GHDs request from the original Suite 3 testing to include heavy metals, VOCs, SVOCs, organo nitrogen and organo phosphorus pesticides (ONOPs), asbestos, and ammonium.

Photo Ionisation Detector (PID) readings were taken from soil samples collected at each location at 0.5 and 1.0 mbgl (or where core was able to be recovered). PID readings ranged from 0 to 6.0 (ppm). The results are summarised in Table 4-1 and detailed on the logs provided in **Appendix B**.

4.3.2 Groundwater

Groundwater levels were encountered between 1 mbgl and 5 mbgl. There were no visual indicators of contamination observed in groundwater during the investigation programme. The groundwater sampled was slightly silty or clear with no odours.

Table 4-1: PID Field Readings

Location	Depth (mbgl)	Soil Type	PID ppm
BH05A	0.35	TGA Group Silty Clay	1.3
BH05A	2	TGA Group Silty Clay	0.4
BH06	0.5	TGA Group Silt	0.1
BH06	1	TGA Group Silt	0
BH07	0.5	Topsoil	0.1
BH07	1	TGA Group Clayey Silt	0
BH08	0.5	FILL - Silty Sandy Clay	0.2
BH08	1	TGA Group Silty Clay	0.8
BH110	0.5	TGA Group Silt	0.6
BH110	1	TGA Group Silty Clay	0.3
BH111A/BH111	0.5	TGA Group Clayey Silt	0.3
BH111A/BH111	1	TGA Group Clayey Silt	0.5
BH113	0.1	Topsoil	0.3
BH113	0.5	TGA Group Sandy Silt	0
BH113	1	CORELOSS	PID not attainable due to coreloss
BH113	2.2	TGA Group Sandy Silt	0
BH116	0.1	FILL - Silty Clay	0.1
BH116	0.5	FILL - Silty Clay	0
BH116	1	TGA Group Silty Clay	0
BH116	2	TGA Group Sandy Silt	0.2
BH117	0.1	Topsoil	0
BH117	0.5	TGA Group Sandy Silt	0.5
ENVR-HA03	0.5	TGA Group Clayey Silt	0
ENVR-HA03	1	TGA Group Silty Clay	0
ENVR-HA04	0.5	TGA Group Clayey Silt	0
ENVR-HA04	1	TGA Group Silty Clay	0
ENVR-HA05	0.5	TGA Group Silt	0
ENVR-HA05	1	TGA Group Clayey Silt	0
ENVR-HA101	0.5	TGA Group Clayey Silt	0
ENVR-HA101	1	TGA Group Clayey Silt	0
HA03	0.5	TGA Group Silty Clay	0
HA03	1	TGA Group Silty Clay	0
HA04	0.5	TGA Group Silty Clay	0
HA04	1	TGA Group Silty Clay	0.1
HA05	0.5	TGA Group Silty Clay	0.1
HA05	1	TGA Group Silty Clay	0.1
HA06	0.5	TGA Group Clayey Silt	0.2
HA06	1	TGA Group Clayey Silt	0.3
HA07	0.5	TGA Group Sandy Silt	0.1
HA07	1	TGA Group Clayey Silt	0.2
HA07a	0.51	TGA Group Clayey Silt	0
HA07a	1	TGA Group Clayey Silt	0.8
HA08	0.5	TGA Group Sandy Silt	1.8
HA08	1	TGA Group Sandy Silt	2.5
HA08a	0.5	Topsoil	1.8
HA08a	1	TGA Group Sandy Silt	2.5
HA107a	0.51	TGA Group Silty Clay	0
HA107a	1	TGA Group Silty Clay	0
HA107b	0.51	FILL - Sandy Silt	0.5
HA107b	1	FILL - Sandy Silt	0.1
HA108	0.5	TGA Group Sandy Silt	0
HA108	1	TGA Group Sandy Silt	0
HA109	0.5	TGA Group Silt	0.3
HA109	1	TGA Group Silt	0.1
HA110a	0.51	FILL - Sandy Clayey Silts	0
HA110a	1	FILL - Sandy Clayey Silts	0
HA110b	0.51	FILL - Sandy Silt	0
HA110b	1	FILL - Silty Clay	0
HA111	0.5	FILL - Silt with sand	1.2
HA111	1	FILL - Silt with sand	0.3
HA112	0.5	FILL - Sandy Silt	0.9
HA112	1	FILL - Sandy Silt	1.8
HA113	0.5	TGA Group Silt	0
HA113	1	TGA Group Clayey Silt	0.4
HA114	0.5	TGA Group Silt	0
HA114	1	TGA Group Clayey Silt	0
HA115	0.5	FILL - Sandy Silt	0.5
HA115	1	TGA Group Sandy Silt	0.3
HA116	0.5	TGA Group Clayey Silt	0.5
HA116	1	TGA Group Clayey Silt	1
HA117	0.5	FILL - Silty Clay	0.8
HA117	1	FILL - Sandy Silt	6
HA119	0.5	TGA Group Silty Clay	0
HA119	1	TGA Group Silty Clay	0

Notes:
TGA Group - Tauranga Group (Geological Unit)

5. Assessment of soil and groundwater contamination

5.1 Soil Screening Criteria

5.1.1 The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health

The NES CS has been adopted for the purposes of undertaking a screening level (Tier 1) risk assessment with respect to potential risk to human health associated with exposure to potential contaminants during the proposed works.

The NES CS sets national standards for contaminants in soil to protect human health. It contains a set of soil contaminant standards for 12 priority contaminants for five standard land use scenarios. The Soil Contaminant Standards (SCSs_(health)) residential 10% produce and commercial/industrial land use screening criteria was adopted, as they most closely reflect the exposure pathways (including ingestion and dermal contact) for maintenance and construction work and adjacent residential land use.

5.1.2 The National Environment Protection Measure Guidelines

In the absence of New Zealand risk based human health screening criteria for nickel and zinc; The Australian National Environment Protection Measure 2013 (NEPM)¹¹ guidelines have been adopted for this assessment. These guidelines are consistent with the requirements of CLMG No. 2¹², which outlines the hierarchy of guidelines to be adopted in human health risk assessment in New Zealand.

The NEPM covers a range of land uses. For the purposes of this assessment, the NEPM Health-based Investigation Levels (HILs) for Residential (HIL A) and Commercial/industrial (HIL D) have been selected to best represent likely exposure pathways, similar with the NES CS standards adopted for this investigation for trace elements (nickel and zinc).

5.1.3 Health and Safety at Work (Asbestos) Regulations 2016

The management and/or removal of asbestos in soils is regulated under the Health and Safety at Work (Asbestos) Regulations 2016¹³ (Asbestos Regulations). However; the Asbestos Regulations do not provide guidance regarding the definitions of what constitutes an asbestos contaminated site. Rather, simply states the Asbestos Regulations apply where a competent person advises that the disturbance and/or removal of soil is likely to lead to airborne contamination at a level that exceeds trace concentrations.

The New Zealand Guidelines for Assessing and Managing Asbestos in Soil (BRANZ Guidelines 2017)

The BRANZ Guidelines 2017¹⁴ provides a methodology consistent with the MfE CLMG for New Zealand and NES Soil for the assessment of asbestos in soil. The analysis for the

¹¹ National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended 2013) Schedule B (1); Guideline on the Investigation Levels for Soil and Groundwater. Table 1A (1) Health investigation levels for soil contaminants.

¹² Ministry for the Environment. 2011. Contaminated Land Management Guidelines No. 2 Hierarchy and Application in New Zealand of Environmental Guideline Values (Revised 2011). Wellington: Ministry for the Environment.

¹³ Health and Safety at Work (Asbestos) Regulations 2016 (15 February 2016) made under sections 24(1) (m), 211, and 218 of the Health and Safety at Work Act 2015

¹⁴ New Zealand Guidelines for Assessing and Managing Asbestos in Soil - Building Research Association of New Zealand (BRANZ), November 2017

presence/absence of asbestos fibres and or asbestos containing material (ACM) debris in soil was undertaken in accordance with sampling under the NES CS and BRANZ guidelines.

5.1.4 Ministry for the Environment Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand 1999 (Revised 2011)

The MfE Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand 1999 (Revised 2011)¹⁵ ('MfE OIG Guidelines') has been adopted for the purposes of undertaking a Tier 1 screening level risk assessment with respect to potential risk to human health associated with exposure to potential contaminants during the proposed works.

The MfE OIG Guidelines provide nationally consistent risk-based criteria for the assessment of risks from petroleum-based contaminants found in typical fuel products (petrol and diesel) to human health. The MfE OIG Guidelines can be applied to a range of land uses, environmental settings and exposure pathways.

Module 4 Soil

The soil analytical results were compared to the MfE OIG Guideline criteria for silty clay substrates in a residential and maintenance/excavation land use setting. These options cover all the current land uses and the excavation workers who will be working along the alignment during construction.

The soil analytical results were also compared against the MfE OIG Guideline criteria for silty clay substrates for the protection of groundwater quality. The guidelines selected are to ascertain whether there are high concentrations of hydrocarbons present in soil (within 1 m depth) that may be leaching into shallow groundwater.

5.1.5 Auckland Unitary Plan – Operative in Part

Chapter E30 Contaminated Land

The Auckland Council is required to regulate both the use of land containing elevated levels of contaminants and the discharge of contaminants from land containing elevated levels of contaminants. The AUP (OP) includes regulations associated with contaminated land and specifies rules that relate to the discharges of contaminants from disturbing soil of land greater than 200 m³ per project (E30.6.1.2(1)(b)) and containing contamination above the permitted activity criteria outlined in Table E30.6.1.4.1 (replicated as Table 5-1).

¹⁵ Ministry for the Environment. 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (Revised 2011). Wellington: Ministry for the Environment.

Table 5-1: AUP (OP) Permitted Activity Criteria

Contaminant	Permitted activity criteria (mg/kg)
Arsenic	100.0
Benzo (a) pyrene (equivalent)	20
Cadmium	7.5
Chromium (total)	400.0
Copper	325.0
Total DDT	12.0
Lead	250.0
Mercury	0.75
Nickel	105.0
Zinc	400.0

Note 1
Total DDT includes the sum of DDT (dichlorodiphenyltrichloroethane), DDD (dichlorodiphenyldichloroethane) and DDE (dichlorodiphenyldichloroethylene).

In addition, Table E30.6.1.4.2 outlines naturally occurring background ranges of trace elements in non-volcanic and volcanic Auckland soils (replicated as Table 5-2).

Table 5-2: Background Concentrations in the Auckland Region

Element (total recoverable)	Non-volcanic range mg/kg	Volcanic range mg/kg
Arsenic (As)	0.4 – 12	
Boron (B)	2 – 45	<2 - 260
Cadmium (Cd)	<0.1 – 0.65	
Chromium (Cr)	2 – 55	3 – 125*
Copper (Cu)	1 – 45	20 – 90
Lead (Pb)	<5 – 65*	
Mercury (Hg)	<0.03 – 0.45	
Nickel (Ni)	0.9 – 35	4 – 320
Zinc (Zn)	9 – 180	54 – 1160

* Work suggests special cases have been found to apply for Ti Point Basalts (Cr), Mt Smart Volcanics (Pb) and as such these lithologies need to be considered individually.

If the concentration of contaminants exceeds the permitted activity criteria and the other permitted activity standards are unable to be met as outlined within the AUP (OP) then a resource consent is required.

However, where nickel and zinc are found in volcanic soils, the natural background level should be applied as the permitted activity criteria.

Chapter E.4 Other Discharges of Contaminants

Chapter E.4 of the AUP (OP) applies to discharges of contaminants onto or into land /or water.

The discharge of groundwater onto or into land and/or into water for the purpose of dewatering trenches or other excavations during construction of the watermain (where dewatering is required) along the alignment is a **Permitted Activity** under the AUP (OP) Rule E4.4.1 (A5).

However, groundwater testing was undertaken for disposal purposes during construction dewatering i.e., to inform whether dewatered groundwater can be discharged to surface water or requires further treatment and/or offsite disposal. The adopted criteria used to assess contaminant concentrations in groundwater is outlined in section 5.2.1.

5.1.6 Technical Publication No. 153

As defined in Chapter E.30 of the AUP (OP), the Auckland Regional Council Technical Publication No. 153 (TP153)¹⁶ provides the range of trace element concentrations considered representative of natural or background soils in the Auckland Region.

The concentrations outlined in TP153 are used to assess whether sampled material is consistent with natural background trace element concentrations for volcanic material and informs the applicability and activity status under the NES CS and AUP (OP) as well as options for soil reuse and/or disposal considerations to respective disposal facilities in the Auckland Region.

If the results from the DSI demonstrate that soil contaminant concentrations are at or below background levels, consent under the NES CS is not required under the NES CS Regulation 5(9).

The site is underlain by undifferentiated alluvium of the Tauranga Group for the northern section of the alignment. Pumiceous deposits of the Tauranga Group occur near the surface for the remainder of the alignment and alternating sandstone and mudstone deposits of the East Coast Bays Formation (ECBF) is the basement geology for the area.

The TP153 volcanic background screening criteria was adopted for soil samples analysed from sections along the alignment where Puketoka and East Coast Bays Formation (ECBF) geology was encountered. The TP153 non-volcanic background screening criteria was also adopted where shallow alluvium was encountered along the alignment.

5.1.7 Soil Disposal Guidelines

The AUP (OP)¹⁷ Section E13.1 defines the types of material that may be disposed of in cleanfills, managed fills and landfills. Where the AUP (OP) does not specify cleanfill waste acceptance criteria, guidance has been adopted from the Technical Guidelines for Disposal to Land Waste Management Institute New Zealand (WasteMINZ) August 2018¹⁸.

In the event that soil material is to be disposed off-site, the background soil concentrations defined in the AUP (OP) and TP153 will be used to inform cleanfill disposal criteria for the purpose of this assessment.

¹⁶ Auckland Regional Council (2001). Background Concentrations of Inorganic Elements in Soils from the Auckland Region. Technical Publication 153.

¹⁷ Auckland Unitary Plan Operative in Part. (2016). E.13. Cleanfills, managed fills and landfills

¹⁸ Waste Management New Zealand. (2018) Technical Guideline for Disposal to Land.

Redvale Landfill Waste Acceptance Criteria

Watercare's Contractor advised GHD that soil was likely to be disposed offsite to Redvale Landfill. The landfill's acceptance criteria¹⁹ was adopted in addition to the WasteMINZ managed fill criteria.

Acceptance of soil from the project should be confirmed by Redvale in advance, to allow them to review compliance with their landfill resource consents.

5.2 Groundwater Screening Criteria

5.2.1 The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000 Guidelines)

The ANZECC 2000 Guidelines have been developed to provide trigger levels protective of surface water ecology, and in this case have been used where discharges of dewatered groundwater into Sinton Creek and Totara Creek (Brigham Creek tributaries), and Slaughterhouse Stream may occur during construction.

The 80% and 95% criteria for freshwater species were adopted as best practise under guidance of the AUP (OP) Sections E.4 and E.30 to assess contaminant discharges into surface freshwater receptors along the alignment, where construction dewatering is proposed.

It should be noted that the ANZECC 2000 Guidelines are intended to be applied after reasonable mixing in the receiving water body and, as such, groundwater analytical results are not directly comparable to the ANZECC 2000 Guidelines for groundwater since the environmental values, which they protect, relate to above-ground uses and surface water receptors.

5.3 Soil and Groundwater Analytical Results

The soil and groundwater analytical results are tabulated in Appendix G of the T+T (2021a) Report **Appendix A**. The laboratory analytical reports are provided in Appendix F of the T+T (2021a) Report **Appendix A**.

For the purpose of this assessment, the soil and groundwater analytical results have been separated into HAIL Sites (refer subsection 5.3.1) and Non-HAIL Sites (refer subsection 5.3.2).

5.3.1 HAIL Sites

The contaminant concentrations in soil and groundwater from samples collected from HAIL Sites have been assessed to inform resource consent applicability under the NES CS Regulations for the protection of human health and the AUP (OP) Section E.30 for discharges into the environment.

The concentrations of heavy metals in soil and groundwater are compared with relevant guideline criteria presented in **Appendix C**.

The results of SVOCs in soil and groundwater reported concentrations below laboratory detection limit and have been excluded from the assessment tables.

¹⁹ Redvale Landfill Waste Acceptance Criteria Version 10 dated 16 November 2007.

Heavy Metals (Trace Elements)

Soil

- All concentrations reported below the adopted NES SCS health criteria.
- All concentrations reported within naturally occurring background levels for volcanic and non-volcanic soils.
- All concentrations reported below the adopted AUP (OP) permitted activity discharge criteria.
- All concentrations reported below the Redvale Landfill Disposal Criteria.

Groundwater

- The concentrations of dissolved heavy metals in groundwater reported below laboratory detection limit and the adopted ANZECC 80% and 95% freshwater criteria.

Organic Compounds

Soil

- OCPs, VOCs, SVOCs reported concentrations below the laboratory detection limit.

Groundwater

- SVOCs reported concentrations below laboratory detection limit.

5.3.2 Non-HAIL Sites

The contaminant concentrations in soil from samples collected from Non-HAIL Sites have been assessed to inform suitability for reuse and disposal.

The human health criteria under the NES CS, BRANZ, and MfE OIG was adopted to screen for potential human health issues and consider if any mitigation is required to manage contaminant exposure to construction and maintenance workers and adjacent residential land users during construction. The primary criteria adopted for assessing hydrocarbon contamination risks to human health is the NES SCS for residential and commercial/industrial outdoor worker exposure. This criterion has been used in preference to the MfE OIG for general characterisation of fill material encountered along the alignment, which is not linked to hydrocarbon contamination sources.

The environmental criteria under the AUP (OP) and ANZECC 2000 FW Guidelines was adopted to screen soil and groundwater contaminants to consider if management of discharges from excavations and construction dewatering is required during the proposed works.

The concentrations of heavy metals, TPH, PAH, and asbestos in soil, and heavy metals and TPH in groundwater are compared with relevant guideline criteria presented in **Appendix C**.

Heavy Metals (Trace Elements)

Soil

- All concentrations reported below the adopted NES SCS health criteria.
- All concentrations reported within naturally occurring background levels for volcanic and non-volcanic soils.
- All concentrations reported below the adopted AUP (OP) permitted activity discharge criteria.

- All concentrations reported below the Redvale Landfill Disposal Criteria.

Groundwater

- The concentrations of Copper reported above the adopted ANZECC 95% freshwater criteria.
- The concentrations Nickel reported above the adopted ANZECC 80% freshwater criteria.
- The concentrations of Zinc reported above the adopted ANZECC 80% and 95% freshwater criteria.

Organic Compounds

Soil

- Concentrations of PAH and TPH reported above the respective laboratory detection limit in shallow soil (0-0.5 m depth) along the proposed alignment.
- The maximum concentration of benzo(a)pyrene at 1.37 mg/kg reported below the adopted NES SCS health criteria, MfE OIG maintenance worker exposure criteria, and protection of groundwater quality. The concentration of 1.37 mg/kg reported above the MfE OIG residential land use criteria for the produce ingestion pathway (0.27 mg/kg) but is still below the NES SCS health criteria for residential land use (10 mg/kg). GHD note these samples were collected from shallow fill along the existing road carriageway and are not linked to any hydrocarbon source (i.e., fuel storage and use).
- The maximum TPH concentration (heavy end C₁₅-C₃₆) reported above the laboratory detection limit, but below MfE OIG residential land use, maintenance worker, and protection of groundwater quality.
- The maximum concentrations of TPH and PAH reported below Redvale Landfill's Disposal Criteria.

Groundwater

- All concentrations of TPH and PAH reported below laboratory detect apart from one sample reporting TPH (C₇-C₉) at 0.14 mg/l (g/m³).

Asbestos in Soil

Only one sample out of 62 samples submitted detected chrysotile fibres at a concentration of <0.001 w/w%, reporting below the adopted BRANZ Guidelines for residential land use. The removal of soil with concentrations below <0.001 w/w% can be undertaken as unlicensed asbestos work in accordance with the BRANZ Guidelines.

5.4 Field Quality Assurance and Quality Control Procedures

5.4.1 Quality Control Procedures

GHD quality assurance/quality control (QA/QC) procedures to assess data quality were maintained throughout the project. All laboratory analysis was undertaken by IANZ or NATA accredited laboratories.

The QA/QC programme undertaken as part of the assessment by GHD included the following:

- Use of appropriately qualified and trained staff;
- Preservation of samples with ice during transport from the field to the laboratory;
- Transportation of samples with accompanying chain-of-custody documentation;
- Compliance with sample holding times; and
- Review of results of field duplicate samples.

5.4.2 Duplicates

Field duplicates involve the collection of two separate samples from a single sample location, stored in separate containers and submitted for analysis to the laboratory as two separate samples for QC purposes. The QC program included the collection and analysis of one field duplicate soil sample.

5.4.3 Relative Percentage Difference

A quantitative measure of the accuracy of the check analyses results obtained was made using calculated relative percentage difference (RPD) values. The RPD values were calculated using the following equation.

$$RPD (\%) = \frac{\langle C_o - C_s \rangle}{\left\langle \frac{C_o + C_s}{2} \right\rangle} \times 100$$

Where C_o = concentration obtained from the original sample
 C_s = concentration obtained from the duplicate sample

The soil and groundwater duplicate QA/QC results are provided in section 5.4.1 of the T+T (2021a) Report in **Appendix A**.

The relative percentage difference (RPD) values were calculated as between 0% and 67% for the soil duplicate samples, 0% and 10% for the groundwater duplicate sample analysed for heavy metals.

The usual acceptance criteria for RPD values are between 0 and 40% in soils and 0 – 20% in water. However, a large percentage differential can occur particularly in soils due to the following:

- A small analytical differential between two samples based on the low levels of detection from the primary and duplicate soil sample; and
- Samples analysed in soil collected from non-homogenous (heterogeneous) soil profile.

5.4.4 QA/QC Discussion

The results of the QA/QC program are considered to provide an acceptable degree of confidence in the sampling and analytical program. Overall, the analytical data provided by accredited laboratories is considered to be acceptable for the purposes of this assessment.

6. Conceptual Site Model

6.1 Refinement of the Conceptual Site Model

A conceptual site model (CSM) is used to communicate information about a site where contamination may pose a risk to human health or the environment. This model provides details of contamination source(s) on the site, the pathways these contaminants could travel through, and the potential receptors they could affect.

The PSI undertaken by GHD in 2020, identified a number of potential high and medium risk contamination sources based on historical and current land uses along the proposed alignment. The findings from the DSI detailed in this report have been applied to the conceptual site model summarised in the following sections.

6.1.1 Sources of Contamination

The testing undertaken has found that concentrations of inorganic (trace elements) in soil are within naturally occurring background levels. Low concentrations of hydrocarbons and asbestos fibres were detected in shallow soils along the alignment. The concentrations of hydrocarbons identified in shallow fill along the proposed alignment are considered to be commensurate with concentrations identified in soils within road carriageways.

Asbestos fibres were detected in soils below the adopted human health criteria under the BRANZ Guidelines and can be managed appropriately onsite for disturbance and removal under unlicensed asbestos works.

Dissolved heavy metal concentrations of copper, nickel, and zinc in groundwater were reported above the adopted ANZECC 80% and 95% screening criteria for the protection of freshwater species, however results for remaining dissolved heavy metals tested, organics, and presence of volatiles were generally non-detected and / or at low concentrations.

6.1.2 Migration and Exposure Pathways

Given the contamination sources, the intended works and the resulting land use, the potential pathways for exposure to the contamination sources include dermal contact, inhalation and ingestion of soil during construction work. Inhalation of dust is most likely to occur during the works as this is when the soil is most likely to be made airborne or be exposed to aeolian processes.

However, less likely, ingestion of soil may also occur during the proposed works. Despite being potential pathway, the likelihood of sufficient exposure occurring through ingestion to cause harm to human health (i.e., construction workers) is very low as health and safety measures such as personal protective equipment (PPE) would be implemented during construction.

Migration of contaminants from the soil into groundwater is considered low risk based on the following considerations:

- There were no high concentrations of inorganic and/or organic compounds detected in soil samples that pose a risk to construction worker and rural residential land users on properties where soil disturbance is required during construction.
- None of the contamination identified in the underlying soils is in sufficient concentrations that it is considered likely o impact on groundwater, and therefore groundwater has not been considered as a pathway or receiving environment.

- The PSI (GHD, 2020a) did not report any sensitive shallow groundwater abstractions within 200 m of the alignment. Therefore, shallow groundwater is unlikely used for drinking water purposes in the area.

6.1.3 Receptors

The receptors that could potentially be exposed to the contaminants during the construction works include; the construction workers, the neighbouring rural residential properties, and the receiving environment (streams or reticulated networks).

The exposure to the soil is expected to be minimal due to the following considerations:

- Construction along an open-cut trench, will involve the trench to be opened and closed progressively as the construction moves along the alignment. Therefore, minimising the length of time soil is exposed during trenching in one location.
- All excavated material shall be taken offsite to a licensed landfill facility for disposal.
- The trench is backfilled with inert quarry subgrade gravels and cleanfill.

Whilst dissolved heavy metal concentrations of copper, nickel, and zinc were reported above the ANZECC screening criteria for the protection of 80% and 95% freshwater species and the laboratory lower limit of detection, it is considered that they would cause less than minor adverse effects on the environment due to the following:

- There were no concentrations of inorganic and/or organic compounds detected in soil samples above naturally occurring background concentrations or at concentrations that would impact groundwater, as contamination is confined at depths between 0 – 1.0.
- The ANZECC freshwater criteria apply at the point of discharge after reasonable mixing and if present at trace concentrations, the contaminants would be expected to be significantly diluted through this process.
- Groundwater dewatered during construction would be managed onsite using appropriate management controls provided in a site management plan.
- Shallow groundwater is unlikely to be used for drinking water purposes in the area, as the PSI did not identify any sensitive groundwater takes in the area.

6.2 Conceptual Site Model Summary

As the earthworks (including areas of cut and fill) are likely to be confined to trenches, drill pits, and the footprint of the new pumpstation during construction, and will include offsite disposal of excavated soil, the contaminated land risk to construction worker health, environmental discharges, and end land use is considered low.

It is recommended that a Site Management Plan (SMP) be prepared, and the controls implemented to manage discharges into the environment from construction dewatering, and soil disposal during construction. Any groundwater encountered during construction would be managed onsite using appropriate management controls as provided in the SMP and by the implementation of appropriate sediment control measures.

Soil and groundwater management procedures outlined in a SMP are recommended to be adhered to during the construction and that contamination discovery protocols be adopted in the case of encountering any unexpected contamination, to manage any potential risks to human health and the environment during construction. The contaminant discovery protocols provided in a SMP should be followed and if further contamination is discovered, soils should be tested and disposed of to an appropriately licensed facility as required.

Groundwater encountered during construction would be managed onsite using appropriate management controls as provided in the SMP and by the implementation of appropriate sediment control measures.

The findings from the CSM have further informed the resource consent requirements which are outlined in section 7.1 of this report.

7. Conclusions and Recommendations

This DSI was undertaken to assess the presence of soil contamination and inform soil disposal requirements in order to assist Watercare in achieving regulatory compliance under the NES CS for the protection of human health and the AUP (OP) for discharges to the environment, during construction along the proposed alignment.

7.1 Statutory Requirements

7.1.1 Protection of human health

The NES CS Regulations are considered to no longer apply to soil disturbance and removal activities during construction works at HAIL Sites along the proposed alignment, as the DSI demonstrates concentrations of select inorganic and organic contaminants are below naturally occurring background levels. Therefore, resource consent is not required in accordance with Regulation 5(9) of the NES CS.

7.1.2 Protection of the environment

The discharge of groundwater onto or into land and/or into water for the purpose of dewatering trenches or other excavations during construction of the watermain (where dewatering is required) along the alignment is a **Permitted Activity** under the AUP (OP) Rule E4.4.1 (A5).

The maximum reported concentrations of nickel and zinc were found to exceed the respective ANZECC Guidelines for the protection of freshwater species, which applies to discharge of groundwater to surface water receptors along the alignment. Testing of groundwater during dewatering activities is recommended prior to discharge and testing and treatment procedures to be implemented under a SMP.

7.2 Recommendations

7.2.1 Management of site earthworks and dewatering activities

Soil and groundwater management procedures outlined in a SMP are recommended to be adhered to during the construction and that contamination discovery protocols be adopted in the case of encountering any unexpected contamination. The contaminant discovery protocols provided in a SMP should be followed and if further contamination is discovered, should be disposed of to an appropriately licensed facility as required.

7.2.2 Soil reuse and disposal

Based on the results of the DSI, soil is considered suitable for reuse as backfill (if geotechnically suitable) or disposal offsite to a licenced managed landfill facility i.e., Redvale Landfill. It is recommended that licenced landfill operators be provided a copy of the laboratory reports and consulted to confirm acceptance requirements prior to delivery of the material to respective facilities.