ENGEO Limited
8 Greydene Place, Takapuna
Auckland 0622
PO Box 33-1527, Takapuna, Auckland 0740
T: +64 9 972 2205
www.engeo.co.nz

**Project Number #19375.000.001**

# Combined Preliminary and Detailed Site Investigation

182 - 184 Kepa Road and 8 Kurahaupo Street, Orakei, Auckland

Submitted to:
Sanctum Projects Ltd
186 Kepa Road
Orakei
Auckland 1071

## Contents

## Tables



## Appendices

**ENGEO Document Control:**

| | | | | |
|---|---|---|---|---|
| Report Title | Combined Preliminary and Detailed Site Investigation - 182 - 184 Kepa Road and 8 Kurahaupo Street, Orakei | | | |
| Project No. | 19375.000.001 | Doc ID | 02 | |
| Client | Sanctum Projects Ltd | Client Contact | Aaron Ghee | |
| Distribution (PDF) | Sanctum Projects Ltd | | | |
| Date | Revision Details / Status | Author | Reviewer | WP |
| 01/02/2021 | Issued to Client | TP | JR | DF |

# 1 Introduction

ENGEO Ltd was requested by Sanctum Projects Ltd to undertake a combined preliminary and detailed site investigation of the property at 182 - 184 Kepa Road and 8 Kurahaupo Street, Orakei, Auckland (herein referred to as 'the site'). This work has been carried out in accordance with our signed agreement dated 13 December 2021. The purpose of the assessment was to support your resource consent application for a new residential development at the site.

ENGEO has been provided with the Monk Mackenzie draft concept architectural plans dated 21 October 2021 (unreferenced), which depict the proposed development as consisting of an eight-storey building in the south and a five-storey building in the north, each to be linked by a two-level basement extending across the majority of the site.

This combined Preliminary and Detailed Site Investigation (PSI and DSI) has been undertaken to satisfy the requirements of the Resource Management (*National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health)* Regulations 2011, herein referred to as the "NES" (NES, 2011). The investigation provides information regarding the presence of land contaminants that pose a potential human health risk to future site users and site redevelopment workers during earthworks and construction. The results of this investigation have been used to evaluate whether remediation is necessary prior to site redevelopment, and to further assess the resource consents required under the NES.

This investigation also addresses the requirements of regional regulations covering discharges to the environment from contaminated sites during and post-redevelopment works; namely, the Auckland Unitary Plan Operative in part – 15 November 2016 (herein referred to as the AUP; AUP, 2016).

This investigation was undertaken in general accordance with:

- Ministry for the Environment (MfE) Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand (MfE, 2021a).
- Ministry for the Environment (MfE) Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils (MfE, 2021b).

# 2 Objectives of the Assessment

The PSI component of the work included a desktop review of historical site information and review / assessment of information gathered during the site walkover. The objective of the PSI was to gather information relating to current and historical potentially contaminating activities at the site.

The DSI was an intrusive investigation, and was undertaken to assess:

- The type, extent and level of contamination within the proposed development site.
- Whether contaminants of concern identified present an unacceptable risk to human health or identified environmental receptors.
- Disposal options for the potentially impacted soil that may be required to be removed from site during redevelopment.
- Whether the soils remaining on-site are suitable for the proposed end use.

The soil sampling locations were positioned to target areas on-site where activities listed on the Ministry for the Environment's Hazardous Activities and Industries List (HAIL; MfE, 2011a) may have been historically and / or are currently present at the site. Further details of the scope of work are provided in Section 6.

# 3 Site Description

Site information is summarised in Table 1, and the site setting is summarised in Table 2.

**Table 1: Site Information**

| Item | Description |
|---|---|
| Site Description | The site currently contains two singe-storey dwellings (at 184 Kepa Road and 8 Kurahaupo Street), and a two-storey dwelling at 182 Kepa Road, as well as standalone garage and sleep-out building at 8 Kurahaupo Street. |
| Legal Description | SEC 745 Town ORAKEI; SEC 744 Town ORAKEI; Lot 169A DP 50580. |
| Current Land Use | Residential |
| Proposed Land Use | High-density residential |
| Site Area | 2,250 meters squared ($m^2$) |
| Territorial Authority | Auckland Council |

**Table 2: Site Setting**

| Item | Description |
|---|---|
| Topography | The majority of the site slopes gently to moderately toward the north at angles of between 5 to 20 degrees, with a fall across the site of approximately 6.5 m from the south-western corner to the northern boundary. |
| Local Setting | The site is located in a mixed urban housing area. |
| Nearest Surface Water & Use | The Purewa Creek is located approximately 330 meters to the south of the site. |
| Geology (GNS, 2021) | GNS maps the site as being underlain by Auckland Basalt tuff of the Auckland Volcanic Field (AVF) comprising; comminuted pre-volcanic materials with basaltic fragments and unconsolidated ash and lapilli deposits. |
| Hydrogeology | Standpipe piezometers were installed to measure standing groundwater levels beneath the site over a monitoring period that extended from 21 October to 18 November 2021. Groundwater was found to fluctuate between 3.6 – 4.8 m depth within MBH01 (southwest corner of site) and between 0.55 – 2.25 m depth within MBH02 (northeast corner of site) (ENGEO, 2021). |

# 4 Site History

ENGEO obtained and reviewed available environmental and geological information relevant to the site, including geological maps, historical aerial photographs and the Auckland Council property files. Historical site information obtained during review of this information is summarised in this section.

## 4.1 Auckland Council Site Contamination Enquiry

The Site Contamination Enquiry (SCE) response provided by Auckland Council was received on 23 November 2021 (Appendix 1). In preparing the response, the former Auckland Regional Council and current databases were searched for records of closed landfills, bores, air discharges, industrial and trade process consents, contaminated site discharge consents and environmental assessments within approximately 200 meters of the site.

Auckland Council's contamination response did not identify any current or historical HAIL land uses. However, Council noted that due to the age of the dwellings on-site, potential contamination from asbestos and / or lead-based paints should be considered.

No relevant records were recorded within a 200 m radius of the site.

## 4.2 Auckland Council Property File Review

The property file held by Auckland Council was received on 25 November 2021. Relevant findings in relation to our environmental assessment are provided in Table 3 below.

**Table 3: Property File Summary**

| Date | Description |
|---|---|
| 8 Kurahaupo Street | |
| December 1956 | Building consent application for the erection of a domestic garage |
| August 1980 | Building consent application for minor alterations to a single dwelling. |
| 182 Kepa Road | |
| *No relevant information identified.* | |
| 184 Kepa Road | |
| May 1975 | Building consent application for alterations to existing dwelling. |
| January 1992 | Building permit for the installation of a swimming pool. |
| April 2004 | Discretionary land use application to construct a single level extension to an existing dwelling. |

| Date | Description |
|---|---|
| May 2008 | Building consent application for alterations to the dwelling, including; removal of carport, construction of double garage, removal of existing entry area and construction of new entrance area, and construction of new block wall along the road boundary. |

### 4.3 Historical Aerial Photograph Review

Aerial photographs dating from 1940 to 2017 have been reviewed and are included in Appendix 2 for reference. The aerials were sourced from Auckland Council GeoMaps and Retrolens. Relevant visible features on the site and surrounding area are summarised below.

The site appears undeveloped in the 1940 image (earliest available image). Kepa Road borders the site to the south and Kurahaupo Street to the east. A third road is observed adjacent to the western boundary (this road has been partly removed and realigned further south by 1959). By 1959 the duplex and outbuildings at 8 Kurahaupo Street has been constructed. Earthworks are occurring at 184 Kepa Road, and a small shed is present in the northeast corner. The dwellings at 182 and 184 Kepa Road are constructed prior to the 1968 image. No obvious changes to the site are observed – until 2006, when a small shed appears in the north-eastern portion of 182 Kepa Road. The site generally remains in this configuration until present day.

## 5 Current Site Conditions

A site walkover was completed by ENGEO on 23 November 2021. Observations of activities and conditions present at the site are summarised in Table 4.

Photographs taken during the site visits are included in Appendix 3.

**Table 4: Current Site Conditions**

| Site Conditions | Comments |
|---|---|
| **Surface Water Appearance** | No surface water observed during the investigation. |
| **Current Surrounding Land Use** | The site is immediately bordered by residential land use to the north, east and west. A petrol station, and a small block of retail shops / bakery is present approximately 40 m west of the site. Surrounding land use to the south comprises a reserve. |
| **Local Sensitive Environments** | No obvious local sensitive environments observed during the investigation. |
| **Visible Signs of Plant Stress** | No signs of plant stress observed during the investigation. |

| Site Conditions | Comments |
|---|---|
| **Ground Cover** | *182 Kepa Road* – primarily grassed, with the exception of accessways, footpaths etc.<br>*184 Kepa Road* – primarily covered in impermeable surfaces, with limited exposed soil in the northern portion of the site.<br>*8 Kurahaupo Street* – primarily grassed, with the exception of accessways, footpaths etc. |
| **Potential for On – Or – Off – Site Migration of Contaminants** | Unlikely. No overland flow paths (OVFP) observed on-site. |
| **Visible Signs of Contamination** | Potential Asbestos Containing Material (PACM) observed on the soffits at 182 Kepa Road and 8 Kurahaupo Street. PACM was also observed on the eastern edge of the deck fencing at 184 Kepa Road (note that no exposed soil was observed beneath the PACM, only bark underlain by a geotextile fabric).<br>The dilapidated shed in the centre of 8 Kurahaupo Street comprised PACM. PACM was also identified buried within soil at this location, at a depth of 0.1 meters below ground level (m bgl). |
| **Additional Comments** | The building at 184 Kepa Road appeared to comprise timber and steel; no PACM observed. |

# 6 Potential HAIL Activities

Activities included on the Ministry for the Environment's Hazardous Activities and Industries List (HAIL; MfE, 2011a) trigger the requirement for an intrusive contaminated land investigation (DSI) prior to redevelopment. Based on the information reviewed as part of this PSI, the following activities listed on the HAIL may have been historically and / or are currently present at the site:

- HAIL ID I: Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment.
    - Due to the age of the site buildings (historical and current), there is potential for asbestos and / or lead-based paints used in construction to weather and contaminate surrounding soils. This area of contamination is generally associated to shallow soils within two meters from building edges and is referred to as the building "halo".

Given the identification of these potentially hazardous activities on-site, further intrusive works were recommended to assess the concentration of contaminants in soils and the relevant consenting requirements, and to determine if the site is suitable for the proposed end land use.

The potential contaminants of concern identified based on the findings of the PSI component of this investigation are summarised in Table 5.

**Table 5: Potential Contaminants**

| Potential Source of Contamination | Primary Contaminants of Concern | Possible Extent of Contamination | HAIL Activity as Defined by the NES (Soil) |
|---|---|---|---|
| Buildings containing lead-based paints in a weathered condition | Lead | Shallow soils within building halo | Category I:<br>Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment. |
| Buildings containing asbestos products in a weathered condition | Asbestos | Shallow soils within building halo | |

# 7 Site Investigation

ENGEO completed the intrusive environmental investigation on 23 November 2021, in conjunction with the site walkover.

Soil samples were collected from eleven locations across the site. Sample locations were positioned to target the potential HAIL activities identified as part of the PSI component of the investigation, and to assess potential contamination and soil disposal options in the balance of the site. Samples were collected from between 0.0 – 0.5 m bgl.

Samples were analysed for a suite of heavy metals / metalloids, and asbestos. Fourteen samples were analysed for heavy metals / metalloids, and nine samples were analysed for asbestos.

Table 6 provides a summary of the soil samples collected and analysed. Refer to attached Figure 1 for sample locations.

**Table 6: Summary of Soil Samples Collected and Requested Analyses**

| Sample ID | Sample Depth (m bgl) | Sampling Rationale | Requested Analyses |
|---|---|---|---|
| S01 | 0.1 | Location of historical building. | Heavy metals / metalloids and asbestos |
| S01 | 0.35 | Location of historical building. Vertical delineation of potential contamination. | Heavy metals / metalloids and asbestos |
| S02 | 0.1 | General indicator of contamination. | Heavy metals / metalloids |
| S03 | 0.1 | Within building “halo”. | Heavy metals / metalloids and asbestos |

| Sample ID | Sample Depth (m bgl) | Sampling Rationale | Requested Analyses |
|---|---|---|---|
| S04 | 0.1 | Within building “halo”. | Heavy metals / metalloids and asbestos |
| S05 | 0.1 | Within building “halo”. | Heavy metals / metalloids and asbestos |
| S05 | 0.3 | Within building “halo”. Vertical delineation of potential contamination. | Heavy metals / metalloids and asbestos |
| S06 | 0.2 | General indicator of contamination. | Heavy metals / metalloids |
| S07 | 0.1 | General indicator of contamination. | Heavy metals / metalloids |
| S08 | 0.1 | General indicator of contamination. | Heavy metals / metalloids |
| S09 | 0.1 | Within building “halo”. | Heavy metals / metalloids and asbestos |
| S10 | 0.1 | Within building “halo”. | Heavy metals / metalloids and asbestos |
| S10 | 0.2 – 0.4 | Within building “halo”. Vertical delineation of potential contamination. | Heavy metals / metalloids and asbestos |
| S11 | 0.1 | General indicator of contamination. | Heavy metals / metalloids |

The following was undertaken during the investigation:

- Soil samples were screened for visual and olfactory evidence of contamination.
- Samples were compressed directly into laboratory supplied containers using a new pair of nitrile gloves for each sample. Prior to sampling, the equipment was decontaminated using a triple wash procedure with potable water, Decon 90 solution and deionised water.
- Samples were placed directly into a cooled container prior to transport to Eurofins laboratory under ENGEO standard chain of custody.
- Fieldwork and sampling was undertaken in general accordance with the procedures for the appropriate handling of potentially contaminated soils as described in the MfE Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils (MfE, 2021b).

## 7.1 Quality Assurance and Quality Control

The quality assurance / quality control (QA/QC) procedures undertaken during the works included:

- The use of standard sample registers and chain of custody records for all samples collected.
- Each soil sample was given a unique identification number.
- Sampling equipment was decontaminated using the triple wash method (as previously stated) between each sample location.
- Eurofins are accredited by International Accreditation New Zealand (IANZ) for analyses performed. Additionally, Eurofins are accredited to AS-4694-2..4: *Method for the Qualitative Identification of Asbestos in Bulk Storage* for the analysis of suspected asbestos in soil samples, and to the international standards NZS ISO/IEC 17025:2-5 *General requirements for the competence testing and calibration laboratories* in accordance with The Building Research Association New Zealand (BRANZ) Guidelines for Assessing and Managing Asbestos in Soil.

## 7.2 Investigation Criteria

### Human Health Criteria

The human health criteria referenced in this report were selected from the NES (MfE, 2012). The Soil Contaminant Standard (SCS) for high-density residential land use were selected for comparison to site data.

For contaminants where human health criteria were not available in the NES, criteria were sourced in accordance with the MfE's Contaminated Land Management Guidelines No.2: Hierarchy and Application in New Zealand of Environmental Guideline Values (MfE, 2011b).

Human health criteria for asbestos in soil were sourced from the BRANZ guidelines (BRANZ, 2017). The high-density residential and commercial / industrial land use criteria were used for ACM and the "all site uses" criterion was used for fibrous asbestos / asbestos fines (FA / AF).

### Environmental Discharge Criteria

In the Auckland region, potential discharges to the environment from land containing elevated levels of contaminants are managed through the AUP (AUP, 2016), operative in part on 15 November 2016. The Auckland Council permitted activity criteria referenced in this report were adopted from section E30 of the AUP.

### Background Criteria

The soil analysis results have also been compared to the background concentration for volcanic soils in the Auckland region (AC, 2001). This comparison allows for further assessment of consenting requirements under the NES and provides information regarding disposal options for excess spoil.

# 8 Soil Analysis Results

Appendix 4 compares soil contaminant concentrations in the samples tested with the adopted investigation criteria. Full analytical laboratory reports are included in Appendix 5.

### 8.1 Summary of Soil Results

A summary of the chemical and asbestos testing results is provided below:

- Asbestos was detected within three of the nine sample analysed. However, only one of these samples (S10) exceed the BRANZ 'all site uses' criteria of 0.001% w/w.
- Lead was detected in excess of the environmental discharge criteria within four of the fourteen samples analysed.
- Heavy metals / metalloids (arsenic, cadmium, copper and lead) were detected on-site in excess of the regional background ranges.

### 8.2 Assessment of lead Soil Results

Lead has been detected on-site in excess of the environmental discharge (250 mg/kg) in four of the fourteen samples collected. Three of the four exceedances (S04, S05, S06) were detected from the yard area to the west of the dwelling at 8 Kurahaupo Street (concentrations ranging from 390 – 460 mg/kg), whilst the other (S02) was detected from yard area in the northern portion of 184 Kepa Road and represents a marginal exceedance (concentration of 260 mg/kg). Based on these results, it is considered likely that topsoil across the site represents differing historical landuses, with soil to the west of Kurahaupo Street containing elevated lead concentrations that exceed the AUP environmental discharge criterion, and lead on the balance of site considered not to exceed the AUP criterion.

The 95% upper confidence limit of the mean (95% UCL) was estimated for the balance of topsoil on the site (excluding samples in the western yard area at 8 Kurahaupo). This was done using the US EPA ProUCL programme; the input and output sheets are included in Appendix 6.

The lead 95% UCL was estimated to be 178.6 mg/kg, which is below the environmental criterion of 250 mg/kg. Lead concentrations across the balance of the site are therefore not considered to pose a risk to environmental receptors.

## 9 Conceptual Site Model

A conceptual site model has been developed to assess the potential exposure pathways present at the site. A contamination conceptual site model consists of three primary components. For a contaminant to present a risk to human health or an environmental receptor, all three components are required to be present and connected. The three components of a conceptual site model are:

- Source of contamination.
- An exposure route, where the receptor and contaminants come into contact (e.g. ingestion, inhalation, dermal contact).
- Receptor(s) that may be exposed to the contaminants.

The potential source, pathway, receptor linkages at this subject site are provided in Table 7.

**Table 7: Conceptual Site Model**

| Source | Exposure Pathway | Potential Receptor | Acceptable Risk |
|---|---|---|---|
| Buildings containing lead-based paints in a weathered condition | Soil ingestion, inhalation of dust, and / or dermal contact | Site redevelopment workers<br>Future site users | **Yes**<br>Contaminant concentrations were below the adopted human health criteria |
| | Leaching of contaminants | Surrounding environment | **No**<br>Contaminant concentrations were detected in excess of the environmental discharge criteria within the western portion of 8 Kurahaupo Street. The 95% UCL of lead within the balance of the site is below the environmental discharge criteria. |
| Buildings containing asbestos products in a weathered condition | Soil ingestion, inhalation of dust, and / or dermal contact | Site redevelopment workers<br>Future site users | **No**<br>Asbestos (FA / AF) was detected in excess of the BRANZ 'all site uses' guidelines of 0.001% w/w within one sample (S10) |

# 10 Areas of uncertainty

ENGEO's geotechnical investigation (ENGEO, 2021) which was undertaken concurrently, identified fill material along the eastern edge of the property at 184 Kepa Road. This material comprises a brown / grey / orange clayey silt, with fine to medium sand, extending to a depth of 0.8 m bgl. The material is considered more likely than not to represent re-worked soils associated with building works on-site.

Asbestos (FA/AF) has been detected at S05 (0.3 m bgl) at a concentration of 0.00044% w/w. This concentration does not exceed the adopted human health criteria; however, any detection of asbestos is considered an exceedance of background criteria. As deeper samples at this location have not been collected, and because shallow fill material has been reported in other areas of site at up to 0.8 m bgs, further investigation of the nature and extent of the fill material is recommended following removal of the dwellings. Details of the proposed investigation works to address the above areas will be prepared in the Remedial Action Plan (RAP; discussed further in Section 12).

# 11 Conclusions

Due to the presence of asbestos concentrations above the adopted human health criteria at one location, remediation of soils in these areas is required for the site to be suitable for the proposed redevelopment. The details of recommended remedial works are discussed further in Section 12. Future land development is likely to be considered a restricted discretionary activity under Regulation 10 of the NES, and requires a Remedial Action Plan.

Additionally, the presence of contaminant concentrations (lead within the western portion of 8 Kurahaupo Street) above the regional environmental discharge criteria indicates a short-term environmental discharge consent is required for disturbance if the permitted activity standards from AUP E30.6.1.2 cannot be met. Based on our experience with similar sites, and a relatively small volume of soil exceeding the environmental discharge criteria, it is considered likely that soil disturbance can be undertaken as a permitted activity under E30.6.1.2 of the AUP, subject to provision of a Site Management Plan.

The presence of contaminants above the regional background levels indicates excess surface soil generated during earthworks cannot be considered “cleanfill” for disposal purposes or reused at another earthworks site (AUP, 2016). Note that it is likely that deeper soil (where not already assessed) may be classified as cleanfill; however, additional testing prior to or as part of redevelopment works is required to confirm this.

# 12 Recommendations

Based on the results of this investigation, the following is recommended:

## Remedial Action Plan

Prepare a remedial action plan (RAP) to support the resource consent application. The RAP will outline remediation requirements for soil impacted by contaminants above human health and environmental discharge criteria, as well as monitoring and management procedures for the balance of earthworks due to the detection of contaminants above background levels and potential for encountering unidentified contamination. The RAP will also fulfil the requirement for a Site Management Plan required under E30.6.1.2 of the AUP

## Completion Reporting

The RAP will include requirements for oversight and validation sampling during earthworks by a suitable qualified and experienced practitioner. Following completion of site earthworks, a Site Validation Report (SVR) will be required to present the validation sampling data and confirm that site earthworks were performed in accordance with the RAP, and that remaining soils do not present an unacceptable risk to human health or the environment.

# 13 Limitations

i. We have prepared this report in accordance with the brief as provided. This report has been prepared for the use of our client, Sanctum Projects Ltd, their professional advisers and the relevant Territorial Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

ii. The recommendations in this report are based on the ground conditions indicated from published sources, site assessments and subsurface investigations described in this report based on accepted normal methods of site investigations. Only a limited amount of information has been collected to meet the specific financial and technical requirements of the client's brief and this report does not purport to completely describe all the site characteristics and properties. The nature and continuity of the ground between test locations has been inferred using experience and judgement and it should be appreciated that actual conditions could vary from the assumed model.

iii. Subsurface conditions relevant to construction works should be assessed by contractors who can make their own interpretation of the factual data provided. They should perform any additional tests as necessary for their own purposes.

iv. This Limitation should be read in conjunction with the Engineering NZ/ACENZ Standard Terms of Engagement.

v. This report is not to be reproduced either wholly or in part without our prior written permission.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on (09) 972 2205 if you require any further information.

Report prepared by

**Tyler Paterson**
Environmental Scientist

Report reviewed by

**Jamie Rhodes, CEnvP (SC)**
Associate Environmental Engineer

# 14 References

AC, 2001. Auckland Regional Council. (2001). Background Concentrations of Inorganic Elements in Soils from the Auckland Region, Auckland Regional Council, Technical Publications No. 153.

AUP, 2016. Auckland Regional Council. (2016). The Auckland Unitary Plan (Operative in Part) notified 15 November 2016.

BRANZ, 2017. The Building Research Association New Zealand. (2017). New Zealand Guidelines for Assessing and Managing Asbestos in Soil.

ENGEO, 2021. ENGEO Limited. (2021). Geotechnical Investigation Report – 182-184 Kepa Road and 8 Kurahaupo Street, Orakei (report reference 19375.000.001_02).

MfE, 2021a. Ministry for the Environment. (2021). Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand (revised 2021).

MfE, 2021b. Ministry for the Environment. (2021). Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils (Revised 2021).

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

MfE, 2011a. Ministry for the Environment. (2011). Hazardous Activities and Industries List (HAIL).

MfE, 2011b. Ministry for the Environment. (2011). Contaminated Land Management Guidelines No.2: Hierarchy and Application in New Zealand of environmental guideline values.

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

# FIGURES


**Legend**

- Site Boundary
- Sample locations
- Potential historical building location

0 5 m 10 m



ENGEO

Produced by **Datanest.earth**

| | | |
|---|---|---|
| Title: Environmental Investigation Plan | | |
| Client: Sanctum Projects Ltd | | |
| Project: 182-184 Kepa Road, Orakei | Drawn: TP | Figure No: 1<br>Size: A4 |
| Date: 14-12-2021 | Checked: JR | |
| Proj No: 19375.000.001 | Scale: 1:397 | Version: 1 |

# APPENDIX 1:

Site Contamination Enquiry Response

23 November 2021

**ENGEO Limited**
8 Greydene Place
**AUCKLAND 0622**

**Attention: Tyler Paterson**

Dear Tyler

**Site Contamination Enquiry – *182 - 184 Kepa Road and 8 Kurahaupo Street, Orakei***

This letter is in response to your enquiry requesting available site contamination information within Auckland Council records for the above site. Please note this report does not constitute a site investigation report; such reports are required to be prepared by a (third-party) Suitably Qualified and Experienced Practitioner.

The following details are based on information available to the Contamination, Air & Noise Team in the Resource Consent Department. The details provided may be from former regional council information, as well as property information held by the former district/city councils. For completeness the relevant property file should also be requested to obtain all historical records and reports via 09 3010101 or online at:

https://www.aucklandcouncil.govt.nz/buying-property/order-property-report/Pages/order-property-file.aspx.

## 1. Hazardous Activities and Industries List (HAIL) Information

This list published by the Ministry for the Environment (MfE) comprises activities and industries that are considered likely to cause land contamination as a result of hazardous substance use, storage, and/or disposal.

There is no contamination information held within Council's records for the site 182 - 184 Kepa Road and 8 Kurahaupo Street, Orakei

Due to the age of the dwellings on site the potential for asbestos and/or lead paint may need to be considered.

*Please note:*

- *If you are demolishing any building that may have asbestos containing materials (ACM) in it, you have obligations under the Health and Safety at Work (Asbestos) Regulations 2016 for*

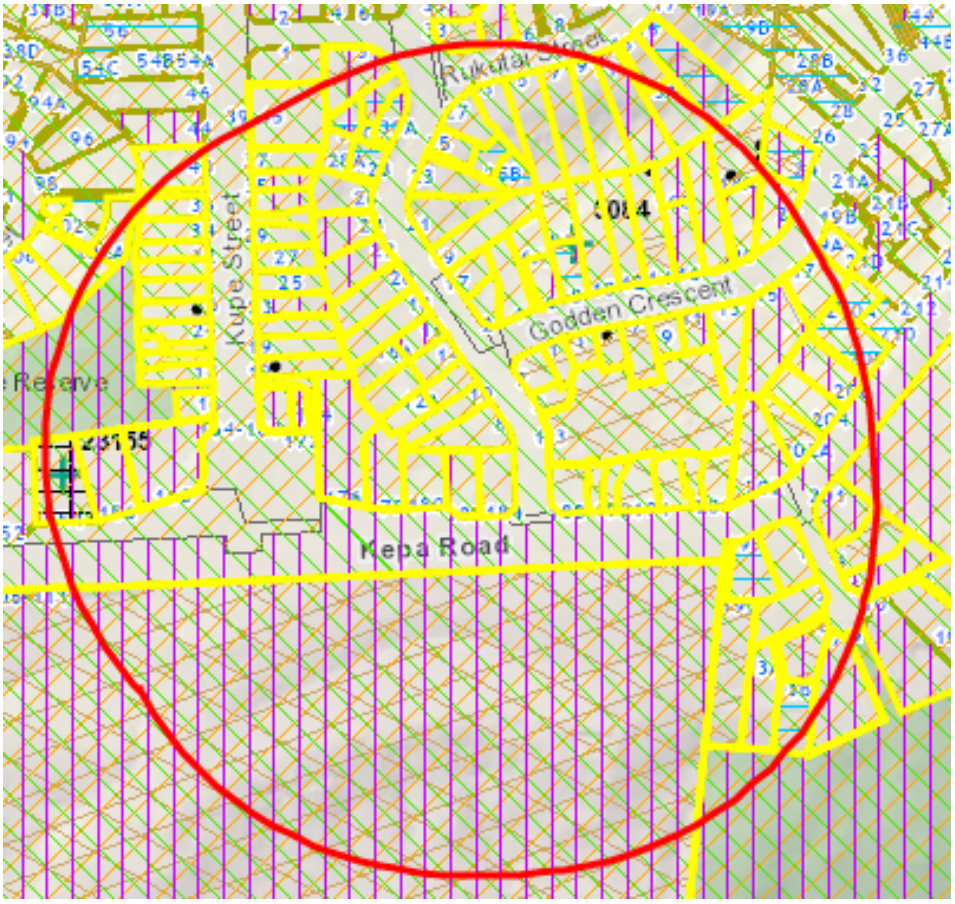
*the management and removal of asbestos, including the need to engage a Competent Asbestos Surveyor to confirm the presence or absence of any ACM.*

- *Paints used on external parts of properties up until the mid-1970's routinely contained lead, a poison and a persistent environmental pollutant. You are advised to ensure that soils affected by old, peeling or flaking paint are assessed in relation to the proposed use of the property, including high risk use by young children.*

## 2. Consents and Incidents Information (200m radius of the selected site)

The Council database was searched for records of the following activities within approximately 200 metres of the site:

- Pollution Incidents (including air discharges, oil or diesel spills)
- Bores
- Contaminated site and air discharges, and industrial trade process consents
- Closed Landfills
- Air quality permitted activities



**Legend:**


Relevant details of any pollution incidents and consents are appended to this letter (Attachment A). Please refer to the column titled 'Property Address' on the spreadsheet to aid in identifying corresponding data on the map.

While the Auckland Council has carried out the above search using its best practical endeavours, it does not warrant its completeness or accuracy and disclaims any responsibility or liability in respect of the information. If you or any other person wishes to act or to rely on this information, or make any financial commitment based upon it, it is recommended that you seek appropriate technical and/or professional advice.

If you wish to clarify anything in this letter that relates to this site, please contact contaminatedsites@aucklandcouncil.govt.nz. Any follow up requests for information on other sites must go through the online order process.

Should you wish to request any of the files referenced above and/or listed in the attached spreadsheet for viewing, please contact the Auckland Council Call Centre on 301 0101 and note you are requesting former Auckland Regional Council records (the records department requires three working days' notice to ensure the files will be available).

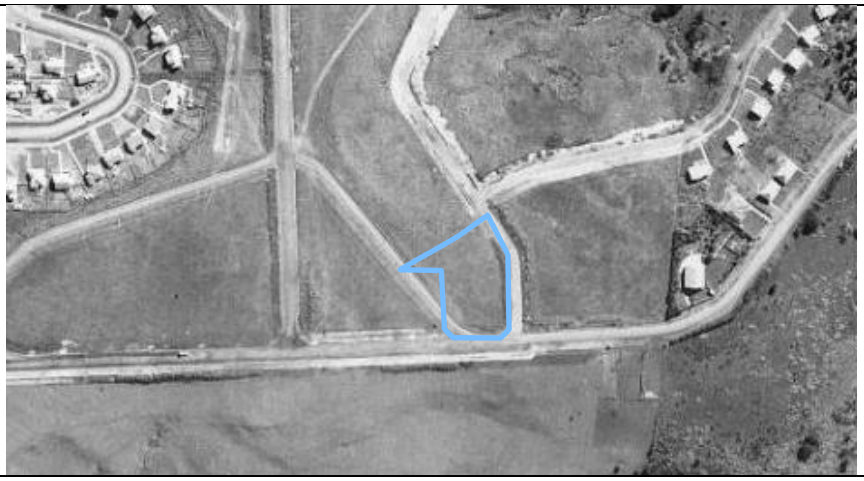
Please note Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for $128 for the time involved in this enquiry will follow shortly.

Yours Sincerely,

**Contamination, Air and Noise Team**
**Specialist Unit | Resource Consents**
**Auckland Council**

# APPENDIX 2:

Historical Aerial Photographs




*1940 (Retrolens)*


*1959 (Retrolens NZ)*


*1968 (Retrolens NZ)*


*1975 (Retrolens NZ)*


*1987 (Retrolens NZ)*


*1996 (Retrolens NZ)*


*2006 (Auckland Council Geomaps)*


*2010/11 (Auckland Council Geomaps)*


*2017 (Auckland Council Geomaps)*

# APPENDIX 3:

Site Walkover Photographs


Arrows indicate the orientation of the following photographs.

Photograph 1: Northern end of 184 Kepa Road, looking west across pool area.

Photograph 2: Northern end of 184 Kepa Road, looking west.

Photograph 3: Western side of dwelling at 184 Kepa, looking south.

Photograph 4: Entrance to 8 Kurahaupo Street, looking west.

Photograph 5: Front yard and dwelling at 8 Kurahaupo Street.

Photograph 6: Dilapidated shed in center of 8 Kurahaupo Street

Photograph 7: Western portion of 8 Kurahaupo Street, looking east.

Photograph 8: Western portion of 8 Kurahaupo Street, looking northwest.

Photograph 9: Northern portion of 182 Kepa Road, looking north.

Photograph 10: Western side of dwelling at 182 Kepa Road, looking south.

Photograph 11: Yard area to the east of 182 Kepa Road, looking southwest.

Photograph 12: Stairs on east of dwelling at 182 Kepa Road, leading to bottom flat.

# APPENDIX 4:

Results Table

| Analyte | | | Heavy Metals / Metalloids (mg / kg) | | | | | | | | Asbestos (% w/w) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sample Name** | **Samples Depth (m bgl)** | **Sample Date** | **Arsenic** | **Cadmium** | **Chromium** | **Copper** | **Lead** | **Mercury** | **Nickel** | **Zinc** | **ACM** | **FA & AF** |
| S01 | 0.1 | 23/11/2021 | 9.2 | 0.15 | 74 | 36 | 23 | 0.1 | 64 | 140 | ND | **0.00026** |
| S01 | 0.35 | 23/11/2021 | 4.8 | 0.09 | 86 | 34 | 17 | 0.12 | 83 | 98 | ND | ND |
| S02 | 0.1 | 23/11/2021 | **17** | **1.5** | 87 | **93** | **260** | 0.12 | 63 | 620 | ND | - |
| S03 | 0.1 | 23/11/2021 | **16** | **0.74** | 72 | 82 | **180** | 0.14 | 56 | 280 | ND | ND |
| S04 | 0.1 | 23/11/2021 | 7.4 | **0.81** | 72 | 69 | **460** | 0.09 | 48 | 350 | ND | ND |
| S05 | 0.1 | 23/11/2021 | **14** | **0.86** | 74 | **96** | **460** | 0.22 | 51 | 530 | ND | ND |
| S05 | 0.3 | 23/11/2021 | 4 | 0.17 | 76 | 41 | **99** | 0.11 | 57 | 160 | ND | **0.00044** |
| S06 | 0.2 | 23/11/2021 | **15** | **1.3** | 79 | **110** | **390** | 0.25 | 62 | 500 | ND | - |
| S07 | 0.1 | 23/11/2021 | 4.4 | 0.16 | 63 | 32 | 32 | 0.09 | 49 | 120 | ND | - |
| S08 | 0.1 | 23/11/2021 | 7.6 | 0.17 | 73 | 44 | **96** | 0.09 | 69 | 120 | ND | - |
| S09 | 0.1 | 23/11/2021 | 10 | 0.32 | 76 | 47 | **160** | 0.2 | 52 | 210 | ND | ND |
| S10 | 0.0 - 0.1 | 23/11/2021 | 11 | 0.36 | 61 | 63 | **170** | 0.15 | 46 | 250 | ND | **0.0013** |
| S10 | 0.2 - 0.4 | 23/11/2021 | 5 | 0.03 | 110 | 33 | 13 | 0.19 | 78 | 78 | ND | ND |
| S11 | 0.1 | 23/11/2021 | 4.3 | 0.17 | 75 | 51 | 64 | 0.14 | 55 | 120 | ND | - |
| **Assessment Criteria** | | | | | | | | | | | | |
| **Auckland Background Criteria – volcanic Soils[1]** | | | 0.4 - 12 | < 0.1 - 0.65 | 2 - 125 | 20 - 90 | < 5 - 65 | < 0.03 - 0.45 | 4 - 320 | 54 - 1160 | < LOR | < LOR |
| **High-Density Residential Human Health Criteria[2]** | | | 45 | 230[4] | 1,500 | >10,000 | 500 | 1,000 | 1,200[6] | 60,000[6] | 0.04[7] | 0.001[7] |
| **Environmental Discharge Criteria[3]** | | | 100 | 7.5 | 400 | 325 | 250 | 0.75 | 320 | 1160 | < LOR | < LOR |

Full analytical laboratory reports are included in Appendix 5.

1. Background Concentrations of Inorganic Elements in volcanic range soils from the Auckland Region. Auckland Regional Council, 2002, and the AUP, 2016). Exceedances are in bold.
2. Resource Management (National Environmental Standard for Assessing and managing Contaminants in Soil to Protect Human Health) Regulation 2012 (NES:CS). Exceedances of high-density residential land use are red.

3. Environmental discharge criteria from the AUP (AUP, 2016). Exceedances are underlined.
4. Assumes soil pH of 5.
5. Criteria for Chromium VI were conservatively selected.
6. Criteria sourced from National Environment Protection (Assessment of Site Contamination) Measure (NEPM). Residential B criteria listed, which assumes minimal opportunities for soil access (i.e. higher density residential).

7 Criteria sourced from BRANZ, 2017. ACM: Asbestos Containing Material; FA & AF: Fibrous Asbestos and Asbestos Fines.

- sample not tested for analyte
LOR laboratory limit of reporting
ND no asbestos detected

# APPENDIX 5:

Full Laboratory Results

# Certificate of Analysis

eurofins | Environment Testing

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

**ENGEO Ltd**
**8 Greydene Place**
**Takapuna**
**Auckland New Zealand 0622**

| | |
|---|---|
| **Attention:** | Jamie Rhodes |
| **Report** | 847523-AID |
| **Project Name** | KEPA ROAD |
| **Project ID** | 19375 |
| **Received Date** | Dec 06, 2021 |
| **Date Reported** | Dec 13, 2021 |

## Methodology:

| | |
|---|---|
| Asbestos Fibre Identification | Conducted in accordance with the Australian Standard AS 4964 – 2004: Method for the Qualitative Identification of Asbestos in Bulk Samples and in-house Method LTM-ASB-8020 by polarised light microscopy (PLM) and dispersion staining (DS) techniques.<br>*NOTE: Positive Trace Analysis results indicate the sample contains detectable respirable fibres.* |
| Unknown Mineral Fibres | Mineral fibres of unknown type, as determined by PLM with DS, may require another analytical technique, such as Electron Microscopy, to confirm unequivocal identity.<br>*NOTE: While Actinolite, Anthophyllite and Tremolite asbestos may be detected by PLM with DS, due to variability in the optical properties of these materials, AS4964 requires that these are reported as UMF unless confirmed by an independent technique.* |
| Subsampling Soil Samples | The whole sample submitted is first dried and then passed through a 10mm sieve followed by a 2mm sieve. All fibrous matter greater than 10mm, greater than 2mm as well as the material passing through the 2mm sieve are retained and analysed for the presence of asbestos. If the sub 2mm fraction is greater than approximately 30 to 60g then a sub-sampling routine based on ISO 3082:2009(E) is employed.<br>*NOTE: Depending on the nature and size of the soil sample, the sub-2 mm residue material may need to be sub-sampled for trace analysis, in accordance with AS 4964-2004.* |
| Bonded asbestos-containing material (ACM) | The material is first examined and any fibres isolated for identification by PLM and DS. Where required, interfering matrices may be removed by disintegration using a range of heat, chemical or physical treatments, possibly in combination.The resultant material is then further examined in accordance with AS 4964 - 2004.<br>*NOTE: Even after disintegration it may be difficult to detect the presence of asbestos in some asbestos-containing bulk materials using PLM and DS. This is due to the low grade or small length or diameter of the asbestos fibres present in the material, or to the fact that very fine fibres have been distributed intimately throughout the materials. Vinyl/asbestos floor tiles, some asbestos-containing sealants and mastics, asbestos-containing epoxy resins and some ore samples are examples of these types of material, which are difficult to analyse.* |
| Limit of Reporting | The performance limitation of the AS 4964 (2004) method for non-homogeneous samples is around 0.1 g/kg (equivalent to 0.01% (w/w)). Where no asbestos is found by PLM and DS, including Trace Analysis, this is considered to be at the nominal reporting limit of 0.01% (w/w).<br>The NEPM screening level of 0.001% (w/w) is intended as an on-site determination, not a laboratory Limit of Reporting (LOR), per se. Examination of a large sample size (e.g. 500 mL) may improve the likelihood of detecting asbestos, particularly AF, to aid assessment against the NEPM criteria. Gravimetric determinations to this level of accuracy are outside of AS 4964 and hence IANZ Accreditation does not cover the performance of this service (non-IANZ results shown with an asterisk).<br>*NOTE: NATA News March 2014, p.7, states in relation to AS 4964: "This is a qualitative method with a nominal reporting limit of 0.01 % " and that currently in Australia "there is no validated method available for the quantification of asbestos".This report is consistent with the analytical procedures and reporting recommendations in the NEPM and the WA DoH.* |

**Project Name** KEPA ROAD
**Project ID** 19375
**Date Sampled** Nov 23, 2021
**Report** 847523-AID

| Client Sample ID | Eurofins Sample No. | Date Sampled | Sample Description | Result |
|---|---|---|---|---|
| S01 0.1 | 21-De14424 | Nov 23, 2021 | Approximate Sample 516g<br>Sample consisted of: Fine grained soil and rocks | AF:<br>Chrysotile asbestos detected in the form of loose fibre bundles.<br>Approximate raw weight of AF = 0.0013g*<br>Estimated asbestos content in AF = 0.0013g*<br>Total estimated asbestos concentration in AF = 0.00026% w/w*<br>No asbestos detected at the reporting limit of 0.001% w/w.*<br><br>Synthetic mineral fibre detected.<br>Organic fibre detected.<br>No trace asbestos detected. |
| S01 0.35 | 21-De14425 | Nov 23, 2021 | Approximate Sample 526g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |
| S03 0.1 | 21-De14427 | Nov 23, 2021 | Approximate Sample 556g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |
| S04 0.1 | 21-De14428 | Nov 23, 2021 | Approximate Sample 492g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |
| S05 0.1 | 21-De14429 | Nov 23, 2021 | Approximate Sample 516g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |

| Client Sample ID | Eurofins Sample No. | Date Sampled | Sample Description | Result |
|---|---|---|---|---|
| S05 0.3 | 21-De14430 | Nov 23, 2021 | Approximate Sample 486g<br>Sample consisted of: Fine grained soil and rocks | FA:<br>Chrysotile and amosite asbestos detected in weathered fibre cement fragments.<br>Approximate raw weight of FA = 0.0038g<br>Estimated asbestos content in FA = 0.0015g*<br><br>AF:<br>Chrysotile and amosite asbestos detected in fibre cement fragments and in the form of loose fibre bundles.<br>Approximate raw weight of AF = 0.00063g*<br>Estimated asbestos content in AF = 0.00063g*<br><br>Total estimated asbestos content in FA and AF = 0.0021g*<br>Total estimated asbestos concentration in FA and AF = 0.00044% w/w*<br>No asbestos detected at the reporting limit of 0.001% w/w.*<br><br>Organic fibre detected. |
| S09 0.1 | 21-De14434 | Nov 23, 2021 | Approximate Sample 450g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |
| S10 0-0.1 | 21-De14435 | Nov 23, 2021 | Approximate Sample 532g<br>Sample consisted of: Fine grained soil and rocks | FA:<br>Chrysotile and amosite asbestos detected in weathered fibre cement fragments.<br>Approximate raw weight of FA = 0.012g<br>Estimated asbestos content in FA = 0.0070g*<br>Total estimated asbestos concentration in FA = 0.0013% w/w*<br><br>Organic fibre detected.<br>No trace asbestos detected. |
| S10 0.2-0.4 | 21-De14436 | Nov 23, 2021 | Approximate Sample 529g<br>Sample consisted of: Fine grained soil and rocks | No asbestos detected at the reporting limit of 0.001% w/w.*<br>Organic fibre detected.<br>No trace asbestos detected. |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| Description | Testing Site | Extracted | Holding Time |
|---|---|---|---|
| Asbestos - LTM-ASB-8020 | Auckland | Dec 13, 2021 | Indefinite |

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

**Eurofins Environment Testing NZ Limited**
NZBN: 9429046024954

**Auckland**
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

**Christchurch**
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

**Eurofins Environment Testing Australia Pty Ltd**
ABN: 50 005 085 521

**Melbourne**
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

**Sydney**
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

**Brisbane**
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

**Newcastle**
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

**Eurofins ARL Pty Ltd**
ABN: 91 05 0159 898

**Perth**
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

**Company Name:** ENGEO Ltd
**Address:** 8 Greydene Place
Takapuna
Auckland New Zealand 0622

**Project Name:** KEPA ROAD
**Project ID:** 19375

**Order No.:**
**Report #:** 847523
**Phone:** 0011 64 9 9722 205
**Fax:**

**Received:** Dec 6, 2021 4:30 PM
**Due:** Dec 13, 2021
**Priority:** 5 Day
**Contact Name:** Jamie Rhodes

**Eurofins Analytical Services Manager : Karishma Patel**

| Sample Detail | | | | | | Asbestos - WA guidelines | HOLD | Moisture Set | Metals M8 (NZ MfE) |
|---|---|---|---|---|---|---|---|---|---|
| **Auckland Laboratory - IANZ# 1327** | | | | | | X | X | X | X |
| **Christchurch Laboratory - IANZ# 1290** | | | | | | | | | |
| **External Laboratory** | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | |
| 1 | S01 0.1 | Nov 23, 2021 | | Soil | K21-De14424 | X | | X | X |
| 2 | S01 0.35 | Nov 23, 2021 | | Soil | K21-De14425 | X | | X | X |
| 3 | S02 0.1 | Nov 23, 2021 | | Soil | K21-De14426 | | | X | X |
| 4 | S03 0.1 | Nov 23, 2021 | | Soil | K21-De14427 | X | | X | X |
| 5 | S04 0.1 | Nov 23, 2021 | | Soil | K21-De14428 | X | | X | X |
| 6 | S05 0.1 | Nov 23, 2021 | | Soil | K21-De14429 | X | | X | X |
| 7 | S05 0.3 | Nov 23, 2021 | | Soil | K21-De14430 | X | | X | X |
| 8 | S06 0.2 | Nov 23, 2021 | | Soil | K21-De14431 | | | X | X |
| 9 | S07 0.1 | Nov 23, 2021 | | Soil | K21-De14432 | | | X | X |
| 10 | S08 0.1 | Nov 23, 2021 | | Soil | K21-De14433 | | | X | X |
| 11 | S09 0.1 | Nov 23, 2021 | | Soil | K21-De14434 | X | | X | X |
| 12 | S10 0-0.1 | Nov 23, 2021 | | Soil | K21-De14435 | X | | X | X |

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

**Eurofins Environment Testing NZ Limited**
NZBN: 9429046024954

**Auckland**
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

**Christchurch**
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

**Eurofins Environment Testing Australia Pty Ltd**
ABN: 50 005 085 521

**Melbourne**
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

**Sydney**
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

**Brisbane**
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

**Newcastle**
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

**Eurofins ARL Pty Ltd**
ABN: 91 05 0159 898

**Perth**
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

**Company Name:** ENGEO Ltd
**Address:** 8 Greydene Place
Takapuna
Auckland New Zealand 0622

**Project Name:** KEPA ROAD
**Project ID:** 19375

**Order No.:**
**Report #:** 847523
**Phone:** 0011 64 9 9722 205
**Fax:**

**Received:** Dec 6, 2021 4:30 PM
**Due:** Dec 13, 2021
**Priority:** 5 Day
**Contact Name:** Jamie Rhodes

**Eurofins Analytical Services Manager : Karishma Patel**

| Sample Detail | | | | | | Asbestos - WA guidelines | HOLD | Moisture Set | Metals M8 (NZ MfE) |
|---|---|---|---|---|---|---|---|---|---|
| **Auckland Laboratory - IANZ# 1327** | | | | | | X | X | X | X |
| **Christchurch Laboratory - IANZ# 1290** | | | | | | | | | |
| **External Laboratory** | | | | | | | | | |
| 13 | S10 0.2-0.4 | Nov 23, 2021 | | Soil | K21-De14436 | X | | X | X |
| 14 | S11 0.1 | Nov 23, 2021 | | Soil | K21-De14437 | | | X | X |
| 15 | S02 0.3 | Not Provided | | Soil | K21-De14438 | | X | | |
| 16 | S03 0.3 | Not Provided | | Soil | K21-De14439 | | X | | |
| 17 | S04 0.3 | Not Provided | | Soil | K21-De14440 | | X | | |
| 18 | S06 0.4 | Not Provided | | Soil | K21-De14441 | | X | | |
| 19 | S07 0.35 | Not Provided | | Soil | K21-De14442 | | X | | |
| 20 | S08 0.2 | Not Provided | | Soil | K21-De14443 | | X | | |
| 21 | S09 0.3-0.5 | Not Provided | | Soil | K21-De14444 | | X | | |
| 22 | S11 0.3 | Not Provided | | Soil | K21-De14445 | | X | | |
| **Test Counts** | | | | | | 9 | 8 | 14 | 14 |

## Internal Quality Control Review and Glossary General

1. QC data may be available on request.
2. All soil results are reported on a dry basis, unless otherwise stated.
3. Samples were analysed on an 'as received' basis.
4. Information identified on this report with the colour **blue** indicates data provided by customer that may have an impact on the results.
5. Information identified on this report with the colour **orange** indicates sections of the report not covered by the laboratory's scope of NATA accreditation.
6. This report replaces any interim results previously issued.

## Holding Times

Please refer to the most recent version of the 'Sample Preservation and Container Guide' for holding times (QS3001).
If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported. Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

## Units

| | |
|---|---|
| % w/w: | Percentage weight-for-weight basis, e.g. of asbestos in asbestos-containing finds in soil samples (**% w/w**) |
| F/fld | Airborne fibre filter loading as Fibres (**N**) per Fields counted (**n**) |
| F/mL | Airborne fibre reported concentration as Fibres per millilitre of air drawn over the sampler membrane (**C**) |
| g, kg | Mass, e.g. of whole sample (**M**) or asbestos-containing find within the sample (**m**) |
| g/kg | Concentration in grams per kilogram |
| L, mL | Volume, e.g. of air as measured in AFM (**V** = **r** x **t**) |
| L/min | Airborne fibre sampling Flowrate as litres per minute of air drawn over the sampler membrane (**r**) |
| min | Time (**t**), e.g. of air sample collection period |

## Calculations

Airborne Fibre Concentration: $C = \frac{}{a} \times \frac{}{n} \times \frac{}{r} \times \frac{}{t} = K \times \frac{}{n} \times \frac{}{V}$

Asbestos Content (as asbestos): $\%\ w/w = \frac{(m \times PA)}{M}$

Weighted Average (of asbestos): $\%_W = \Sigma \frac{(m \times P_A)_X}{X}$

## Terms

| | |
|---|---|
| **%asbestos** | Estimated percentage of asbestos in a given matrix. May be derived from knowledge or experience of the material, informed by HSG264 *Appendix 2*, else assumed to be 15% in accordance with WA DOH *Appendix 2* (**$P_A$**). |
| **ACM** | Asbestos Containing Materials. Asbestos contained within a non-asbestos matrix, typically presented in bonded (non-friable) condition. For the purposes of the NEPM and WA DOH, ACM corresponds to material larger than 7 mm x 7 mm. |
| **AF** | Asbestos Fines. Asbestos contamination within a soil sample, as defined by WA DOH. Includes loose fibre bundles and small pieces of friable and non-friable material such as asbestos cement fragments mixed with soil. Considered under the NEPM as equivalent to "non-bonded / friable". |
| **AFM** | Airborne Fibre Monitoring, e.g. by the MFM. |
| **Amosite** | Amosite Asbestos Detected. Amosite may also refer to Fibrous Grunerite or Brown Asbestos. Identified in accordance with AS 4964-2004. |
| **AS** | Australian Standard. |
| **Asbestos Content (as asbestos)** | Total % w/w asbestos content in asbestos-containing finds in a soil sample (**% w/w**). |
| **Chrysotile** | Chrysotile Asbestos Detected. Chrysotile may also refer to Fibrous Serpentine or White Asbestos. Identified in accordance with AS 4964-2004. |
| **COC** | Chain of Custody. |
| **Compliant** | Indicates the item has been assessed against the relevant criteria, e.g. NATA SAC_07. |
| **Crocidolite** | Crocidolite Asbestos Detected. Crocidolite may also refer to Fibrous Riebeckite or Blue Asbestos. Identified in accordance with AS 4964-2004. |
| **Dry** | Sample is dried by heating prior to analysis. |
| **DS** | Dispersion Staining. Technique required for Unequivocal Identification of asbestos fibres by PLM. |
| **FA** | Fibrous Asbestos. Asbestos containing material that is wholly or in part friable, including materials with higher asbestos content with a propensity to become friable with handling, and any material that was previously non-friable and in a severely degraded condition. For the purposes of the NEPM and WA DOH, FA generally corresponds to material larger than 7 mm x 7 mm, although FA may be more difficult to visibly distinguish and may be assessed as AF. |
| **Fibre Count** | Total of all fibres (whether asbestos or not) meeting the counting criteria set out in the NOHSC:3003 |
| **Fibre ID** | Fibre Identification. Unequivocal identification of asbestos fibres according to AS 4964-2004. Includes Chrysotile, Amosite (Grunerite) or Crocidolite asbestos. |
| **Friable** | Asbestos-containing materials of any size that may be broken or crumbled by hand pressure. For the purposes of the NEPM, this includes both AF and FA. It is outside of the laboratory's remit to assess degree of friability. |
| **HSG248** | UK HSE HSG248, *Asbestos: The Analysts Guide*, 2nd Edition (2021). |
| **HSG264** | UK HSE HSG264, *Asbestos: The Survey Guide* (2012). |
| **ISO (also ISO/IEC)** | International Organization for Standardization / International Electrotechnical Commission. |
| **K Factor** | Microscope constant (**K**) as derived from the effective filter area of the given AFM membrane used for collecting the sample (**A**) and the projected eyepiece graticule area of the specific microscope used for the analysis (**a**). |
| **LOR** | Limit of Reporting. |
| **MFM (also NOHSC:3003)** | Membrane Filter Method. As described by the Australian Government National Occupational Health and Safety Commission, *Guidance Note on the Membrane Filter Method for Estimating Airborne Asbestos Fibres*, 2nd Edition [NOHSC:3003(2005)]. |
| **N/A** | Not Applicable. Indicates a result or assessment is not required or applicable to that item. |
| **NATA** | National Association of Testing Authorities, Australia. |
| **NEPM (also ASC NEPM)** | National Environment Protection (Assessment of Site Contamination) Measure, (2013, as amended). |
| **Organic** | Organic Fibres Detected. Organic may refer to Natural or Man-Made Polymeric Fibres. Identified in accordance with AS 4964-2004. |
| **PCM** | Phase Contrast Microscopy. As used for Fibre Counting according to the MFM. |
| **PLM** | Polarised Light Microscopy. As used for Fibre Identification and Trace Analysis according to AS 4964-2004. |
| **SAC_07** | Specific Accreditation Criteria: ISO/IEC 17025 Application Document, Life Sciences – Annex, Asbestos sampling and testing. |
| **SMF** | Synthetic Mineral Fibre Detected. SMF may also refer to Man Made Vitreous Fibres. Identified in accordance with AS 4964-2004. |
| **SRA** | Sample Receipt Advice. |
| **Trace Analysis** | Analytical procedure used to detect the presence of respirable fibres (particularly asbestos) in a given sample matrix. |
| **UK HSE HSG** | United Kingdom, Health and Safety Executive, Health and Safety Guidance, publication. |
| **UMF** | Unidentified Mineral Fibre Detected. Fibrous minerals that are detected but have not been unequivocally identified by PLM with DS according the AS 4964-2004. May include (but not limited to) Actinolite, Anthophyllite or Tremolite asbestos. |
| **WA DOH** | Reference document for the NEPM. Government of Western Australia, *Guidelines for the Assessment, Remediation and Management of Asbestos- Contaminated Sites in Western Australia* (updated 2021), including Appendix Four: *Laboratory analysis* |
| **Weighted Average** | Combined average % w/w asbestos content of all asbestos-containing finds in the given aliquot or total soil sample (**$\%_{WA}$**). |

## Comments

### Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

### Asbestos Counter/Identifier:

| | |
|---|---|
| Katyana Gausel | Senior Analyst-Asbestos (Key Technical Personnel) (NSW) |

### Authorised by:

| | |
|---|---|
| Destiny Cruickshanks | Senior Analyst-Asbestos (NZS) |

**Katyana Gausel**
**Senior Analyst-Asbestos (Key Technical Personnel)**

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates ISO/IEC 17025:2017 accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

All tests reported herein have been performed in accordance with the laboratory's scope of accreditation

**ENGEO Ltd**
**8 Greydene Place**
**Takapuna**
**Auckland New Zealand 0622**

**Attention:** **Jamie Rhodes**

**Report** **847523-S**
Project name KEPA ROAD
Project ID 19375
Received Date Dec 06, 2021

| **Client Sample ID** | | | **S01 0.1** | **S01 0.35** | **S02 0.1** | **S03 0.1** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Soil** | **Soil** | **Soil** | **Soil** |
| **Eurofins Sample No.** | | | **K21-De14424** | **K21-De14425** | **K21-De14426** | **K21-De14427** |
| **Date Sampled** | | | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** |
| Test/Reference | LOR | Unit | | | | |
| **Metals M8 (NZ MfE)** | | | | | | |
| Arsenic | 0.1 | mg/kg | 9.2 | 4.8 | 17 | 16 |
| Cadmium | 0.01 | mg/kg | 0.15 | 0.09 | 1.5 | 0.74 |
| Chromium | 0.1 | mg/kg | 74 | 86 | 87 | 72 |
| Copper | 0.1 | mg/kg | 36 | 34 | 93 | 82 |
| Lead | 0.1 | mg/kg | 23 | 17 | 260 | 180 |
| Mercury | 0.01 | mg/kg | 0.10 | 0.12 | 0.12 | 0.14 |
| Nickel | 0.1 | mg/kg | 64 | 83 | 63 | 56 |
| Zinc | 5 | mg/kg | 140 | 98 | 620 | 280 |
| | | | | | | |
| % Moisture | 1 | % | 27 | 24 | 24 | 21 |

| **Client Sample ID** | | | **S04 0.1** | **S05 0.1** | **S05 0.3** | **S06 0.2** |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Soil** | **Soil** | **Soil** | **Soil** |
| **Eurofins Sample No.** | | | **K21-De14428** | **K21-De14429** | **K21-De14430** | **K21-De14431** |
| **Date Sampled** | | | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** |
| Test/Reference | LOR | Unit | | | | |
| **Metals M8 (NZ MfE)** | | | | | | |
| Arsenic | 0.1 | mg/kg | 7.4 | 14 | 4.0 | 15 |
| Cadmium | 0.01 | mg/kg | 0.81 | 0.86 | 0.17 | 1.3 |
| Chromium | 0.1 | mg/kg | 72 | 74 | 76 | 79 |
| Copper | 0.1 | mg/kg | 69 | 96 | 41 | 110 |
| Lead | 0.1 | mg/kg | 460 | 460 | 99 | 390 |
| Mercury | 0.01 | mg/kg | 0.09 | 0.22 | 0.11 | 0.25 |
| Nickel | 0.1 | mg/kg | 48 | 51 | 57 | 62 |
| Zinc | 5 | mg/kg | 350 | 530 | 160 | 500 |
| | | | | | | |
| % Moisture | 1 | % | 17 | 20 | 22 | 27 |

| Client Sample ID | | | S07 0.1 | S08 0.1 | S09 0.1 | S10 0-0.1 |
|---|---|---|---|---|---|---|
| **Sample Matrix** | | | **Soil** | **Soil** | **Soil** | **Soil** |
| **Eurofins Sample No.** | | | **K21-De14432** | **K21-De14433** | **K21-De14434** | **K21-De14435** |
| **Date Sampled** | | | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** | **Nov 23, 2021** |
| Test/Reference | LOR | Unit | | | | |
| **Metals M8 (NZ MfE)** | | | | | | |
| Arsenic | 0.1 | mg/kg | 4.4 | 7.6 | 10 | 11 |
| Cadmium | 0.01 | mg/kg | 0.16 | 0.17 | 0.32 | 0.36 |
| Chromium | 0.1 | mg/kg | 63 | 73 | 76 | 61 |
| Copper | 0.1 | mg/kg | 32 | 44 | 47 | 63 |
| Lead | 0.1 | mg/kg | 32 | 96 | 160 | 170 |
| Mercury | 0.01 | mg/kg | 0.09 | 0.09 | 0.20 | 0.15 |
| Nickel | 0.1 | mg/kg | 49 | 69 | 52 | 46 |
| Zinc | 5 | mg/kg | 120 | 120 | 210 | 250 |
| | | | | | | |
| % Moisture | 1 | % | 29 | 27 | 26 | 8.4 |

| Client Sample ID | | | S10 0.2-0.4 | S11 0.1 |
|---|---|---|---|---|
| **Sample Matrix** | | | **Soil** | **Soil** |
| **Eurofins Sample No.** | | | **K21-De14436** | **K21-De14437** |
| **Date Sampled** | | | **Nov 23, 2021** | **Nov 23, 2021** |
| Test/Reference | LOR | Unit | | |
| **Metals M8 (NZ MfE)** | | | | |
| Arsenic | 0.1 | mg/kg | 5.0 | 4.3 |
| Cadmium | 0.01 | mg/kg | 0.03 | 0.17 |
| Chromium | 0.1 | mg/kg | 110 | 75 |
| Copper | 0.1 | mg/kg | 33 | 51 |
| Lead | 0.1 | mg/kg | 13 | 64 |
| Mercury | 0.01 | mg/kg | 0.19 | 0.14 |
| Nickel | 0.1 | mg/kg | 78 | 55 |
| Zinc | 5 | mg/kg | 78 | 120 |
| | | | | |
| % Moisture | 1 | % | 26 | 24 |

## Sample History

Where samples are submitted/analysed over several days, the last date of extraction is reported.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

| Description | Testing Site | Extracted | Holding Time |
|---|---|---|---|
| Metals M8 (NZ MfE) | Auckland | Dec 07, 2021 | 28 Days |
| - Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS | | | |
| % Moisture | Auckland | Dec 07, 2021 | 14 Days |
| - Method: LTM-GEN-7080 Moisture Content in Soil by Gravimetry | | | |

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

**Eurofins Environment Testing NZ Limited**
NZBN: 9429046024954

**Auckland**
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

**Christchurch**
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

**Eurofins Environment Testing Australia Pty Ltd**
ABN: 50 005 085 521

**Melbourne**
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

**Sydney**
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

**Brisbane**
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

**Newcastle**
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

**Eurofins ARL Pty Ltd**
ABN: 91 05 0159 898

**Perth**
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

**Company Name:** ENGEO Ltd
**Address:** 8 Greydene Place
Takapuna
Auckland New Zealand 0622

**Project Name:** KEPA ROAD
**Project ID:** 19375

**Order No.:**
**Report #:** 847523
**Phone:** 0011 64 9 9722 205
**Fax:**

**Received:** Dec 6, 2021 4:30 PM
**Due:** Dec 13, 2021
**Priority:** 5 Day
**Contact Name:** Jamie Rhodes

**Eurofins Analytical Services Manager : Karishma Patel**

| Sample Detail | | | | | | Asbestos - WA guidelines | HOLD | Moisture Set | Metals M8 (NZ MfE) |
|---|---|---|---|---|---|---|---|---|---|
| **Auckland Laboratory - IANZ# 1327** | | | | | | X | X | X | X |
| **Christchurch Laboratory - IANZ# 1290** | | | | | | | | | |
| **External Laboratory** | | | | | | | | | |
| **No** | **Sample ID** | **Sample Date** | **Sampling Time** | **Matrix** | **LAB ID** | | | | |
| 1 | S01 0.1 | Nov 23, 2021 | | Soil | K21-De14424 | X | | X | X |
| 2 | S01 0.35 | Nov 23, 2021 | | Soil | K21-De14425 | X | | X | X |
| 3 | S02 0.1 | Nov 23, 2021 | | Soil | K21-De14426 | | | X | X |
| 4 | S03 0.1 | Nov 23, 2021 | | Soil | K21-De14427 | X | | X | X |
| 5 | S04 0.1 | Nov 23, 2021 | | Soil | K21-De14428 | X | | X | X |
| 6 | S05 0.1 | Nov 23, 2021 | | Soil | K21-De14429 | X | | X | X |
| 7 | S05 0.3 | Nov 23, 2021 | | Soil | K21-De14430 | X | | X | X |
| 8 | S06 0.2 | Nov 23, 2021 | | Soil | K21-De14431 | | | X | X |
| 9 | S07 0.1 | Nov 23, 2021 | | Soil | K21-De14432 | | | X | X |
| 10 | S08 0.1 | Nov 23, 2021 | | Soil | K21-De14433 | | | X | X |
| 11 | S09 0.1 | Nov 23, 2021 | | Soil | K21-De14434 | X | | X | X |
| 12 | S10 0-0.1 | Nov 23, 2021 | | Soil | K21-De14435 | X | | X | X |

eurofins | Environment Testing

web: www.eurofins.com.au
email: EnviroSales@eurofins.com

**Eurofins Environment Testing NZ Limited**
NZBN: 9429046024954

**Auckland**
35 O'Rorke Road
Penrose, Auckland 1061
Phone : +64 9 526 45 51
IANZ # 1327

**Christchurch**
43 Detroit Drive
Rolleston, Christchurch 7675
Phone : 0800 856 450
IANZ # 1290

**Eurofins Environment Testing Australia Pty Ltd**
ABN: 50 005 085 521

**Melbourne**
6 Monterey Road
Dandenong South VIC 3175
Phone : +61 3 8564 5000
NATA # 1261 Site # 1254

**Sydney**
Unit F3, Building F
16 Mars Road
Lane Cove West NSW 2066
Phone : +61 2 9900 8400
NATA # 1261 Site # 18217

**Brisbane**
1/21 Smallwood Place
Murarrie QLD 4172
Phone : +61 7 3902 4600
NATA # 1261 Site # 20794

**Newcastle**
4/52 Industrial Drive
Mayfield East NSW 2304
PO Box 60 Wickham 2293
Phone : +61 2 4968 8448
NATA # 1261 Site # 25079

**Eurofins ARL Pty Ltd**
ABN: 91 05 0159 898

**Perth**
46-48 Banksia Road
Welshpool WA 6106
Phone : +61 8 6253 4444
NATA # 2377 Site # 2370

**Company Name:** ENGEO Ltd
**Address:** 8 Greydene Place
Takapuna
Auckland New Zealand 0622

**Project Name:** KEPA ROAD
**Project ID:** 19375

**Order No.:**
**Report #:** 847523
**Phone:** 0011 64 9 9722 205
**Fax:**

**Received:** Dec 6, 2021 4:30 PM
**Due:** Dec 13, 2021
**Priority:** 5 Day
**Contact Name:** Jamie Rhodes

**Eurofins Analytical Services Manager : Karishma Patel**

| Sample Detail | | | | | | Asbestos - WA guidelines | HOLD | Moisture Set | Metals M8 (NZ MfE) |
|---|---|---|---|---|---|---|---|---|---|
| **Auckland Laboratory - IANZ# 1327** | | | | | | X | X | X | X |
| **Christchurch Laboratory - IANZ# 1290** | | | | | | | | | |
| **External Laboratory** | | | | | | | | | |
| 13 | S10 0.2-0.4 | Nov 23, 2021 | | Soil | K21-De14436 | X | | X | X |
| 14 | S11 0.1 | Nov 23, 2021 | | Soil | K21-De14437 | | | X | X |
| 15 | S02 0.3 | Not Provided | | Soil | K21-De14438 | | X | | |
| 16 | S03 0.3 | Not Provided | | Soil | K21-De14439 | | X | | |
| 17 | S04 0.3 | Not Provided | | Soil | K21-De14440 | | X | | |
| 18 | S06 0.4 | Not Provided | | Soil | K21-De14441 | | X | | |
| 19 | S07 0.35 | Not Provided | | Soil | K21-De14442 | | X | | |
| 20 | S08 0.2 | Not Provided | | Soil | K21-De14443 | | X | | |
| 21 | S09 0.3-0.5 | Not Provided | | Soil | K21-De14444 | | X | | |
| 22 | S11 0.3 | Not Provided | | Soil | K21-De14445 | | X | | |
| **Test Counts** | | | | | | 9 | 8 | 14 | 14 |

## Internal Quality Control Review and Glossary

### General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

### Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

### Units

**mg/kg:** milligrams per kilogram
**mg/L:** milligrams per litre
**ug/L:** micrograms per litre
**ppm:** Parts per million
**ppb:** Parts per billion
**%:** Percentage
**org/100mL:** Organisms per 100 millilitres
**NTU:** Nephelometric Turbidity Units
**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

### Terms

| | |
|---|---|
| **Dry** | Where a moisture has been determined on a solid sample the result is expressed on a dry basis. |
| **LOR** | Limit of Reporting. |
| **SPIKE** | Addition of the analyte to the sample and reported as percentage recovery. |
| **RPD** | Relative Percent Difference between two Duplicate pieces of analysis. |
| **LCS** | Laboratory Control Sample - reported as percent recovery. |
| **CRM** | Certified Reference Material - reported as percent recovery. |
| **Method Blank** | In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water. |
| **Surr - Surrogate** | The addition of a like compound to the analyte target and reported as percentage recovery. |
| **Duplicate** | A second piece of analysis from the same sample and reported in the same units as the result to show comparison. |
| **USEPA** | United States Environmental Protection Agency |
| **APHA** | American Public Health Association |
| **TCLP** | Toxicity Characteristic Leaching Procedure |
| **COC** | Chain of Custody |
| **SRA** | Sample Receipt Advice |
| **QSM** | US Department of Defense Quality Systems Manual Version |
| **CP** | Client Parent - QC was performed on samples pertaining to this report |
| **NCP** | Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within. |
| **TEQ** | Toxic Equivalency Quotient |
| **WA DWER** | Sum of PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA |

### QC - Acceptance Criteria

The acceptance criteria should be used as a guide only and may be different when site specific Sampling Analysis and Quality Plan (SAQP) have been implemented

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

NOTE: pH duplicates are reported as a range not as RPD

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs..

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM where no positive PFAS results have been reported have been reviewed and no data was affected.

.

### QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling. Therefore, laboratory analysis is unlikely to be completed within holding time.Analysis will begin as soon as possible after sample receipt.
4. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of recovery the term "INT" appears against that analyte.
5. For Matrix Spikes and LCS results a dash "-" in the report means that the specific analyte was not added to the QC sample.
6. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

**Quality Control Results**

| Test | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|
| **Method Blank** | | | | | | | |
| **Metals M8 (NZ MfE)** | | | | | | | |
| Arsenic | mg/kg | < 0.1 | | | 0.1 | Pass | |
| Cadmium | mg/kg | < 0.01 | | | 0.01 | Pass | |
| Chromium | mg/kg | < 0.1 | | | 0.1 | Pass | |
| Copper | mg/kg | < 0.1 | | | 0.1 | Pass | |
| Lead | mg/kg | < 0.1 | | | 0.1 | Pass | |
| Mercury | mg/kg | < 0.01 | | | 0.01 | Pass | |
| Nickel | mg/kg | < 0.1 | | | 0.1 | Pass | |
| Zinc | mg/kg | < 5 | | | 5 | Pass | |
| **LCS - % Recovery** | | | | | | | |
| **Metals M8 (NZ MfE)** | | | | | | | |
| Arsenic | % | 96 | | | 80-120 | Pass | |
| Cadmium | % | 93 | | | 80-120 | Pass | |
| Chromium | % | 108 | | | 80-120 | Pass | |
| Copper | % | 103 | | | 80-120 | Pass | |
| Lead | % | 103 | | | 80-120 | Pass | |
| Mercury | % | 115 | | | 80-120 | Pass | |
| Nickel | % | 106 | | | 80-120 | Pass | |
| Zinc | % | 103 | | | 80-120 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | | | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| **Spike - % Recovery** | | | | | | | | | |
| **Metals M8 (NZ MfE)** | | | | Result 1 | | | | | |
| Arsenic | K21-De14433 | CP | % | 91 | | | 75-125 | Pass | |
| Cadmium | K21-De14433 | CP | % | 90 | | | 75-125 | Pass | |
| Chromium | K21-De14433 | CP | % | 88 | | | 75-125 | Pass | |
| Copper | K21-De14433 | CP | % | 85 | | | 75-125 | Pass | |
| Lead | K21-De14433 | CP | % | 92 | | | 75-125 | Pass | |
| Mercury | K21-De14433 | CP | % | 104 | | | 75-125 | Pass | |
| Nickel | K21-De14433 | CP | % | 96 | | | 75-125 | Pass | |
| Zinc | K21-De14433 | CP | % | 97 | | | 75-125 | Pass | |

| Test | Lab Sample ID | QA Source | Units | Result 1 | Result 2 | RPD | Acceptance Limits | Pass Limits | Qualifying Code |
|---|---|---|---|---|---|---|---|---|---|
| **Duplicate** | | | | | | | | | |
| **Metals M8 (NZ MfE)** | | | | Result 1 | Result 2 | RPD | | | |
| Arsenic | K21-De14432 | CP | mg/kg | 4.4 | 4.6 | 3.0 | 30% | Pass | |
| Cadmium | K21-De14432 | CP | mg/kg | 0.16 | 0.16 | 1.0 | 30% | Pass | |
| Chromium | K21-De14432 | CP | mg/kg | 63 | 64 | 2.0 | 30% | Pass | |
| Copper | K21-De14432 | CP | mg/kg | 32 | 33 | 2.0 | 30% | Pass | |
| Lead | K21-De14432 | CP | mg/kg | 32 | 34 | 6.0 | 30% | Pass | |
| Mercury | K21-De14432 | CP | mg/kg | 0.09 | 0.10 | 17 | 30% | Pass | |
| Nickel | K21-De14432 | CP | mg/kg | 49 | 50 | 3.0 | 30% | Pass | |
| Zinc | K21-De14432 | CP | mg/kg | 120 | 120 | 3.0 | 30% | Pass | |

## Comments

### Sample Integrity

| | |
|---|---|
| Custody Seals Intact (if used) | N/A |
| Attempt to Chill was evident | Yes |
| Sample correctly preserved | Yes |
| Appropriate sample containers have been used | Yes |
| Sample containers for volatile analysis received with minimal headspace | Yes |
| Samples received within HoldingTime | Yes |
| Some samples have been subcontracted | No |

### Authorised by:

| | |
|---|---|
| Karishma Patel | Analytical Services Manager |
| Shasti Ramachandran | Senior Analyst-Metal (NZN) |

**Michael Ritchie**
**Head of Semi Volatiles (Key Technical Personnel)**

Final Report – this report replaces any previously issued Report

- Indicates Not Requested

* Indicates IANZ accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

# APPENDIX 6:

ProUCL Sheets

| | A |
|---|---|
| 1 | Lead |
| 2 | 23 |
| 3 | 260 |
| 4 | 180 |
| 5 | 32 |
| 6 | 96 |
| 7 | 160 |
| 8 | 170 |
| 9 | 64 |

## UCL Statistics for Uncensored Full Data Sets

| | |
|---|---|
| User Selected Options | |
| Date/Time of Computation | ProUCL 5.128/01/2022 9:59:38 AM |
| From File | WorkSheet.xls |
| Full Precision | OFF |
| Confidence Coefficient | 95% |
| Number of Bootstrap Operations | 2000 |

**Lead**

### General Statistics

| | | | |
|---|---|---|---|
| Total Number of Observations | 8 | Number of Distinct Observations | 8 |
| | | Number of Missing Observations | 0 |
| Minimum | 23 | Mean | 123.1 |
| Maximum | 260 | Median | 128 |
| SD | 82.88 | Std. Error of Mean | 29.3 |
| Coefficient of Variation | 0.673 | Skewness | 0.306 |

**Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1**

### Normal GOF Test

| | | |
|---|---|---|
| Shapiro Wilk Test Statistic | 0.938 | **Shapiro Wilk GOF Test** |
| 5% Shapiro Wilk Critical Value | 0.818 | Data appear Normal at 5% Significance Level |
| Lilliefors Test Statistic | 0.172 | **Lilliefors GOF Test** |
| 5% Lilliefors Critical Value | 0.283 | Data appear Normal at 5% Significance Level |

**Data appear Normal at 5% Significance Level**

### Assuming Normal Distribution

| 95% Normal UCL | | 95% UCLs (Adjusted for Skewness) | |
|---|---|---|---|
| 95% Student's-t UCL | 178.6 | 95% Adjusted-CLT UCL (Chen-1995) | 174.7 |
| | | 95% Modified-t UCL (Johnson-1978) | 179.2 |

### Gamma GOF Test

| | | |
|---|---|---|
| A-D Test Statistic | 0.336 | **Anderson-Darling Gamma GOF Test** |
| 5% A-D Critical Value | 0.724 | Detected data appear Gamma Distributed at 5% Significance Level |
| K-S Test Statistic | 0.232 | **Kolmogorov-Smirnov Gamma GOF Test** |
| 5% K-S Critical Value | 0.298 | Detected data appear Gamma Distributed at 5% Significance Level |

**Detected data appear Gamma Distributed at 5% Significance Level**

### Gamma Statistics

| | | | |
|---|---|---|---|
| k hat (MLE) | 1.955 | k star (bias corrected MLE) | 1.305 |
| Theta hat (MLE) | 62.98 | Theta star (bias corrected MLE) | 94.34 |
| nu hat (MLE) | 31.28 | nu star (bias corrected) | 20.88 |
| MLE Mean (bias corrected) | 123.1 | MLE Sd (bias corrected) | 107.8 |
| | | Approximate Chi Square Value (0.05) | 11.5 |
| Adjusted Level of Significance | 0.0195 | Adjusted Chi Square Value | 9.791 |

### Assuming Gamma Distribution

| | | | |
|---|---|---|---|
| 95% Approximate Gamma UCL (use when n>=50)) | 223.5 | 95% Adjusted Gamma UCL (use when n<50) | 262.6 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 55 | | | | | | | | | | | | |
| 56 | **Lognormal GOF Test** | | | | | | | | | | | |
| 57 | | | | | Shapiro Wilk Test Statistic | 0.91 | **Shapiro Wilk Lognormal GOF Test** | | | | | |
| 58 | | | | | 5% Shapiro Wilk Critical Value | 0.818 | Data appear Lognormal at 5% Significance Level | | | | | |
| 59 | | | | | Lilliefors Test Statistic | 0.231 | **Lilliefors Lognormal GOF Test** | | | | | |
| 60 | | | | | 5% Lilliefors Critical Value | 0.283 | Data appear Lognormal at 5% Significance Level | | | | | |
| 61 | **Data appear Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 62 | | | | | | | | | | | | |
| 63 | **Lognormal Statistics** | | | | | | | | | | | |
| 64 | | | | | Minimum of Logged Data | 3.135 | Mean of logged Data | 4.536 | | | | |
| 65 | | | | | Maximum of Logged Data | 5.561 | SD of logged Data | 0.877 | | | | |
| 66 | | | | | | | | | | | | |
| 67 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 68 | | | | | 95% H-UCL | 386.7 | 90% Chebyshev (MVUE) UCL | 251.6 | | | | |
| 69 | | | | | 95% Chebyshev (MVUE) UCL | 307.1 | 97.5% Chebyshev (MVUE) UCL | 384.2 | | | | |
| 70 | | | | | 99% Chebyshev (MVUE) UCL | 535.5 | | | | | | |
| 71 | | | | | | | | | | | | |
| 72 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 73 | **Data appear to follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 74 | | | | | | | | | | | | |
| 75 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 76 | | | | | 95% CLT UCL | 171.3 | 95% Jackknife UCL | 178.6 | | | | |
| 77 | | | | | 95% Standard Bootstrap UCL | 167.7 | 95% Bootstrap-t UCL | 184.9 | | | | |
| 78 | | | | | 95% Hall's Bootstrap UCL | 171 | 95% Percentile Bootstrap UCL | 170.4 | | | | |
| 79 | | | | | 95% BCA Bootstrap UCL | 169.4 | | | | | | |
| 80 | | | | | 90% Chebyshev(Mean, Sd) UCL | 211 | 95% Chebyshev(Mean, Sd) UCL | 250.9 | | | | |
| 81 | | | | | 97.5% Chebyshev(Mean, Sd) UCL | 306.1 | 99% Chebyshev(Mean, Sd) UCL | 414.7 | | | | |
| 82 | | | | | | | | | | | | |
| 83 | **Suggested UCL to Use** | | | | | | | | | | | |
| 84 | | | | | 95% Student's-t UCL | 178.6 | | | | | | |
| 85 | | | | | | | | | | | | |
| 86 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 87 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 88 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 89 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 90 | | | | | | | | | | | | |