DETAILED SITE INVESTIGATION (DSI)

34-36 SANDSPIT ROAD, WARKWORTH

REFERENCE NUMBER: REP-1568A/DSI/FEB22

PREPARED FOR: THE KILNS LTD C/- THE PLANNING COLLECTIVE LTD

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Statement

This site investigation has been prepared in accordance with the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. It has been managed by a suitably qualified and experienced practitioner (SQEP); and reported on in accordance with the current edition of the Ministry for the *Environment's Contaminated Land Management Guidelines No.1 – Reporting on Contaminated Sites in New Zealand.*

Report prepared on behalf of GSL by:	Report reviewed and authorised on behalf of GSL by:
	
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Thank you for the opportunity to carry out this investigation. Should you have any queries regarding this report please do not hesitate to contact us on 09 475 0222 or 06 281 2454.

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EXECUTIVE SUMMARY

The Kilns Ltd propose to subdivide and develop the piece of land at 34 and 36 Sandspit Road, Warkworth, into a higher density residential configuration following completion of a private plan change currently under consideration by Auckland Council. The proposal will result in changing the land from Future Urban zoning to Residential – Mixed Housing Urban zoning under Auckland Unitary Plan (Operative in Part) (AUP(OP)) and subsequent development into mixed urban housing lots. As a previous Preliminary Site Investigation (PSI) identified several actual and potential activities and industries encompassed by the Ministry for the Environment (MfE) Hazardous Activities and Industries List (HAIL) on the site, Geosciences Ltd (GSL) were engaged to undertake a Detailed Site Investigation (DSI) of the property in accordance with the *National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES). The purpose of this DSI is to provide an assessment of actual and potential soil contamination risks through an analysis of soil quality on site.

The previous PSI included a desktop study of the site history through a review of the current and historical records of title, historic aerial photographs, and the Auckland Council property file, followed by a visual site inspection. Desktop study identified that the site was the location of lime manufacturing from the early 1860's and decommissioned by the 1880's after it remained largely vacant until being developed into changing residential configuration. Residences on site were noted to be buildings potentially containing asbestos building materials, some of which had been removed but remained on site in a deteriorated condition, the location of buildings potentially subject to lead-based paint use and the subsequent potential for its accidental discharge to the environment as well as the location of on-site septic systems, and the location of small-scale, domestic vehicle maintenance activities.

Based on the findings of the PSI, GSL developed a Conceptual Site Model (CSM) of potential contamination on site, further expanding it following a second site inspection as part of this DSI. Based on the CSM, a judgemental sampling regime was employed to target potential sources of contamination where their locations were known, with a systematic sampling regime employed to target the southern portion of the site where no distinct source locations could be identified through desktop review. GSL subsequently collected soil samples from 29 locations across the site, with the samples analysed for the contaminants of concern identified by the CSM.

Laboratory analysis of soil samples identified two locations on 36 Sandspit Road, being the north-western corner of the car port north of the main dwelling and the footprint of the former 1930's dwelling location on the knoll near the centre of the site, that contained concentrations of contaminants that pose a potential risk to human and environmental health. Several locations across the site also returned low-level concentrations of potential contaminants above the expected natural background concentration ranges, but do not pose a risk to human or environmental health under the proposed residential landuse.

As a result of the identification of contaminants exceeding both the NES and AUP(OP) criteria, consent will be required to undertake the proposed works. The proposed subdivision and development will likely be considered a Restricted Discretionary Activity under Regulation 10 of the NES, and a Controlled Activity under rule E30.6.2.1 of Chapter E30 of the AUP(OP). A Remediation Action Plan (RAP) commensurate with the degree of contamination identified on site has been

prepared in support of the consent application and is included in this report. Following completion of remedial works, a Site Validation Report (SVR) will be submitted to Auckland Council.

1 INTRODUCTION

Geosciences Ltd (GSL) has prepared the following report for The Kilns Ltd C/- Planning Collective Ltd in accordance with the GSL proposal, Ref: *Pro-2372/Apr21, dated 30 April 2021*.

This report has been prepared in accordance with the Ministry for the Environment (MfE) Contaminated Land Management Guidelines (CLMG): No. 1 – *"Guidelines for Reporting on Contaminated Sites in New Zealand",* and No. 5 – *"Site Investigation and Analysis of Soils"* (References 1 and 2).

2 PROPERTY DETAILS

TABLE 1: PROPERTY DETAILS

Address	Legal Description	Area	Zoning
34 Sandspit Road, Warkworth	Lot 1 DP 66360	0.1224 Ha	Future Urban Zone
36 Sandspit Road, Warkworth	Pt Lot 51 DP 703, Pt Lot 51 DP 703, Lot 1 DP 39634	2.8365 Ha	Future Urban Zone
Total Investigation Area		2.9589 Ha	

The properties at the above addresses, hereafter referred to as 'the site' in this report, are located on the north-eastern margins of the Warkworth township, on the transition from urban to rural land, some 350 m northwest of Warkworth's Central Business Area (Figure 1). Areas to the north-east and east of the site consist of a large lot of rural residential holdings, while the remaining areas surrounding the property form single lot residential configurations.

2.1 ENVIRONMENTAL CONTEXT

The site is a rural residential lot with residential landuse focused on the northern portion of the site. The site's topography is dominated by steep gullies along the east, south and western boundaries of the site.

2.1.1 GEOLOGY & GEOHYDROLOGY

The local geology is described by Edbrooke (Reference 3) as clastic sediments, including:

- Alternating thick-bedded, volcanic-rich, graded sandstone, siltstone, and turbidite of the Pakiri Formation of the Warkworth Subgroup to the north and south; and
- Micritic muddy limestone, calcareous mudstone and glauconitic sandstone as part of the Mahurangi Limestone (Motatau Complex) in the Northland Allochthon traversing the middle of the site.

The site lies within the footprint of the Mahurangi Waitemata Aquifer as defined in the Auckland Council GEOMaps website groundwater overlay.

2.1.2 TOPOGRAPHY AND DRAINAGE

The site, at its highest point roughly in the middle of the site, is situated 26 m above sea level (asl) with a shallow ridge containing a metalled accessway running north towards the site boundary on Sandspit Road. The site falls rapidly to the east and west, towards an unnamed stream and the Viponds Creek respectively, with the southern end of the ridge forming a shallower fall towards the Mahurangi River to the south-east. The gullies decrease in elevation from the north to south with overland flow discharging into the Mahurangi Harbour via the Mahurangi River.

Drainage is via overland flow toward Mahurangi River and the unnamed stream and Viponds Creek, both of which discharge into the Mahurangi River, with some soakage through permeable surfaces across the site. A review of the floodplains, flood prone, or flood sensitive areas of the Auckland Region (available on the Auckland Council GEOMaps website) revealed that western, eastern, and southern lower elevations are located on a flood plain associated with the streams.

2.2 AUCKLAND UNITARY PLAN OVERLAYS

The Auckland Unitary Plan (Operative in Part) identifies the site as being subject to the following overlays:

- Natural resources
  - Significant Ecological Areas Overlay – SEA_T_6684 (Terrestrial)
  - High use Aquifer Management Overlays – Mahurangi Waitemata aquifer
- Natural heritage
  - Outstanding Natural Landscapes Overlay – Area 43, West Mahurangi Harbour
- Historic Heritage and Special Character
  - Historic Heritage Overlay Extent of Place – 569, Combes / Daldy lime works site (R09_2240)

3 PROPOSED CHANGE IN LANDUSE, SUBDIVISION AND DEVELOPMENT

GSL understand that The Kilns Ltd have lodged an application for a private plan change to rezone the site from the existing Future Urban zoning to Residential – Mixed Housing Urban zoning. Following completion of the rezoning, the site will be developed to facilitate a proposed residential subdivision, including associated access lots, Significant Ecological Areas (SEAs), esplanade reserves, and preservation of significant heritage features present on the site.

A preliminary bulk and location plan (Pacific Environments NZ Ltd Ref: *21007 A101 rev. 3*, issued 30/05/2021) proposes a medium to high-density residential configuration comprised of a mixture of 2 and 3-storey terrace units, duplex units, standalone units, and apartments. While GSL expect the terrace, duplex, and standalone units to have small ornamental gardens, it is considered unlikely that any will be of a size that can support domestic vegetable growing at a capacity that can supply 10% of an individual's daily intake.

A copy of the preliminary plan is attached in Appendix A.

4 STANDARDS AND REGULATIONS

As a result of the proposed change in landuse, subdivision, and development outlined above, it will be necessary to address the requirements of the following applicable standards and regulations for the site.

4.1 NATIONAL ENVIRONMENTAL STANDARD (NES)

The *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES) (Reference 4), which came into effect on 1 January 2012, ensures that land affected by contaminants in soil is appropriately identified and assessed when soil disturbance and/or land development activities take place and, if necessary, remediated or the contaminants contained to make the land safe for human use.

Under the NES, land is considered to be actually or potentially contaminated if an activity or industry on the MfE Hazardous Activities and Industries List (HAIL) has been, is, or is more likely than not to have been, undertaken on the land. Consequently, a change in landuse, subdivision, or development on HAIL land requires a detailed site investigation (DSI) of the piece of land to determine if there is a risk to human health as a result of the former activities.

The NES defines five standard landuse scenarios for which soil contaminant standards have been derived. The most sensitive landuse scenario which is applicable to the proposed change in landuse, subdivision and development at this site is defined by the NES as: *High-density residential: urban residential with limited soil contact, including small ornamental gardens but not vegetable gardens (no home-grown produce consumption); applicable to urban townhouses, flats and ground-floor apartments with small ornamental gardens, but not high-rise apartments.*

4.2 AUCKLAND UNITARY PLAN (OPERATIVE IN PART) (AUP(OP))

Section 30(1)(f) of the RMA provides the Auckland Council with a statutory duty to investigate land for the purposes of identifying and monitoring contaminated land and for the control of discharges of contaminants into or onto land or water and discharges of water into water.

The Auckland Unitary Plan (Operative in Part) (AUP(OP)), which was formally notified on 30 September 2013, is a combined regional policy statement, regional coastal plan, regional plan and district plan. Auckland Council notified an operative in part version of the plan on 15 November 2016 (Reference 5).

Chapter E.30 of the AUP(OP) deals specifically with contaminated land and maintains that Council is 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. As no appeals have been lodged on Chapter E.30, the provisions of that section can be considered operative under Section 87 of the Resource Management Act 1991. For all purposes of this investigation, the relevant provisions of the AUP(OP) relating to soil contamination have legal jurisdiction and those provision have been considered where they may have an impact on the proposed development.

5 OBJECTIVES AND PROJECT DESIGN

The primary objective of this investigation is to provide an assessment of whether any actual or potential soil contamination exists within the piece of land for the purposes of regulatory assessment of the proposed subdivision, change in landuse and development under the Resource Management Act 1991.

In competing the primary objective GSL has;

- undertaken a review of the former Preliminary Site Investigation completed for the proposed plan change
- conducted a visual inspection of the site extent;
- developed a preliminary conceptual site model for potential soil contamination;
- carried out an intrusive investigation of the site based on the preliminary conceptual model to determine the soil quality and any associated risk to human health and / or the environment arising from actual or potential soil contamination on site;
- determined what, if any, contaminated land rules of the AUP(OP) apply to the proposed subdivision and development and any further work that may be required; and
- prepared this Detailed Site Investigation report in accordance with contaminated land management guideline No.1 – "Reporting on contaminated sites in New Zealand" (Ministry for the Environment, 2011) detailing the findings of this investigation and the recommendations, if any, for further work.

6 PREVIOUS INVESTIGATIONS

The following investigations have previously been undertaken for the site and are reviewed in turn in the sections below:

- *Preliminary Site Investigation (PSI) – 34-36 Sandspit Road, Warkworth*, Ref: *Rep-1568/PSI/Apr21/Rev3*, Geosciences Ltd, issued 30 April 2021, revised 30 July 2021; and
- *Geotechnical Investigation Report, 36 Sandspit Road, Warkworth*, Ref: *AKL2021-0060AB Rev 1*, CWM Geosciences Ltd, issued 13 May 2021, revised 8 September 2021.

6.1 PRELIMINARY SITE INVESTIGATION (PSI) – GEOSCIENCES LTD 2021

GSL conducted a preliminary site investigation (PSI) of the site in April 2021, the findings of which are summarised in the GSL report, *Rep-1568/PSI/Apr21/Rev3*, as mentioned above. An excerpt of the Executive Summary is attached in Appendix B.

The PSI, conducted in accordance with CLMG No. 1, included an historical appraisal of the site history and site inspection that revealed the site is the location of at least one current and one historic activity and industry encompassed by the MfE Hazardous Activities and Industries List (HAIL). These items include:

- HAIL Item E.3 – historic lime manufacturing using kilns on the southern portion of the site within the Extent of Place 569;
- HAIL Item G.5 / G.6 – domestic septic systems (including tanks and effluent discharge fields) associated with four separate dwellings present on the site;

Additional to the above confirmed HAIL activity and industry, the following potential sources of accidental contamination were identified which may trigger HAIL Item I should they be found to have resulted in concentrations of contaminants in soil that pose a risk to human or environmental health:

- Accidental discharge of lead from lead-based paint used on the exteriors of structures erected on site prior to 1970; and
- Accidental discharge of pollutants (heavy metals and hydrocarbons), from small scale domestic vehicle maintenance activities, including maintenance of a ride-on lawn mower, and storage of associated fuel jerry cans / oil cans (not of a scale commensurate with Class F HAIL activities or industries).

The PSI also identified suspected asbestos containing materials (ACM) during the desktop review of historic building plans and during visual inspection of structures on site. At the time of the investigation, the suspected ACM was observed to be in a generally good condition with only minor damage noted in a few locations where underlying concrete surfaces would prevent migration of asbestos fibres to underlying soils. As such, the site was not regarded as encompassed by HAIL Item E.1 as the asbestos products were not observed to be in a deteriorated condition.

The PSI concluded that as actual and potential HAIL activities and industries were identified on the site, a DSI would be required to address the requirements of the NES and Chapter E30 of the AUP(OP). However, it was noted that while further investigation was required under a DSI, the identified potential sources of contamination are unlikely to preclude development of site following remedial works in isolated locations if deemed necessary following intrusive investigation under the DSI.

6.2 GEOTECHNICAL INVESTIGATION – CMW GEOSCIENCES 2021

GSL were provided with a copy of the Geotechnical Investigation Report undertaken by CMW Geosciences in 2021 for review to provide further geological context for the investigation.

As part of the investigation nine hand auger boreholes were advanced across the site, three of which fall within the 20 m riparian buffer zone. Review of borehole logs identified uncontrolled fill beneath 200 mm of topsoil in one borehole (*HA04-21*), located within the southern riparian buffer zone and Historic Heritage extent of place, approximately 25 m west of the historic kiln vents. While the fill was classified as uncontrolled, it appears generally consistent with the documented natural lithologies underlying the site and did not contain any evidence of refuse or building materials (brick, timber etc.). As a result, GSL notes that the presence of uncontrolled fill within the southern riparian buffer zone presents a negligible risk in light of the proposed development and future residential use of the site as this area will be outside of any development footprints.

An extract of the geotechnical borehole logs is attached in Appendix C.

7 DSI SITE INSPECTION AND ARCHAEOLOGICAL EXCAVATION OBSERVATION

GSL personnel attended the site on 13 and 14 January 2022 for the purpose of observing archaeological excavations within the historic heritage extent of place by Plan Heritage Ltd,

observation of geotechnical pit excavation by CMW Geosciences Ltd, and for the collection of soil samples.

The features discussed in the sections below are outlined on Figure 2 with site photographs attached in Appendix D.

7.1 ARCHAEOLOGICAL TRENCH OBSERVATION

Archaeological trenches, and the associated soil samples, were excavated in accordance with land use consent LUC60378963 (s9 land use consent) allowing exploratory investigation within the riparian yard, Outstanding Natural Landscapes Overlay, and Historical Heritage Overlay. Trenches were excavated at ten locations, including seven within the Historic Heritage extent of place, through incremental scraping of soil under observation by Plan Heritage Ltd and GSL personnel. Each trench was approximately 10 m long and 1 m wide, averaging 350 – 400 mm deep before terminating when natural subgrade material was identified.

Six of the ten trenches (*T02, T03*, *T04*, *T05*, *T07*, & *T09*) did not contain any evidence of soil disturbance, grading naturally from organic topsoil into subgrade soil consistent with the geotechnical investigation findings; being silty clay with traces of fine sand. The remaining four trenches all displayed some evidence of historic soil disturbance, including:

- *T01* and *T08* contained historic buried iron pipes, likely for water transfer, backfilled with natural soil;
- *T06* contained archaeological demolition waste from the historic tram line linking the historic lime quarry in the west to the kilns in the south-east. Material observed included fragments of limestone, iron, and mussel shell; and
- *T10* contained evidence of the former dwelling located at the crest of the knoll, including fragments of glass, brick, and ceramics in a very thin (50 mm) layer of topsoil, and historic timber piles embedded in natural subgrade soil (silt with trace clay) within the dwelling footprint.

Localised surface disturbance as a result of relatively recent burning of organic waste (green waste, treated / construction timber, and suspected timber furniture) was also noted at *T01* and to a lesser extent at the eastern end of *T05*. While the burn footprint at *T05* was small (approximately 2 m^2) and appeared disused, the burn footprint at *T01* encompassed approximately 60 m^2 and appeared more actively used, with a large pile of unburnt green waste present at the time of the inspection. Both locations contained a layer of ash on the surface of the topsoil but did not display any mixing with the underlying natural subgrade soils. No visual evidence of potentially hazardous materials, such as asbestos containing material (ACM) was noted at either location. Given the size and content of the burn footprint at *T05*, it is likely that it was used for occasional recreational fires and not for wholesale burning of waste materials.

7.2 GEOTECHNICAL TEST PIT OBSERVATION

A geotechnical test pit was excavated under observation by CMW Geosciences Ltd and GSL personnel to the north of archaeological test pit *TP10*, adjacent to the southern boundary of 34 Sandspit Road. The test pit displayed natural grading from organic topsoil to the expected underlying subgrade clayey silt and eventual deeper limestone material; however, a distinct narrow

band of darker material approximately 300 mm below surface level at the transition of topsoil to subgrade soil was noted running in a straight line from the position of the historic house on the knoll south-east of the pit. Inspection of the anomaly by an archaeologist suggested that it may have been the effluent discharge drain associated with the historic house.

7.3 GENERAL SITE-WIDE INSPECTION

Following completion of the archaeological and geotechnical excavations, a general inspection of the wider site was undertaken by GSL personnel to expand on the conceptual model compiled. During the inspection, three septic tanks were identified, each servicing one of the three dwellings currently present on site. A small diameter black PVC pipe was identified leading from the minor dwelling's septic tank to the crest of the knoll, south-west of the historic house footprint. While the pipe was located on the soil surface between the septic tank and the knoll, it became buried at the crest of the knoll. As it is an active septic system, the pipe could not be excavated, and the discharge location could therefore not be confirmed.

Inspection of the existing structures on site indicates that potential asbestos containing materials (ACM) are present on the main dwelling and storeroom at the northern end of 36 Sandspit Road, and on the dwelling on 34 Sandspit Road. The minor dwelling near the southern end of 36 Sandspit Road is of modern construction and did not appear to contain any suspected ACM. All suspected ACM on the 34 Sandspit Road dwelling were in good condition and well painted, with no visual evidence of damage or deterioration.

Suspected ACM on the main dwelling on 36 Sandspit Road were also in good condition and well painted; however, suspected ACM cladding on the associated storeroom was generally unpainted and displayed damage and deterioration at the southern end of the building. Additionally, several large sheets of suspected ACM appeared to have been removed from the building and replaced with a modern compressed cement product, with the suspected ACM sheets stacked on the soil surface adjacent to a concrete slab in the north-eastern corner of 34 Sandspit Road. The concrete slab, previously the location of a single garage for 34 Sandspit Road, also contained several large, heavy duty refuse bags containing broken fragments of suspected ACM sheets.

The general site area was well maintained and neat with no evidence of fly tipping or burying of rubbish. Several jerry cans of fuel were identified adjacent to a small, galvanised metal shed on the southern portion of the site; however, they appeared old and disused, were empty, and did not emit any odours. They were likely used for refuelling the ride-on lawnmower stored in the car port on the northern side of the main dwelling on 36 Sandspit Road. There was no visual or olfactory evidence suggest that they have impacted surrounding soils.

The car port on the northern side of the main dwelling on 36 Sandspit Road is constructed of timber posts, corrugated iron walls on two side, a steel roof, and a concrete floor with a very shallow gradient to the west. It appears to be used for the storage and maintenance of garden equipment, such as the ride-on lawnmower, and storage of a personal vehicle. Several general domestic items (plastic pots, furniture, timber, rope etc) appeared discarded around its periphery, but did not display evidence of leaching or discharge of potential contaminants. Minor volumes of fuel and oil associated with the maintenance and operation of the ride-on lawnmower were noted, with minor staining on the concrete slab surface and a faint hydrocarbon aroma where the lawnmower is stored. Minor erosion of the soil surface directly adjacent to the north-western corner of the

concrete slab suggests that surface runoff, from either heavy rainfall events or intentional hosing down of the concrete slab, discharges from the concrete slab at that point; however, no visual or olfactory evidence of hydrocarbon egress from the concrete slab onto the surrounding soils was noted.

8 CONCEPTUAL SITE MODEL FOR POTENTIAL CONTAMINATION

Based on the observations made during the site inspection, GSL refined the preliminary conceptual site model for potential contamination on the site developed during the PSI. The following sections outline the potential sources of contaminants, the contaminants of concern, the expected spatial distribution of those contaminants and the intrusive investigation required during this DSI.

8.1 POTENTIAL SOURCES OF CONTAMINATION

The following potential HAIL activities or industries were identified:

- HAIL Item I - *Potential accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment* – applies to:
    - structures likely subject to lead-based paint use, including the main northern dwelling, footprint of the removed historic dwelling, the large storeroom on 36 Sandspit Road, as well as the footprint of the small storeroom formerly located on 34 Sandspit Road;
    - locations where potential refuse / building materials have been burnt alongside green waste identified during the DSI site inspection on the south-eastern portion of the site; and
    - locations where minor volumes of fuel / oil have been stored for use in lawnmowers and may have resulted in incidental spills / leaks of hydrocarbons.

The following confirmed HAIL activities or industries were identified:

- HAIL Item E.1 – *Asbestos product* […] *disposal including sites with buildings containing asbestos products known to be in a deteriorated condition* – applies to the southern end of the storeroom where suspected ACM has been replaced, with old panels and fragments stored nearby;
- HAIL Item E.3 - *Lime manufacturing using a kiln including the storage of wastes from the manufacturing process* – applies to the Combes and Daldy lime works on the southern portion of the property; and
- HAIL Item G.5 / G.6 - *Waste disposal to land / wastewater treatment* – applies to any domestic septic tanks and effluent disposal fields associated with the current and historic dwellings on site.

GSL note that Item I above is regarded as 'potential' HAIL activities and industries as sample collection and laboratory analysis is required to confirm whether surrounding soil has been impacted to a degree that poses a risk to human health or the environment. Additionally, the storage of minor volumes of fuel and oil associated with maintenance and operation of the ride-on lawnmower in the car port north of the main dwelling on 36 Sandspit Road are not regarded as

being on a scale commensurate with HAIL Class F *Vehicle refuelling, service and repair* as no bulk storage of fuels or chemicals was identified, and maintenance activities are likely minor and infrequent. If these activities result in discharge of contaminants to soil, they are likely to be constrained to small, localised hotspots and may be encompassed by HAIL Item I where found to pose a risk to human or environmental health.

The approximate areas subject to actual and potential HAIL activities are illustrated on Figure 3, while each potential source is discussed in turn below.

8.1.1 Uncontrolled Fill Material

During their geotechnical investigation of the site, CMW Geosciences identified a shallow (200mm to 700mm below surface level) horizon of uncontrolled fill material described as '*SILT with trace clay and minor fine sand: Light brown mottled black and light orange*'. This material is not regarded as a potential source of contamination requiring investigation for the following reasons:

- It does not contain foreign inclusions such as refuse, building materials, demolition waste, or ash;
- It is generally consistent with the soil types found across the site, and while structurally uncontrolled, is likely locally derived and not imported from offsite;
- It is located at the crest of the southern bank, near the historic lime kilns and within the Extent of Place 569 and 20m esplanade reserve, and will therefore not be disturbed during or after development; and
- The material is capped by 200 mm of topsoil, preventing future recreational land users from coming into contact with the material.

8.2 Expected Spatial Distribution and Contaminants of Concern

The expected spatial distributions of each of the potentially contaminating HAIL activity identified above, and their associated primary contaminants of concern, are discussed in turn in the following sections.

8.2.1 Historic Lead-based Paint Use

The use of lead-based paint on the exterior of the northern residential dwelling on 36 Sandspit Road was specified in the original 1952 building application and hinted at in the building application specification for the adjacent large storeroom. Given the age of the original southern dwelling, present on site by 1931, it is also highly likely that lead-based paints were used for an extended period prior to it being phased out from 1965. As the dwelling on 34 Sandspit Road was not constructed until the early 1970s, it is unlikely to have been subject to the use of lead-based paints.

While the use of lead-based paint is not itself a HAIL activity, the potential discharge of lead to the surrounding environment during maintenance activities, such as sanding or scraping, or degradation may result in concentrations in soil that pose a risk to human health or the environment. Lead is generally highly immobile in soil, with the highest concentrations expected in surface soils in proximity to the source and rapidly attenuating with depth and distance. In GSL's experience, background concentrations are generally reached within 2 m of the structure with

impacts of lead-based paints limited to the uppermost topsoil horizon and rapidly attenuate to background concentrations with depths between 200 mm and 500 mm.

8.2.2 BURNT GREEN WASTE / TIMBER

The burning of organic waste such as green waste and timber (treated and / or untreated construction timber etc.) can result in the accidental release of potential contaminants to a degree that poses a risk to human or environmental health. Combustion of construction timber can release heavy metals, such as arsenic, chromium, and copper used in CCA treatment or lead from timber painted with lead-based paints, while incomplete combustion of organic materials, including green waste, can release polycyclic aromatic hydrocarbons (PAHs). Accidental or unintentional inclusion of asbestos containing materials (ACM) when burning construction timber can also result in the accidental release of asbestos fibres. The primary contaminants of concern associated with the two burn areas are therefore heavy metals, PAHs, and asbestos fibres in soil.

Inspection of the two identified burn areas, located at archaeological test pits *TP01* and *TP05* indicates that the burning activities are restricted to very distinct locations, with no evidence of ash or partially burnt material mixing further than 50 mm into the underlying topsoil. While rainfall may have resulted in percolation / leaching of the more mobile contaminants from ash into the topsoil horizon, migration is likely to be minimal as the burning activities appear relatively recent and once within the soil matrix, persistent contaminants such as heavy metals tend to adhere strongly to soil particles. Concentrations of potential contaminants are therefore expected to be highest within the top 100 mm soil horizon within the visible extent of each burn area.

8.2.3 GENERAL DISCHARGES FROM DOMESTIC EQUIPMENT MAINTENANCE AND OPERATION

While the presence of small volumes of fuel and oils for the maintenance and operation of a domestic ride-on lawnmower are not regarded as triggering HAIL Class F, accidental discharges of potential contaminants may impact surrounding soils in localised hotspots where their use or storage may result in discharges to the soil surface. Maintenance activities appear minor and infrequent, and restricted to the concrete floor of the partially enclosed car port north of the main dwelling on 36 Sandspit Road. Given the general nature of the activities in the car port, a range of heavy metals and polycyclic aromatic hydrocarbons (PAHs) may be present in soil on the down-gradient (west) side of the concrete slab.

8.2.4 ASBESTOS CONTAINING MATERIALS

The majority of the identified suspected ACM was on both the large storeroom and the residential dwelling on 36 Sandspit Road, as well as the residential dwelling on 34 Sandspit Road. Overall, the material was in good condition with only minor damage noted in a few locations; however, several large panels had been removed from the southern end of the storeroom on 36 Sandspit Road. These panels, and several large plastic bags fragments assumed to be from the panels' removal from the storeroom, were still present on site, with the panels stacked upright on a soil surface while the bags of fragments were stored on a concrete slab.

If asbestos fibres have been released from the cement matrix of the suspected ACM panels, fibre concentrations would be expected to be highest in the soil directly below and surrounding the panels or section of the building from which the panels had been removed. Asbestos fibres are not

mobile in soil, remaining at or near the surface on which they were deposited, unless mechanical disturbance of the soil has resulted in their mixing with underlying soil. Based on visual inspection of the area, no mixing is suspected and as such, asbestos fibres in soil are only expected to be present in a narrow strip of soil at the southern end of the storeroom, between the building and the adjacent concrete slab and driveway. Any fibres deposited on the concrete surface or driveway are likely to have been washed down the driveway, based on the gradient, exiting the property via stormwater without being deposited in soil on site.

While no suspected ACM was noted in either of the two burn areas identified on the southern portion of the property, the presence of construction timber and suspected furniture suggests that burning activities were not limited to green waste materials. While the risk is considered low, the burning of ACM is possible and would have resulted in the release of asbestos fibres as moisture in the cement matrix of ACM expands and cracks the material, releasing fibres to the surrounding soil. As noted at the southern end of the storeroom, no mechanical mixing of soil within the burn areas was noted, and as such if fibres are present, they are expected to be limited to the surface soil horizon.

The original dwelling on the crest of the knoll on the southern portion of 36 Sandspit Road likely pre-dates the use of ACM. While the dwelling on 34 Sandspit Road was noted as having suspected ACM on the building's exterior, it was all in good condition and well painted. As such, these two locations are not considered to be potential locations of asbestos fibres in soil.

GSL note that while the material is referred to as 'suspected ACM' in the absence of an official asbestos survey or material sample analysis, the specification of asbestos building materials in the 1952 and 1953 building applications make its presence extremely likely. Its presence should therefore be assumed, and the requirements of the *Health and Safety at Work (Asbestos) Regulations 2016 (amended 2017)* must be exercised.

8.2.5 LIME KILNS

As the method and location of waste ash disposal associated with the historic lime kilns is unknown, the expected spatial distribution cannot yet be determined. Maps created by Auckland Council indicate an approximate area of the expected activities, described by the Extent of Place on the southern portion of the property. As the kilns have not been used in over 130 years, surface residues deposited by smoke are unlikely to be detectable and if present, may not be discernible from modern sources (such as petrol / diesel powered lawnmowers, boats etc.). As such, the locations of buried fly ash (if coal was used as fuel), waste ash disposed of during the lime burning activities, or demolition wastes left in place following the decommissioning of the activity are likely the only remaining potential sources of contamination associated with the historic lime manufacturing process.

Where buried ash deposits or demolition wastes are identified, residual heavy metals or polycyclic aromatic hydrocarbons (PAH) with low mobility in soil may be present at elevated concentrations. Additionally, if coal fly ash was present on site, the potential leaching of boron may have occurred where soil pH is low.

8.2.6 DOMESTIC WASTEWATER SYSTEMS

The discharge of effluent to land and the treatment of black water within the septic system are encompassed by Items G.5 and G.6 of the HAIL; however, in GSL's experience, the risk of a single-dwelling domestic septic system and its associated discharge posing a risk to human or environmental health when properly managed is extremely low. Biological constituents of discharged effluent (e.g. *E. coli* bacteria or other human pathogens) are rapidly out-competed by naturally occurring soil microbes, resulting in a relatively short retention time within the soil profile. Longer-lasting potential contaminants, such as heavy metals, generally have a low mobility in soil as they tend to adsorb strongly to soil particles, limiting their movement through the soil profile.

GSL recommend a stand-down period of three months, during which the septic system should not be used, prior to its decommissioning and removal from site to ensure that the biological constituents in the residual effluent have been neutralised. The primary contaminants of concern associated with the disturbance of the septic system and effluent discharge field are therefore persistent heavy metals likely to be present when the system is disturbed. Due to the low mobility of heavy metals in soil, concentrations are expected to be highest in the topsoil horizon surrounding the dropper lines and attenuate rapidly with depth and lateral distance, with any potential lateral migration expected to move down-gradient.

8.3 INTRUSIVE INVESTIGATION REQUIREMENTS

Desktop review and visual inspection of the site have identified several discrete potential sources of contamination on site and one general area (the historic extent of place) where potential contamination may be present in soil, but no discrete source location is known. Under Contaminated Land Management Guideline (CLMG) No. 5 *Site Investigation and Analysis of Soil* and Gilbert's (1987) *Statistical methods for environmental pollution monitoring* (Van Nostrand Reinhold Publishers, New York), incorporated by reference, a judgemental, targeted soil sampling regime is considered appropriate when assessing potential releases of contaminants from known suspected sources. These sources include the three septic tanks and effluent discharge fields associated with the dwellings currently on site and the suspected septic drain associated with the historic house, the existing structures and historic dwelling on 36 Sandpit Road where lead may have been utilised, and the two burn areas on the southern portion of the site. While a single soil sample was collected from nine of the archaeological test pits (discussed below), additional soil samples were collected from the archaeological test pit at the historic dwelling on the knoll, aligned with the approximate locations of the four walls of the dwelling where lead concentrations are expected to be highest.

As historic lime burning activities took place across an unknown area within the extent of place, systematic investigation of the area is required. However, given the heritage value of the area, intrusive investigation is limited to locations where consent has been granted (LUC60378963) to perform archaeological excavations to identify any remnants of the lime burner activities. The area under archaeological investigation under LUC60378963 is approximately 5,000 m^2 and includes nine archaeological trenches (the tenth archaeological trench is excluded as it is located at a known potential source of contamination, the historic dwelling on the knoll). Archaeological trenches are spaced between 10 m and 20 m apart, and are 10 m long, allowing for collection of one soil sample per trench to give an approximate sampling density equivalent to a systematic grid size of 23.5m, allowing for the detection of contaminant hotspots averaging 13.9 m in radius.

The soil sampling regime employed on site is summarised in Table 2 below.

9 SOIL SAMPLING AND ANALYSIS

As noted, GSL elected to implement a judgemental, targeted sampling methodology for known potential sources of contamination on the northern portions of the site, and a systematic sampling methodology on the southern portion of the site where no discrete potential sources of contaminants could be identified. Soil samples were generally collected from the top 75 mm of soil as the horizon most likely to be contaminated based on the identified source-contaminant pathways and as the most likely horizon with which residential land users will be exposed.

The exceptions to that include samples collected from the discharge point of buried septic tanks (approximately 500mm below surface level) where leaks from the tanks are most likely, and from the effluent discharge fields (100 mm below surface level) where contaminant concentrations are expected to be highest based on the depth of the effluent dripper lines. Similarly, soil samples for the analysis of asbestos were collected from the top 50 mm of soil by scraping an area of approximately 100 cm^2 to a depth of 50 mm to acquire at least 500 ml of soil (over 500 g) as required for semi-quantitative analysis of asbestos fibre concentrations in soil.

Judgemental soil samples were collected by progressing a stainless-steel hand auger to the desired depth, while systematic soil samples were collected from the exposed walls of the archaeological trenches using a stainless-steel hand spade. Samples were placed directly into laboratory supplied glass jars or resealable plastic zipper bags (for asbestos only) with the date, location, sample identification number, sample depth, and initials of the sampler noted on the container.

Soil sampling equipment was decontaminated in between samples using a soft soap solution in accordance with GSL internal quality control procedures. The sampling protocol followed was in accordance with the CLMG No. 5 *Site Investigation and Analysis of Soils.*

Soil sample locations are shown in Figure 4.

TABLE 2: SOIL SAMPLING REGIME

Soil Sample No.	Location	Anticipated Risk	Indicated Laboratory Analysis
SS1	Small storage shed	Low	Heavy metals, PAH
SS2 & SS3	36 Sandspit Road minor dwelling septic tank and discharge pipe	Low	Heavy metals
SS4	Historic pre-1931 dwelling suspected septic drain	Low	Heavy metals
SS5 & SS6	34 Sandspit Road dwelling septic tank and discharge field	Low	Heavy metals
SS7 – SS9	36 Sandspit Road main dwelling septic tank and discharge field	Low	Heavy metals
SS10 & SS11	36 Sandspit Road car port	Moderate	Heavy metals, PAH
SS12, SS13, & SS16	36 Sandspit Road main dwelling and associated storeroom / sheds (current and historic)	Low	Lead
SS14 & SS15	36 Sandspit Road storeroom	Moderate	Lead, asbestos
T01	Archaeological trench with buried iron pipes and major organic waste burn area	Moderate	Heavy metals, boron, PAH, asbestos
T02 – T04, T07, T09	Archaeological trenches with no visual disturbance	Negligible	Arsenic, boron
T05	Archaeological trench and minor organic waste burn area	Low	Heavy metals, boron, PAH, asbestos
T06	Archaeological trench with demolition waste from historic tramline	Low	Arsenic, boron, PAH, pH
T08	Archaeological trench with buried iron water pipes	Low	Arsenic, boron, PAH, pH
T10N, E, S, W	Approximate cardinal faces of historic pre-1931 dwelling on knoll	Moderate	Lead

Notes:

1. PAH = polycyclic aromatic hydrocarbons.

10 LABORATORY ANALYSIS AND ACCREDITATION

Sample containers were placed in a chilly bin with ice packs and a chain of custody document (COC) indicating the analysis to be performed and were dispatched to Eurofins Environment Testing in Penrose, Auckland for the analysis of the contaminants of concern as indicated in Table 2 above.

Eurofins Environment Testing are accredited by International Accreditation New Zealand (IANZ) for the analyses undertaken.

10.1 QUALITY ASSURANCE AND QUALITY CONTROL

GSL field staff are appropriately qualified, suitably trained and experienced in undertaking contaminated land assessments. Personnel are cognisant of the requirements for sample handling and storage, and equipment decontamination procedures alongside completion of field assessments, notes and record keeping and documentation.

During this assessment, appropriate sample handling and storage protocols were followed to ensure sample integrity was maintained during sampling and transport while laboratory analysis has been undertaken at an IANZ accredited laboratory.

Consequently, it is considered that appropriate QA/QC has been met for this investigation.

10.2 ACCEPTANCE CRITERIA AND RELEVANT GUIDELINES

The NES mandates fourteen soil contaminant standards (SCS) for the protection of human health for organic compounds and inorganic elements for various landuse criteria. The NES human health SCS criteria for high-density residential landuse have been applied to the proposed change in landuse, subdivision, and development. While the proposed subdivision configuration includes single-unit lots, townhouses, and apartments, the size of the proposed single-unit lots are unlikely to provide enough space for occupants to grow enough produce to form 10% of their daily intake, with any garden space being ornamental. The high-density residential SCS whereby no home-grown produce is consumed is therefore considered a more appropriate assessment of potential exposure risk for the proposed future landuse.

The NES has no specific soil contaminant standards for asbestos in soil but instead acknowledges the Tier 1 Risk Assessment Threshold as set by the BRANZ/ALGA (2017) *New Zealand Guidelines for Assessing and Managing Asbestos in Soil* (NZGAMAS). Where applicable the analytical results are compared against these criteria. Asbestos is not considered an environmental contaminant and is therefore not assessed under the AUP(OP).

The AUP(OP) also set permitted activity environmental discharge and soil acceptance criteria for potentially contaminated land, against which the results have been compared. As the AUP(OP) does not set criteria for boron, the results have been compared to a site-specific ecological soil guideline value (Eco-SGVs) derived using the methodology described by Landcare Research in their 2019 Contract Report LC2605 (Updated) titled *Updated Development of Soil Guideline Values for the Protection of Ecological Receptors (Eco-SGVs): Technical Document* (Eco-SGV = background concentration + added contaminant limit).

Results are also compared to the background concentration ranges of inorganic elements in soils in the Auckland Region for non-volcanic soils defined in Table 3 of Auckland Regional Council's

Technical Publication 153 (TP153:2001) *Background Concentrations of Inorganic Elements in Soils from the Auckland Region*.

11 ANALYTICAL RESULTS

A comparison of the analytical results with the relevant guideline criteria is provided in Table 3, 4, 5, and 6 below. Copies of the laboratory chain of custody document (COC) and analytical transcripts are attached in Appendix E, while a discussion of the results is provided below.

TABLE 3: DISCRETE SOIL SAMPLE HEAVY METAL ANALYTICAL RESULTS[1]

	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
SS1 (0-75mm)	0.8	0.08	6.4	1.7	6.5	1	6.2
SS2 (500mm)	**14**	0.13	18	21	33	2.4	46
SS3 (0-75mm)	2	0.24	12	13	**220**	2.6	160
SS4 (400mm)	1.6	< 0.01	14	3.1	8.7	3	6.3
SS5 (500mm)	3	0.04	31	8	12	6.6	20
SS6 (100mm)	2.3	0.1	8.3	9	20	3.2	36
SS7 (500mm)	3.9	0.04	8	1.1	6.3	1	< 5
SS8 (100mm)	0.9	0.03	4.9	1.9	5	0.8	5.4
SS9 (100mm)	1.2	0.04	9.2	3.6	8.1	1.4	7.5
SS10 (0-75mm)	**64**	**0.79**	32	41	36	12	**830**
SS11 (0-75mm)	8.6	0.13	11	9.6	41	2.9	97
SS12 (0-75mm)	-	-	-	-	**89**	-	-
SS13 (0-75mm)	-	-	-	-	28	-	-
SS14 (0-75mm)	-	-	-	-	**150**	-	-
SS15 (0-75mm)	-	-	-	-	26	-	-
SS16 (0-75mm)	-	-	-	-	28	-	-
NES[2]	45	230	1,500	>10,000	500	NL	NL
AUP(OP)[3]	100	7.5	400	325	250	105	400
Background[4]	0.4 – 12	<0.1 – 0.65	2 – 55	1 – 45	<1.5 - 65	0.9 – 35	9 – 180

Notes:

1. All metal concentrations measured in mg/kg;
2. National Environmental Standards (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health – High-density residential soil contaminant standard;
3. Auckland Unitary Plan (Operative in Part) (AUP(OP)) Chapter E30 permitted activity soil acceptance criteria;
4. Auckland Regional Council Technical Publication No.153 (2001) Background Concentrations of Inorganic Elements in the Auckland Region – Table 3 (non-volcanic soils);
5. Values in **BOLD** exceed the NES criteria, values in **BOLD** exceed the AUP(OP) criteria, Values in **BOLD** exceed the Background Ranges;
6. NA = Not applicable / NL = No Limit / ND = not detected / - = not analysed.

TABLE 4: TRENCH SOIL SAMPLE HEAVY METAL ANALYTICAL RESULTS[1]

	Arsenic	Boron	Cadmium	Chromium	Copper	Lead	Nickel	Zinc
T01 (0-75mm)	**17**	41	0.1	24	11	7.2	1	19
T02 (0-75mm)	2.5	< 10	-	-	-	-	-	-
T03 (0-75mm)	1.2	< 10	-	-	-	-	-	-
T04 (0-75mm)	3.3	< 10	-	-	-	-	-	-
T05 (0-75mm)	2.3	< 10	0.07	27	5.5	13	5.4	28
T06 (0-75mm)	1.4	< 10	-	-	-	-	-	-
T07 (0-75mm)	1	< 10	-	-	-	-	-	-
T08 (0-75mm)	1.2	< 10	-	-	-	-	-	-
T09 (0-75mm)	1.6	< 10	-	-	-	-	-	-
T10N (0-75mm)	-	-	-	-	-	**1,200**	-	-
T10S (0-75mm)	-	-	-	-	-	**190**	-	-
T10E (0-75mm)	-	-	-	-	-	**410**	-	-
T10W (0-75mm)	-	-	-	-	-	**1,200**	-	-
NES [2]	45	>10,000	230	1,500	>10,000	500	NL	NL
AUP(OP)[3]	100	62[5]	7.5	400	325	250	105	400
Background [4]	0.4 – 12	2 – 45	<0.1 – 0.65	2 – 55	1 – 45	<1.5 - 65	0.9 – 35	9 – 180

Notes:

1. All metal concentrations measured in mg/kg;
2. National Environmental Standards (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health – High-density residential soil contaminant standard;
3. Auckland Unitary Plan (Operative in Part) (AUP(OP)) Chapter E30 permitted activity soil acceptance criteria;
4. Auckland Regional Council Technical Publication No.153 (2001) Background Concentrations of Inorganic Elements in the Auckland Region – Table 3 (non-volcanic soils);
5. Landcare Research LC2605 (2019) Eco-SGV = background concentration + added contaminant limit (ACL);
6. Landcare Research New Zealand Fundamental Soil Layer estimate of minimum pH, accessed via Land Resource Information Systems (LRIS) portal;
7. Values in **BOLD** exceed the NES criteria, values in **BOLD** exceed the AUP(OP) criteria, Values in **BOLD** exceed the Background Ranges;
8. NA = Not applicable / NL = No Limit / ND= not detected / - = not analysed.

TABLE 5: POLYCYCLIC AROMATIC HYDROCARBON (PAH) & PH ANALYTICAL RESULTS[1]

	BaP Equiv.[5]	Pyrene[6]	pH[7]
SS1 (0-75mm)	< 0.03	< 0.03	-
SS10 (0-75mm)	< 0.03	< 0.03	-
SS11 (0-75mm)	< 0.03	< 0.03	-
T01 (0-75mm)	< 0.03	< 0.03	-
T05 (0-75mm)	< 0.03	< 0.03	-
T06 (0-75mm)	**0.0488**	**0.03**	5.9
T08 (0-75mm)	< 0.03	< 0.03	5.7
NES[2]	24	1,600	NA
AUP(OP)[3]	20	1.3	NA
Background[4]	ND	ND	5.5 - 6.4

Notes:

1. All PAH concentrations measured in mg/kg, pH measured in pH units;
2. National Environmental Standards (NES) for Assessing and Managing Contaminants in Soil to Protect Human Health – High-density residential soil contaminant standard;
3. Auckland Unitary Plan (Operative in Part) (AUP(OP)) Chapter E30 permitted activity soil acceptance criteria;
4. Auckland Regional Council Technical Publication No.153 (2001) Background Concentrations of Inorganic Elements in the Auckland Region – Table 3 (non-volcanic soils);
5. BaP Equiv. = equivalent BaP concentration calculated as the sum of each of the detected concentrations of nine carcinogenic PAHs multiplied by their respective potency equivalency factors;
6. MfE (2011) Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Module 4 Tier 1 soil acceptance criteria – Table 4.10 and Table 4.20, silty clay, contamination < 1m, GW 2m;
7. Landcare Research New Zealand Fundamental Soil Layer estimate of minimum pH, accessed via Land Resource Information Systems (LRIS) portal;
8. Values in **BOLD** exceed the NES criteria, values in **BOLD** exceed the AUP(OP) criteria, Values in **BOLD** exceed the Background Ranges;
9. NA = Not applicable / NL = No Limit / ND= not detected.

TABLE 6: ASBESTOS ANALYTICAL RESULTS[1]

	Asbestos (% w/w)
SS14 (0-50mm)	Not detected
SS15 (0-50mm)	Not detected
T01 (0-75mm)	Not detected
T05 (0-75mm)	Not detected
NZGAMAS [2]	0.001

Notes:

1. Asbestos concentrations measured in per cent dry weight by weight (% w/w);
2. BRANZ 2017 New Zealand Guidelines for Assessing and Managing Asbestos in Soil – Table 5 Soil guidelines values for asbestos in New Zealand, fibrous asbestos / asbestos fines (AF/FA) all landuses;
3. Values in **BOLD** exceed the NZGAMAS criteria.

11.1 DISCUSSION - HEAVY METALS

Soil samples from two general areas, the historic dwelling footprint on the crest of the knoll (*T10N* and *T10W*) and the north-western corner (*SS10*) of the car port on 36 Sandspit Road returned concentrations of lead and arsenic respectively above the NES soil contaminant standard (SCS) for high-density residential landuse. Additionally, both areas returned concentrations of lead (*T10S*) and zinc (*SS10*) above the AUP(OP) permitted activity soil acceptance criteria.

An additional six soil samples returned concentrations of contaminants of concern above the expected naturally occurring background concentration ranges for non-volcanic soils in the Auckland Region, including lead around the dwelling (*SS12*) and storeroom (*SS14*) on 36 Sandspit Road, lead near the south-western face of the historic dwelling on the knoll (*SS3* and *T10S*), arsenic at the discharge point of the septic tank at the minor dwelling (*SS2*), and arsenic at the large burn area at the end of the farm track (*T01*).

It is noted that all concentrations of contaminants of concern were within the NES SCS for commercial / industrial outdoor workers (unpaved), applicable to site workers during development earthworks.

11.2 DISCUSSION - POLYCYCLIC AROMATIC HYDROCARBONS (PAH)

Both carcinogenic (BaP equivalence) and non-carcinogenic (pyrene) polycyclic aromatic hydrocarbons (PAHs) were detected at only one location, in the archaeological trench (*T06*) where remnants of the historic tram line were identified. It is noted that the detected concentrations are virtually indistinguishable from the laboratory limit of reporting and do not pose a risk to either human or environmental health as they are within the applicable NES and AUP(OP) criteria; however, they're detection is regarded as being above the expected naturally occurring background concentrations for non-volcanic soils in the Auckland Region as they are anthropogenic in origin.

11.3 DISCUSSION – BORON

Of the nine soil samples analysed for boron, only one (*T01*) returned a detectable concentration above the laboratory limit of reporting but within the expected naturally occurring background concentration range for non-volcanic soils in the Auckland Region. As the area has recently been used for burning green waste and suspected treated timber, the detectable concentration is more likely a result of burnt treated timber than a residual concentration left by historic lime burning activities.

11.4 DISCUSSION - PH

Soil pH in the two archaeological trenches where features (the tram line and iron water pipes) were identified as within the predicted soil pH range for the site. Additionally, the measured pH falls within pH Class 3 'near neutral', described by Parfitt (1984) *Reserves of Nutrients in New Zealand Soils* and Webb and Wilson (1995) *A Manual of Land Characteristics for Evaluation of Rural Land* and used by the Land Resource Information System (LRIS), and are considered a satisfactory pH for most plants.

11.5 DISCUSSION – ASBESTOS

No asbestos fibres were detected in any of the soil samples analysed.

It is noted that the failure to detect asbestos fibres in soil does not preclude the site from being subject to an appropriate asbestos building survey prior to demolition or relocation or any other requirements under the *Health and Safety at Work (Asbestos) Regulations 2016 (amended 2017)*.

12 SOIL CONTAMINATION RISK ASSESSMENT & UPDATED CONCEPTUAL SITE MODEL

For actual or potential soil contamination to pose a risk to current or end land users, and/or the receiving environment, a source-pathway-receptor relationship pathway must exist. Following the completion of visual inspection of the site, intrusive investigation, and assessment of analytical results received, the risk associated with soil contamination is considered low to moderate with all potential risks confined to direct contact with soil within the two identified hotspot areas, being the north-western side of the northern car port and the historic dwelling footprint at the crest of the knoll.

12.1 SOURCES OF CONTAMINATION

The following sources of contamination are present on site and pose a moderate risk to future residential land users and the receiving environment if mobilised during development works. The indicative extent of these areas is illustrated on Figure 5; however, the exact extent of the contamination, and therefore the volume of soil requiring disposal, must be determined by additional delineation soil sampling described under Section 14.1 below.

Northern Car Port

Analytical results have confirmed that elevated concentrations of arsenic are present above the applicable NES SCS for the protection of human health, and that zinc is present at concentrations above the AUP(OP) criteria for the protection of the environment, at the north-western corner of the car port on 36 Sandspit Road. Additionally, copper and chromium concentrations were higher than the site average, but well within the applicable NES and AUP(OP) criteria.

While the area was initially identified as a potential source of contamination due to small-scale domestic vehicle maintenance (e.g. of the ride-on lawnmower), the concentrations of arsenic, copper, and chromium suggest that the source of the arsenic contamination may be the timber poles forming the structure of the car port, if the poles had been treated with chromated copper arsenate (CCA) and not been allowed to try completely following treatment. As the poles displayed a green staining, typical of CCA treatment, it is considered likely.

Acidic rainfall can result in arsenic, copper, and chromium leaching from the timber into the surrounding soil, with leaching increasing as pH decreases; however, once in the soil matrix, all three metals adhere strongly to soil particles, especially in clay or organic soils. The extent of any elevated concentrations of arsenic, copper, or chromium from CCA treated timber is therefore expected to be highly constrained around the poles.

An elevated concentration of zinc present in the same sample containing elevated arsenic is most likely attributed to degradation of a rusting piece of galvanised steel forming the north-western wall of the car port. As with arsenic, the elevated concentrations are expected to attenuate rapidly

with distance from the car port and be highest in the surface soil horizon as discharge zinc adhere to soil particles.

Historic Dwelling Footprint

As concentrations of lead were confirmed to be significantly elevated in soil around the historic residential dwelling formerly present at the crest of the knoll on 36 Sandspit Road, indicating that lead-based paint was used for an extended period on its external surfaces. Despite the age of the contamination, lead has very low mobility in soil and is expected to be highest in shallow soils, attenuating rapidly with depth. In GSL's experience, the lateral distribution of lead contamination from lead-based paint is usually constrained to within 2 – 3 m from the walls on which it was used, as paint chips and dust during degradation or maintenance activities are deposited on the soil surface surrounding the building.

12.2 EXPOSURE PATHWAYS

The results of the investigation have indicated that the sources of contamination discussed above present a risk to the following most sensitive final receptors which may be affected via the predominant potential pathways of exposure associated with each contaminant:

Source / Location	Predominant Pathway	Final Receptor	Complete (Y/N)
Arsenic – northern car port	Ingestion / Dust Inhalation	Residential end users (Children)	Yes
Lead – historic dwelling footprint	Ingestion / Dust Inhalation	Residential end users (Children)	Yes
	Soil Contact / Ingestion / Uptake	Plants / invertebrates / microbial processes	
Zinc – northern car port	Soil Contact / Ingestion / Uptake	Plants / invertebrates / microbial processes	Yes

It is noted that while the identified arsenic and lead concentrations pose a potential risk to future residential land users, the concentrations are within the NES SCS for commercial / industrial outdoor workers (unpaved). As such, the identified concentrations do not pose a risk to the health of site workers while standard site management practices, such as dust control and personal hygiene, are adhered to.

12.3 DISPOSAL CHARACTERISATION

Laboratory analytical results have identified concentrations of contaminants that require disposal at three different types of receiving facility, if the material is removed from site:

- Cleanfill material: all soil containing concentrations of potential contaminants within the expected natural background ranges for non-volcanic soils in the Auckland Region;

- Managed fill material: soil containing low-level concentrations of contaminants above the expected natural background ranges, but generally within the AUP(OP) permitted activity soil acceptance criteria; and
- Landfill material: soil containing concentrations of contaminants above the AUP(OP) permitted activity soil acceptance criteria.

Soil containing concentrations of potential contaminants below the applicable NES and AUP(OP) criteria may remain on site, as far as practicable under the development requirements; however, soil from the two areas where exceedances have been identified (the northern car port and historic dwelling footprint) will likely require excavation and offsite disposal under the controls of a Remediation Action Plan (RAP) to make the land fit for residential landuse.

Given the concentrations of lead and zinc identified at the historic dwelling footprint and northern car port respectively, soil from those areas will require disposal at a licensed Class A landfill facility able to accept material of that nature. Additional delineation soil sampling is recommended to determine the full extents of the lead contamination around the historic dwelling footprint and arsenic and zinc contamination around the northern car port, and therefore minimise the volume of soil requiring disposal at a landfill facility. It is noted that while the zinc concentration is within the expected natural background range for volcanic soils in the Auckland Region, it is likely anthropogenic in origin and therefore should not be accepted at managed fill facilities consented to accept volcanically derived soils containing elevated zinc concentrations.

Where excess soil, such as topsoil, from those areas of the site outside the northern car port and historic dwelling contamination hotspots cannot be incorporated into the final landform, GSL recommends the offsite disposal of cleanfill material in the first instance and retention of as much managed fill material on site as possible to minimise offsite disposal costs.

13 CONCLUSIONS

Assessment of the site's history under the previous Preliminary Site Investigation (PSI) identified several activities or industries encompassed by the MfE HAIL that have been or are currently occurring on the site. Development of a Conceptual Site Model (CSM) under the PSI, and subsequently expanded in this Detailed Site Investigation (DSI) identified potential sources of contamination associated with the identified HAIL activities, as well as potential sources of contamination that could not be classified as HAIL until tested through laboratory analysis of soil samples.

Based on the desktop investigation and subsequent laboratory analysis of 29 soil samples collected across the site in accordance with the CSM, GSL have made the following conclusions:

- Two discrete locations on site contain contamination in soil that poses a risk to human and environmental health, being the north-west corner of the northern car port and the historic dwelling footprint at the crest of the knoll on 36 Sandspit Road, and will trigger the need for consent under the NES and Chapter E30 of the AUP(OP);
- Remedial works under the controls of a Remediation Action Plan (RAP) will be required to make those two areas fit for use under the proposed high-density residential landuse;

- Low-level contamination where concentrations exceed the expected natural background ranges is present in several locations and will require management during general earthworks to ensure potential contaminants are not released to the surrounding environment; and
- The historic lime burning activities in the heritage extent of place on the southern portion of the site does not appear to have had any adverse effects on soil quality that will impede the proposed works. The site management requirements for low-level contamination across the site will apply to disturbance of the historic tram line, should the heritage assessment allow for its disturbance.

13.1 THE NATIONAL ENVIRONMENTAL STANDARDS (NES)

This Detailed Site Investigation (DSI) has identified concentrations of contaminants of concern that exceed the high-density residential landuse soil contaminant standard, selected as the applicable standard under Regulation 7(2) of the NES. As such, the proposed subdivision and development will likely be regarded as a Restricted Discretionary Activity under Regulation 10 of the NES.

A Remediation Action and Site Management Plan (RAP/SMP) commensurate with the level of contamination identified in the two hotspots and low-level contamination on site has been provided in Section 14 below to address the requirements of the NES under Regulation 10. Additionally, following completion of any remedial earthworks, a Site Validation Report (SVR) must be prepared and submitted to Auckland Council detailing the remedial earthworks undertaken, the volume of soil classified as managed fill or landfill material removed from site and details of the receiving facility, whether any accidental discoveries of previously unidentified contamination in soil, and details of any complains or incidents that may occur during the remedial works.

13.2 THE AUCKLAND UNITARY PLAN (OPERATIVE IN PART) (AUP(OP))

As soil samples returned concentrations of lead and zinc above the AUP(OP) permitted activity soil acceptance criteria, the piece of land meets the Auckland Council definition of *"land containing elevated levels of contaminants"*, as such, the contaminated land rules of Chapter E30 of the AUP(OP) must be addressed.

As the identified environmental contaminants (lead and zinc) have very low mobility in soil and do not readily leach, and as remedial earthworks will be undertaken in accordance with an RAP under the NES to remove the identified hotspots of contamination under appropriate dust, sediment, and erosion controls, GSL regard discharges from the land as highly unlikely to cause significant adverse effects on the environment. As such, the proposed subdivision and development, including remedial earthworks, may be regarded as a Controlled Activity under Rule E30.6.2.1 of the AUP(OP).

The RAP/SMP supplied in Section 14 below to address the NES incorporates appropriate controls to ensure the protection of environmental health during remedial and general development earthworks. Following completion of the remedial works and acceptance of an appropriate Site Validation Report (SVR) by Auckland Council, the site will no longer be considered *land containing elevated levels of contaminants*.

14 REMEDIATION ACTION AND SITE MANAGEMENT PLAN (RAP/SMP)

GSL has prepared the following Remediation Action and Site Management Plan (RAP/SMP) outlining the controls which are to be implemented prior to future remedial and development earthworks commencing to ensure the safe removal and disposal of the identified arsenic, lead, and zinc impacted soil from site. The remediation and validation of the identified contamination, described below, must be performed prior to any general development earthworks commencing within the general vicinity of the contaminated material.

These controls have been developed to a degree commensurate to human and environmental health risk posed by soil onsite, and to satisfy the Restricted Discretionary Activity requirements of Regulation 10 of the NES and Controlled Activity requirements of Rule E30.6.2.1 of the AUP(OP).

14.1 DELINEATION OF IMPACTED AREA

Based on the findings of the DSI, two areas on site, the western side of the northern car port and the historic dwelling footprint at the crest of the knoll, have been identified as requiring remediation (Figure 5). While the vertical extent of the impacted soil has not been defined, based on the conceptual model developed in the PSI and refined in the DSI it's likely that only the topsoil horizon may have been impacted and that contamination is likely restricted to a discrete area within a short distance of each source. However, as the exact lateral and vertical extents of the contamination hotspots are not known, GSL recommend that systematic grid-based delineation soil sampling around those sample locations containing elevated concentrations of contaminants (*SS11*, *T10E*, *T10N*, & *T10W*) be undertaken prior to remedial earthworks commencing. Delineation soil samples will be analysed for arsenic and zinc as the primary contaminants of concern at the northern car port, and for lead only as the primary contaminant of concern at the historic dwelling footprint.

Once the full lateral and vertical extents of the two contamination hotspots have been defined by delineation soil sampling, the areas will be considered 'pre-validated' pending visual inspection, and no further validation soil sampling will be required.

14.2 REMEDIAL GOALS

The NES outlines soil contaminant standards (SCS) for the protection of human health for arsenic and lead with the most applicable SCS being High Density residential landuse. This SCS is considered sufficiently conservative for the intended end landuse of the site and has been adopted as the remedial goal for the project. As lead and zinc were identified as environmental contaminants, the permitted activity soil acceptance criteria of Chapter E30 of the AUP(OP) have been adopted as the applicable remedial goals. It is noted that while lead concentrations identified on site also pose a risk to human health, the AUP(OP) criteria are lower than the NES SCS for high-density residential landuse and have therefore been selected as the appropriate remedial goal for the protection of both human and environmental health on site.

The remedial goals are detailed in Table 7 below.

Table 7: Remediation Goals[1]

	Remedial Goal
Arsenic	45[2]
Lead	250[3]
Zinc	400[3]

Notes:

1. All concentrations measured in mg/kg;
2. National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect human Health – high density residential landuse;
3. Auckland Unitary Plan (Operative in Part) Chapter E30 *Contaminated Land* – Table E30.6.1.4.1 Permitted activity soil acceptance criteria.

14.3 REMEDIATION & MANAGEMENT STRATEGY

It is proposed to excavate and dispose of soil from the identified impacted areas offsite at an appropriately licensed receiving facility able to accept material of this nature.

Prior to any earthworks commencing on site (remedial or general development), the following aspects will be addressed by the consent holder.

14.3.1 RESPONSIBILITIES AND SITE MANAGEMENT

The consent holder will appoint an earthworks contractor and site manager who will be responsible for the implementation of this RAP/SMP. A copy of this RAP/SMP is to always be kept on site.

14.3.2 ENGAGEMENT OF CONTAMINATED LAND ADVISOR (CLA)

GSL will provide on-call direction in relation to contamination / disposal issues for the project. GSL are a professional consultancy, suitably qualified and experienced in the investigation, reporting, remediation, and validation of contaminated land.

14.3.3 HEALTH AND SAFETY PROCEDURES

While this RAP/SMP provides steps that are required because of the concentrations of arsenic, lead, and zinc identified during the DSI, the earthworks contractor is ultimately responsible for the H&S procedures related to the earthworks.

Assessed arsenic, lead, and zinc concentrations in soils on site do not exceed the soil contaminant standard (SCS) for commercial / industrial site workers (unpaved), as outlined in the NES. As such, soil onsite is not considered to present a risk to the health of site workers undertaking works. That said, conservative controls should be in place and effective during remedial soil disturbance activities and general site development earthworks to ensure that any risks associated with potential mobilisation of contaminants are managed to an acceptably low level.

The primary risks associated with the disturbance of arsenic impacted soil are inhalation and direct contact with skin or eyes. These primary risks are managed through the implementation of appropriate staff hygiene and dust suppression as documented in Sections 14.3.4 and 14.3.6 respectively. In addition, mechanical excavation will be the primary method of remediation, further limiting potential for direct contact with soils.

14.3.4 Establishment of On – Site Amenities & Commencement of Works

Prior to remedial earthworks commencing, the site manager will ensure that appropriate site amenities are available on site and will include as a minimum:

- Designated 'clean' area for personnel to take breaks away from the identified impacted areas; and
- An appropriate personal decontamination area such that all personnel have facility to wash hands and face prior to eating, drinking, or smoking.

Once the on-site amenities are established, the site manager will ensure that dust, erosion, and sediment controls are in place and effective, and that all personnel undertaking the works have been briefed on their obligations and have appropriate PPE for the works being completed.

14.3.5 Personal Protective Equipment

The minimum Personal Protective Equipment (PPE) which will be available on-site will be in accordance with the contractor's specific health and safety plan. Additional PPE that may be required include:

- Protective leather or rubber gloves
- Safety glasses
- Dust masks

The site manager will use his discretion regarding the use of the additional PPE and might call on the CLA for advice on this matter.

14.3.6 Dust Control

Dust controls are required in accordance with the MfE *Good Practice Guide for Assessing and Managing Dust (2016)* to minimize pollutants becoming airborne and reduce stormwater sediment loads. If the proposed earthworks are undertaken in dry conditions, dust will be controlled by light frequent water spraying. Water spraying will be frequent enough to suppress the generation of dust, but not as heavy as to generate sediment laden water run-off.

The site manager will use his discretion regarding dust suppression and will be ultimately responsible for ensuring the control of dust during earthworks on site.

14.3.7 Erosion and Sediment Control

To prevent generation of contaminated sediment laden run-off, stormwater protection measures shall be incorporated around the perimeter of the proposed works in accordance with Auckland

Council Guidance Document GD05 *"Erosion and Sediment Control Guide for Land Disturbing Activities in New Zealand, June 2016"*.

14.3.8 IMPORTED SOIL

Should any soil be imported to the site, for landscaping or backfilling if required, that material should be certified as Cleanfill material under the AUP(OP).

14.4 REMEDIAL EARTHWORKS PROCEDURES

The arsenic, lead, and zinc impacted material that is to be excavated will be predominantly silty topsoil emplaced over silty clay deposits.

The affected areas will be excavated to the depth determined by delineation soil sampling for offsite disposal to a suitably licensed receiving facility able to accept material of this nature. GSL note that soil excavated from the historic dwelling footprint must be disposed of at a licensed Class A landfill facility due to elevated lead concentrations; however, soil excavated from the northern car port may be acceptable to certain managed fill facilities, depending on their site-specific soil acceptance criteria. Pre-approval for acceptance of the material must be sought from the nominated receiving facility prior to remedial excavations commencing.

The procedures below will be followed to ensure that potentially contaminated soil is adequately handled and disposed of off-site.

- The impacted area, as determined by further delineation soil sampling, will be marked with fluorescent paint, pegs, or other appropriate markers in the field;
- Prior to earthworks commencing, the earthworks contractor will arrange for the off-site disposal of impacted soil to a suitably licensed receiving facility;
- Impacted soil will be mechanically excavated and, where possible, will be loaded directly into a truck and taken directly to a facility authorised to receive soil of this kind;
- All trucks leaving the site hauling impacted soil will be covered prior to leaving the property boundary and will proceed directly to the appointed disposal location;
- Water sprayers or similar water dust suppression equipment will be available to manage dust generation if required. Dust controls will be in accordance with the MfE *Good Practice Guide for Assessing and Managing Dust (2016)*;
- The CLA will be notified of the commencement of works and be available on call in the event of discovery of unexpected contamination.
- Should unexpected contamination be encountered, the CLA will be notified to inspect any suspicious or noxious material in accordance with the contingency measures set out in Section 14.5 below. If necessary, the CLA will take soil samples for analysis of any foreign material that is discovered. The CLA will advise on the disposal of any such material;
- Upon completion of the remedial excavation works the site manager shall ensure that plant and equipment are cleaned and decontaminated appropriately before moving to work on any other portion of the site; and

- A landfill manifest or weigh bridge dockets of all material disposed of at a managed fill or landfill facility will be kept and provided to the consent holder.

14.4.1 VALIDATION REQUIREMENTS

Following the completion of the remedial excavation validation will in the first instance consist of a visual inspection confirming that the impacted area has been excavated to the depth determined by the recommended delineation soil sampling outlined in Section 14.1 above, followed by a consolidation of the landfill manifest or weighbridge dockets supplied by the receiving facility.

If no delineation soil sampling is undertaken prior to remedial excavations commencing, validation soil samples will be collected from the base and four walls of each of the excavations. Validation soil samples collected from the northern car port excavation will be analysed for arsenic and zinc, while validation soil samples from the historic dwelling footprint will be analysed for lead only. Should any validation soil sample return a concentration of a contaminant above the remedial goal noted in Table 7 above, further excavation, direct loadout and offsite disposal of impacted soil will be undertaken followed by further validation soil sampling until compliant results are obtained.

14.5 CONTINGENCIES

In the event that other contamination is encountered on the site during the works, the site manager, in consultation with the CLA, will either:

- Identify the material in situ if possible (staining, odour, visible fibres or refuse etc.); or
- Excavate the material to a suitable leak proof and covered skip-bin or truck and take representative samples for analysis, placing the material on hold for appropriate disposal; or
- Halt excavations in the immediate vicinity of the discovery while the material is sampled in-situ, and removal / disposal options explored once the analytical results are returned.

An appropriate log will be kept by the site manager of any unidentified contamination encountered during the excavations.

GSL has produced a contaminated soil discovery guideline (CSDG) document that outlines the signs, risks, and remedial actions required for contamination scenarios that may be encountered during remedial earthworks (Appendix F).

Suspicious material will be investigated by the CLA, and laboratory analysed if deemed necessary. The CLA will advise on the disposal options of any uncertain materials. Disposal options can include:

- remove to an appropriate temporary stockpile area for further testing and analysis; or
- disposal at a clean fill, managed fill or landfill facility.

The appointed contractor might have their own discovery procedures based upon their specific experiences in working with contaminated land of various natures (urban to rural). Contractor specific documents may be used alongside or in conjunction with this SMP.

If any staff, contractors, or consultants discover contamination, they should notify the site manager immediately, who should enact the provisions of the plan.

14.5.1 FIBROUS MATERIAL (ASBESTOS)

It is not anticipated that any asbestos materials will be encountered on the site. However, where asbestos containing materials (ACM) are identified in the soil matrix, all works shall cease (including the excavation and disposal of affected materials) until the provisions of the *Health and Safety at Work (Asbestos) Regulations* are exercised.

ACM identification will primarily be through visual identification by a suitably competent person. Any fibrous material observed during excavations will be visually inspected, photographed and representative sample submitted to an accredited laboratory for analysis. Following receipt of results, the site manager in conjunction with the CLA shall determine what, if any, further remedial steps may be required, including the provisions of asbestos removal control plans, semi-quantitative analysis, or site assessment under the WorkSafe endorsed *BRANZ New Zealand Guidelines for Assessing and Managing Asbestos in Soils* (November 2017).

14.6 SITE VALIDATION REPORT

Upon completion of the remedial works, a site validation report (SVR) will be completed by a Suitably Qualified and Experienced Practitioner and provided to Auckland Council. The SVR will include:

- The quantity of soil material removed from site, including copies of the disposal manifests / weighbridge dockets;
- A description of any unforeseen contaminated soil material encountered during the remedial works; and
- Laboratory analytical results from any soil testing, including validation soil samples if required, that occurred during the remedial works.

15 REFERENCES

1. Ministry for the Environment (2003) — *Contaminated Land Management Guidelines No.1: Reporting on contaminated Sites in New Zealand*. Ministry for the Environment, Wellington, New Zealand.

2. Ministry for the Environment (2003) — *Contaminated Land Management Guidelines No.5: Site Investigation and Analysis of Soils*. Ministry for the Environment, Wellington, New Zealand.

3. Ministry for the Environment (2012) - Users Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health. Ministry for the Environment, Wellington, New Zealand.

4. Ministry for the Environment (2011) – *Methodology for Deriving Standards for contaminants in Soil to Protect Human Health.* Ministry for the Environment, Wellington, New Zealand.

5. Auckland Council (2013) –*Auckland Unitary Plan (Operative in Part)*, Auckland, New Zealand.

6. Auckland Regional Council (2001) – *Background Concentrations of Inorganic Elements in Soils from the Auckland region (TP153*) – Auckland.

7. Edbrooke, S.W (2001) — *Geology of the Auckland Urban Area,* Institute of Geological and Nuclear Sciences Geological Map 3, Lower Hutt, New Zealand.

8. Auckland Council (2011) - *Auckland Council GEOMAPS*. http://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

9. Ministry for the Environment (rev 2011) - *Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand.* Ministry for the Environment, Wellington, New Zealand.

16 LIMITATIONS

The conclusions and all information in this Report are given strictly in accordance with and subject to the following limitations and recommendations:

1. The assessment undertaken to form this conclusion is limited to the scope of work agreed between GSL and the client, or the client's agent as outlined in this Report. This report has been prepared for the sole benefit of the client and neither the whole nor any part of this report may be used or relied upon by any other party except for Regional and Territorial authorities in their duties under the Resource Management Act 1991.
2. The investigations carried out for the purposes of the report have been undertaken, and the report has been prepared, in accordance with normal prudent practice and by reference to applicable environmental regulatory authority and industry standards, guidelines and assessment criteria in existence at the date of this report.
3. This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by GSL for use of any part of this report in any other context.
4. This Report was prepared on the dates and times as referenced in the report and is based on the conditions encountered on the site and information reviewed during the time of preparation. GSL accepts no responsibility for any changes in site conditions or in the information reviewed that have occurred after this period of time.
5. Where this report indicates that information has been provided to GSL by third parties, GSL has made no independent verification of this information except as expressly stated in the report. GSL assumes no liability for any inaccuracies in or omissions to that information.
6. Given the limited Scope of Works, GSL has only assessed the potential for contamination resulting from past and current known uses of the site.
7. Environmental studies identify actual sub-surface conditions only at those points where samples are taken and when they are taken. Actual conditions between sampling locations or differ from those inferred. The actual interface between materials may be far more gradual or abrupt than an assessment indicates. Actual conditions in areas not sampled may differ from that predicted. Nothing can be done to prevent the unanticipated and GSL does not guarantee that contamination does not exist at the site.
8. Except as otherwise specifically stated in this report, GSL makes no warranty or representation as to the presence or otherwise of asbestos and/or asbestos containing materials ("ACM") on the site. If fill has been imported on to the site at any time, or if any buildings constructed prior to 1 January 2000 have been demolished on the site or materials from such buildings disposed of on the site, the site may contain asbestos or ACM.
9. No investigations have been undertaken into any off-site conditions, or whether any adjoining sites may have been impacted by contamination or other conditions originating from this site. The conclusion set out above is based solely on the information and findings contained in this report.
10. Except as specifically stated above, GSL makes no warranty, statement or representation of any kind concerning the suitability of the site for any purpose or the permissibility of any use, development or re-development of the site.
11. The investigation and remediation of contaminated sites is a field in which legislation and interpretation of legislation is changing rapidly. Our interpretation of the investigation findings should not be taken to be that of any other party. When approval from a statutory authority is required for a project, that approval should be directly sought by the client.
12. Use, development or re-development of the site for any purpose may require planning and other approvals and, in some cases, environmental regulatory authority and accredited site auditor approvals. GSL offers no opinion as to whether the current use has any or all approvals required, is operating in accordance with any approvals, the likelihood of obtaining any approvals, or the conditions and obligations which such approvals may impose, which may include the requirement for additional environmental works.
13. GSL makes no determination or recommendation regarding a decision to provide or not to provide financing with respect to the site. The on-going use of the site and/or use of the site for any different purpose may require the owner/user to manage and/or remediate site conditions, such as contamination and other conditions, including but not limited to conditions referred to in this report.
14. Except as required by law or for the purposes of Regional & Territorial Authorities discharging their duties under the Resource Management Act 1991, no third party may use, or rely on, this report unless otherwise agreed by GSL in writing. Where such agreement is provided, GSL will provide a letter of reliance to the agreed third party in the form required by GSL.
15. To the extent permitted by law, GSL expressly disclaims and excludes liability for any loss, damage, cost or expenses suffered by any third party relating to or resulting from the use of, or reliance on, any information contained in this Report. GSL does not admit that any action, liability or claim may exist or be available to any third party.
16. Except as specifically stated in this section regarding Regional and Territorial Authorities, GSL does not authorise the use of this report by any other third party.

FIGURES

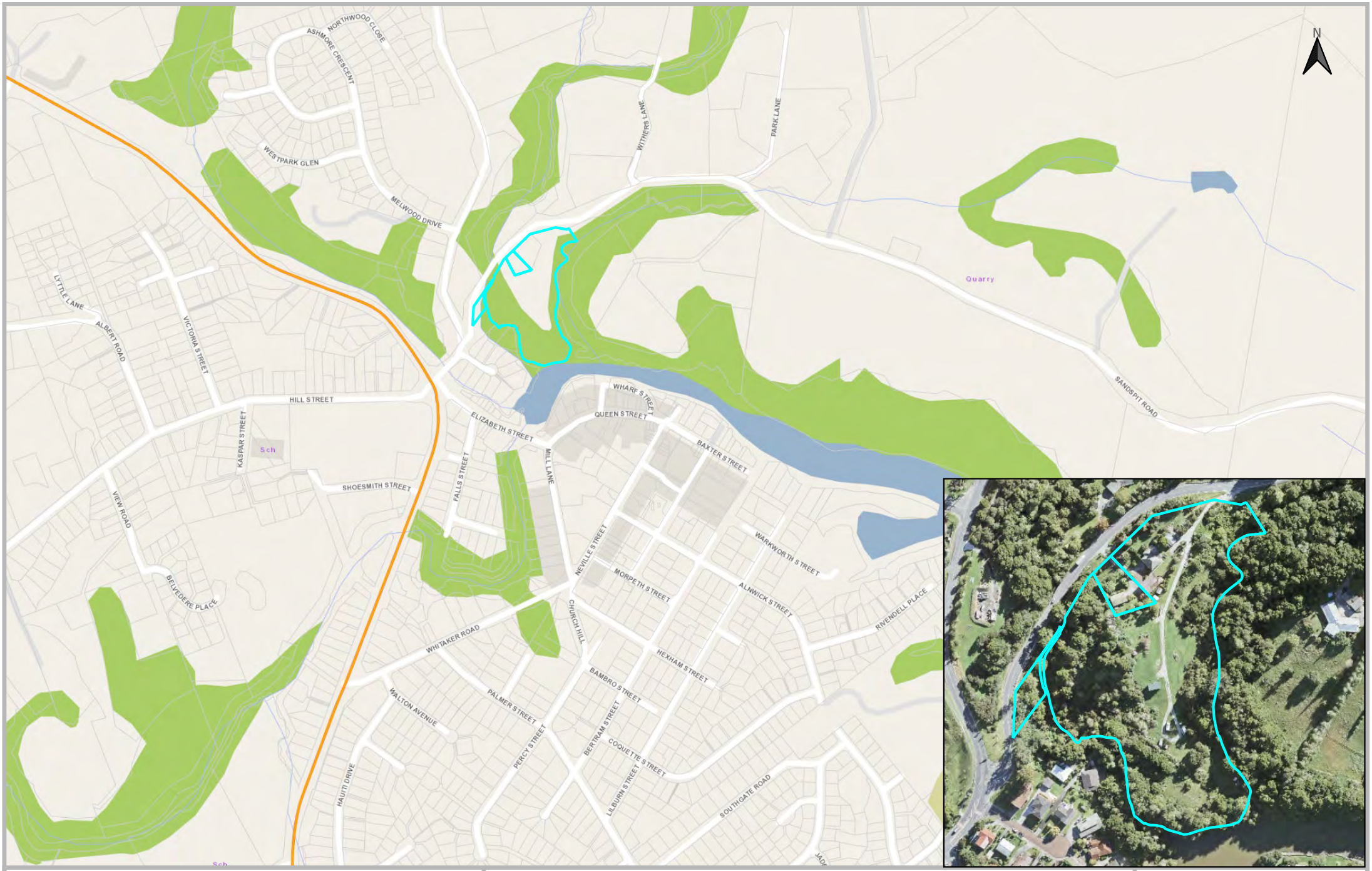

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Figure 1 - Site Location

34 & 36 Sandspit Road, Warkworth, Auckland

Reference:	J1568a
Date:	30/04/2021
Drawn:	CD
Approved:	COB

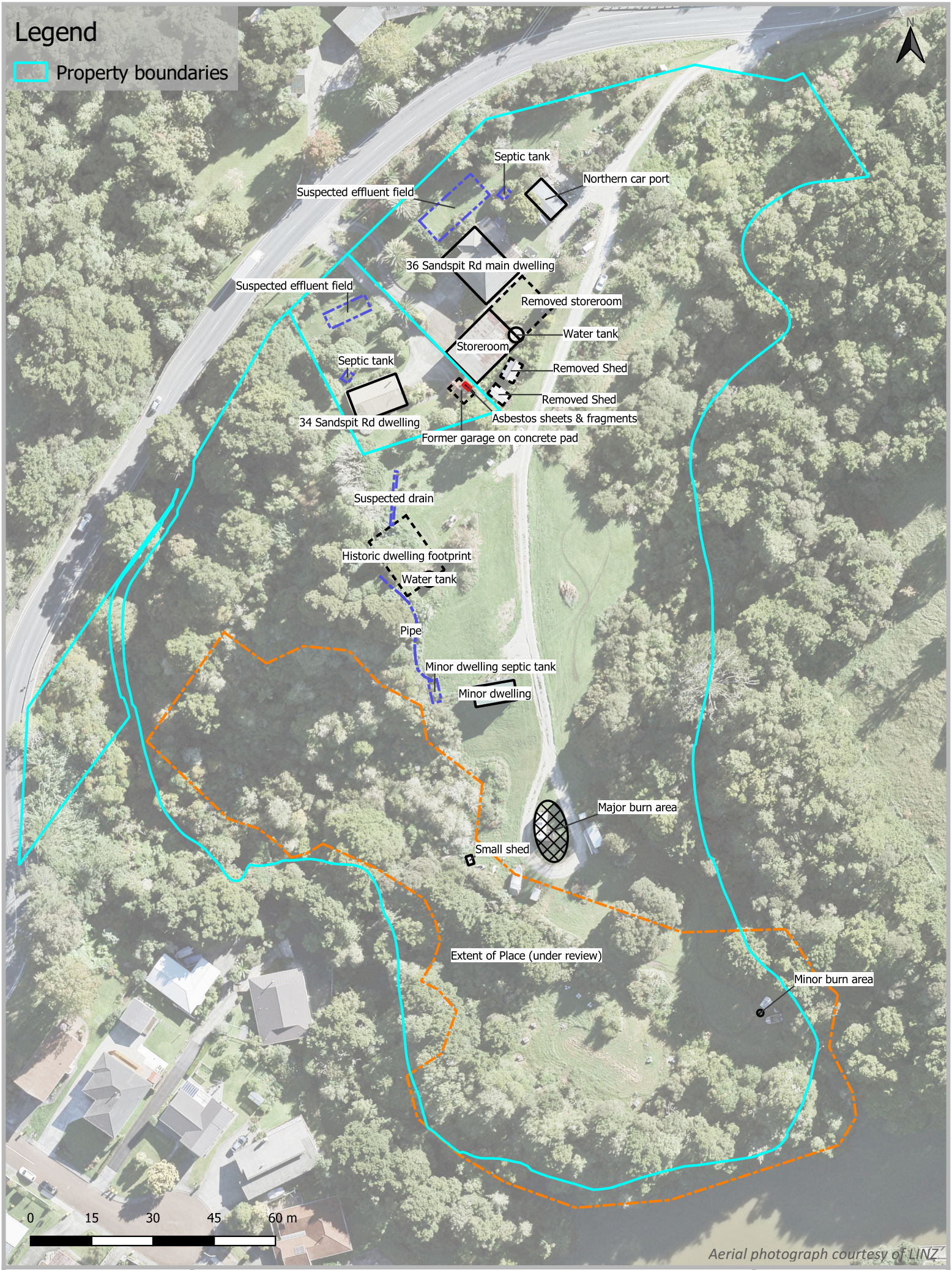

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Figure 2 - Site Infrastructure

34 & 36 Sandspit Road, Warkworth, Auckland

Reference:	J1568a
Date:	16/02/2022
Drawn:	CD
Approved:	COB

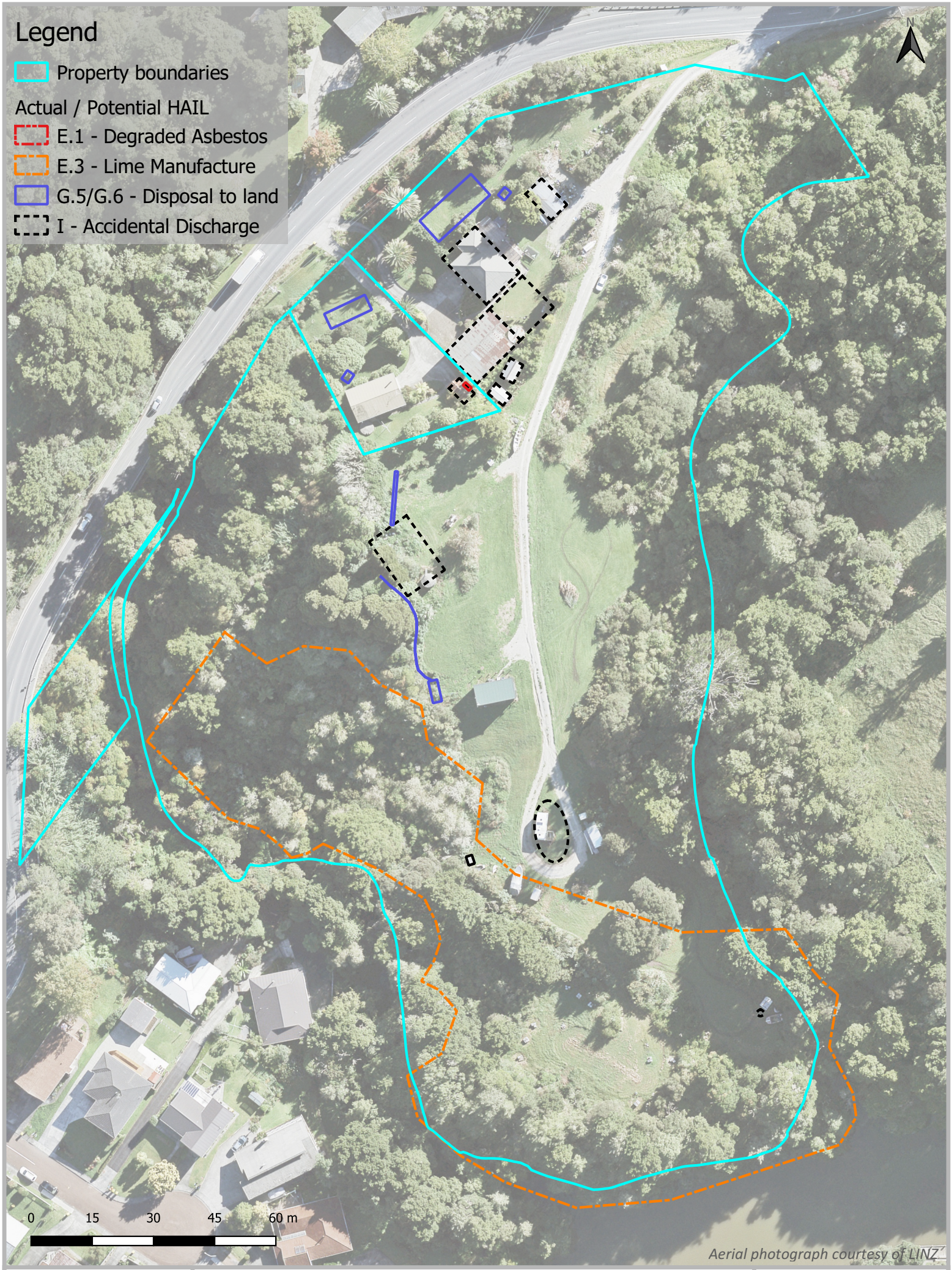

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Figure 3 - Actual / Potential HAIL

34 & 36 Sandspit Road, Warkworth, Auckland

Reference:	J1568a
Date:	16/02/2022
Drawn:	CD
Approved:	COB

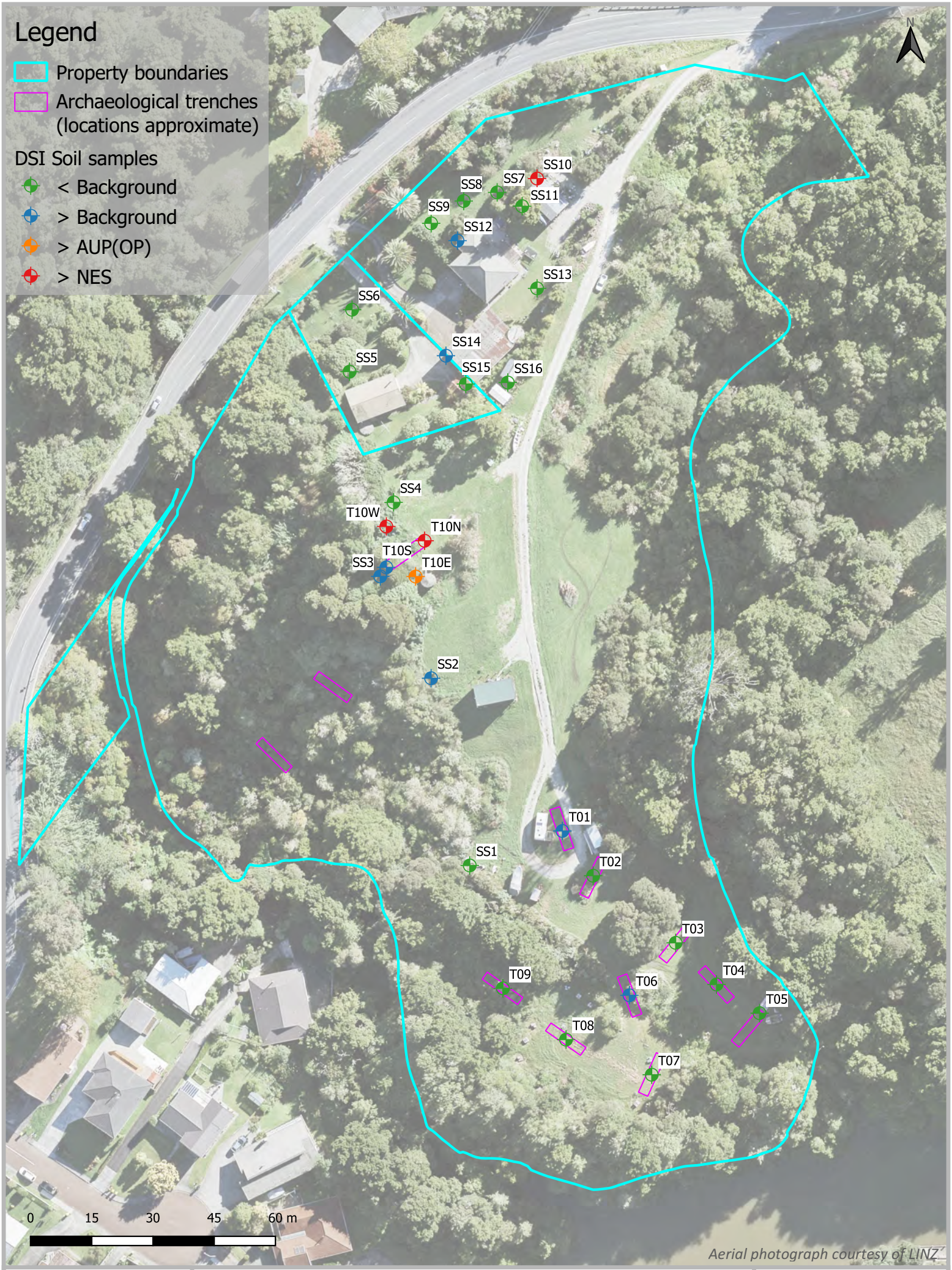

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Figure 4 - Soil Sample Locations

34 & 36 Sandspit Road, Warkworth, Auckland

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Approved:	COB

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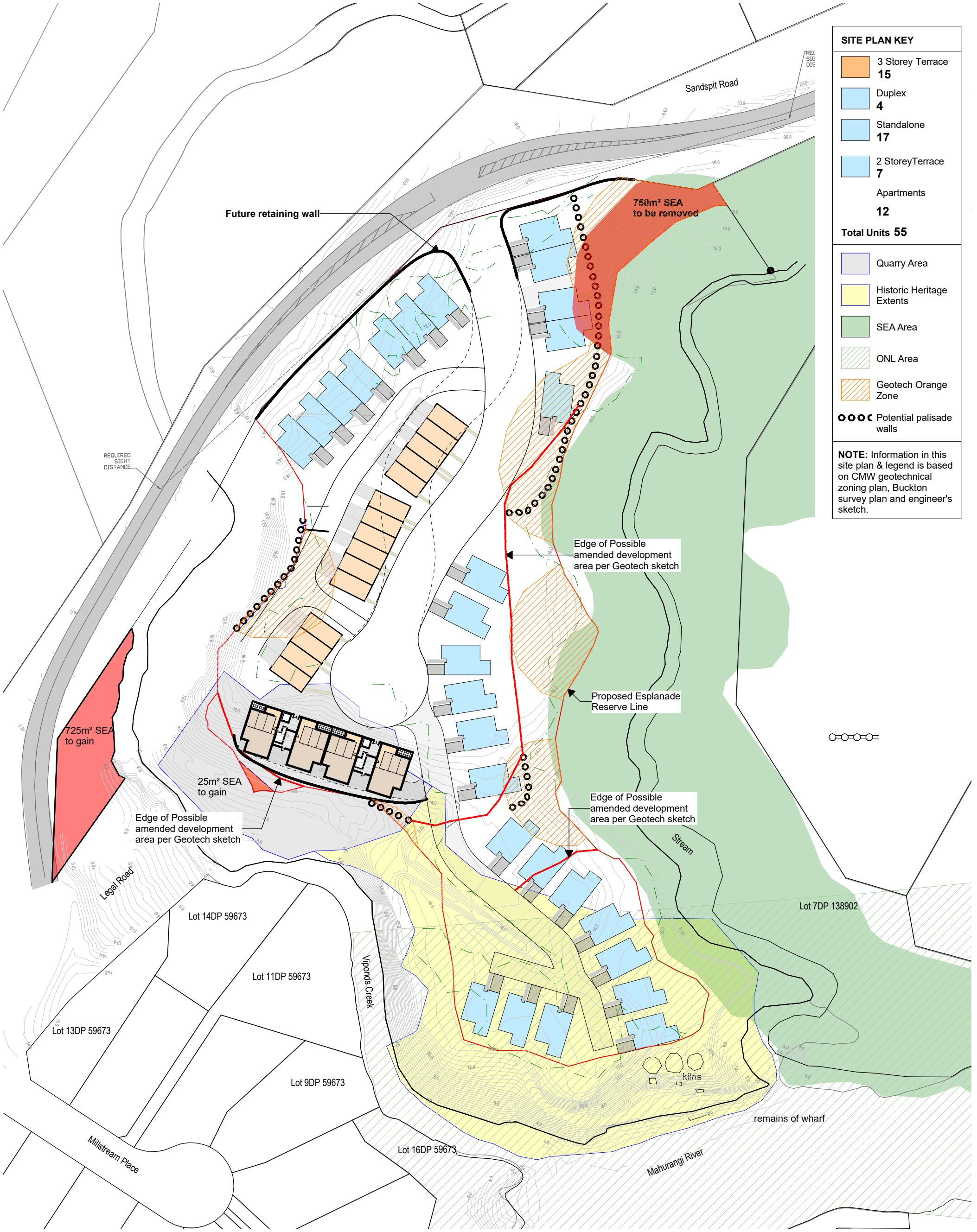
Figure 5 - Indicative Remedial Areas

34 & 36 Sandspit Road, Warkworth, Auckland

Reference:	J1568a
Date:	16/02/2022
Drawn:	CD
Approved:	COB

APPENDIX A PRELIMINARY SCHEME PLAN



Bulk & Location Plan 1:1000

36 Sandspit Road Development

36 Sandspit Road Warkworth 0982

N

DRAFT

BULK AND LOCATION ISSUE

Title
Bulk & Location Plan

Date
30/05/2021

Scale
1:1000, 1:1 @A3

Client
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ref no.
21007

sheet no.
A101

revision
3

APPENDIX B PRELIMINARY SITE INVESTIGATION EXTRACT

PRELIMINARY SITE INVESTIGATION

34-36 SANDSPIT ROAD, WARKWORTH

Reference Number: REP-1568/PSI/APR21/REV3

PREPARED FOR: THE KILNS LTD C/- THE PLANNING COLLECTIVE LTD

ISSUED: 30 APRIL 2021

REVISED: 30 JULY 2021

Geosciences Limited
47 Clyde Road, Browns Bay, Auckland
PO Box 35-366, Browns Bay, Auckland
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EXECUTIVE SUMMARY

The Kilns Ltd are investigating potential redevelopment options of the properties at 34 and 36 Sandspit Road, Warkworth and consequently Geosciences Ltd (GSL) were engaged to undertake a Preliminary Site Investigation (PSI) of the property in accordance with the *National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES). The purpose of this PSI is to provide an assessment of actual and potential soil contamination risks in light of potential future development.

The PSI included a desktop study of the site history through a review of the current and historical records of title, historic aerial photographs, and the Auckland Council property file, followed by a visual site inspection. The desktop study identified that the site has been the location of lime manufacturing between the early 1860's and was decommissioned by the 1880's.

Following decommissioning of the lime manufacturing operations, the site has been under rural residential use with a dwelling located at the highest elevation of the site since at least the early 1900s. A second dwelling on 36 Sandspit Road and several storerooms were constructed to the north of the original dwelling in the early 1950s, with a third dwelling constructed on 34 Sandspit Road in the early 1970s. The oldest dwelling was removed shortly after in the mid-1970s. Apart from the residences, the site has remained under a mixture of scrub and bush for its observable past, with a fourth, small dwelling erected on site between 2010 and 2017.

Documents retained on the property file indicate that the residential dwelling and the large shed currently situated on the northern portion of 36 Sandspit Road were constructed using asbestos containing material (ACM) and were subject to lead-based paint use. Given the age of the historic southern dwelling, the use of lead-based paint is assumed; however, the structure likely pre-dates the widespread use of asbestos containing buildings materials.

When conducting the site walkover, all ACM containing material was in good condition on both dwellings and large storeroom with minor discrete damage noted but unlikely to pose a risk to soil quality. A septic tank was also identified to the east of the sleepout house.

In completing this PSI, GSL have concluded that while current and historical HAIL activities have been identified on site, their presence and extent is unlikely to present a significant constraint to a proposed plan change process. Rather, the Regulations of the NES and AUP(OP) will apply to any proposed change of landuse, subdivision, or development and a Detailed Site Investigation (DSI) will need to be conducted as part of the resource consent process to determine whether soil quality has been adversely affected by the identified HAIL activities and industries to a degree that poses a risk to human health and / or the environment. Where adverse impacts are identified, remediation and / or management followed by validation may also be required.

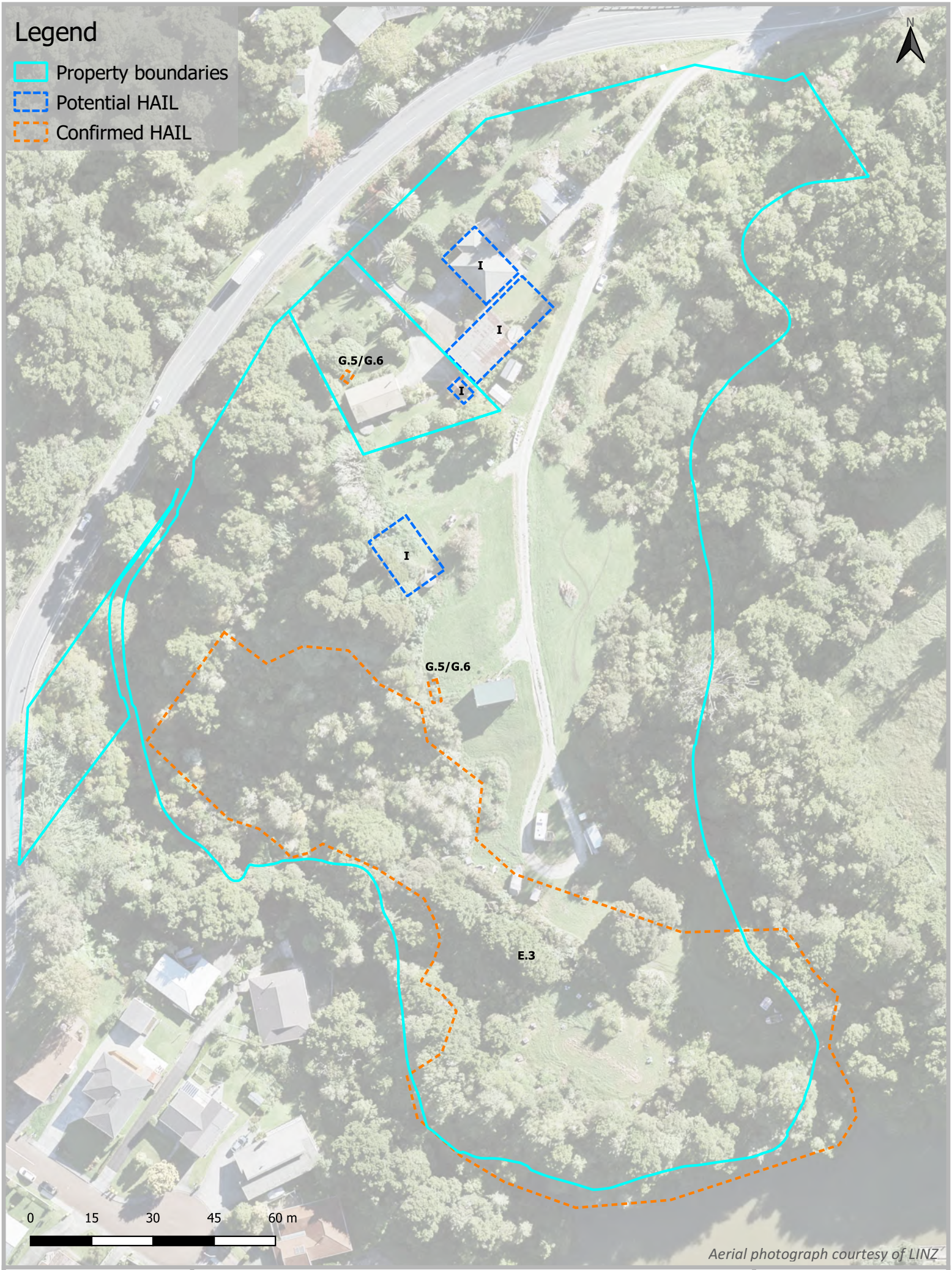

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Figure 2 - Potential HAIL Areas

34 & 36 Sandspit Road, Warkworth, Auckland

Reference:	J1568
Date:	30/04/2021
Drawn:	CD
Approved:	COB

APPENDIX C GEOTECHNICAL INVESTIGATION REPORT EXTRACT

8 September 2021

36 SANDSPIT ROAD, WARKWORTH

GEOTECHNICAL INVESTIGATION REPORT

The Kilns Limited

AKL2021-0060AB Rev 1

EXECUTIVE SUMMARY

This report presents a geotechnical investigation and geohazards assessment for the development of the block of land at 36 Sandspit Road, Warkworth, and the total site comprises an area of approximately 2.84 hectares.

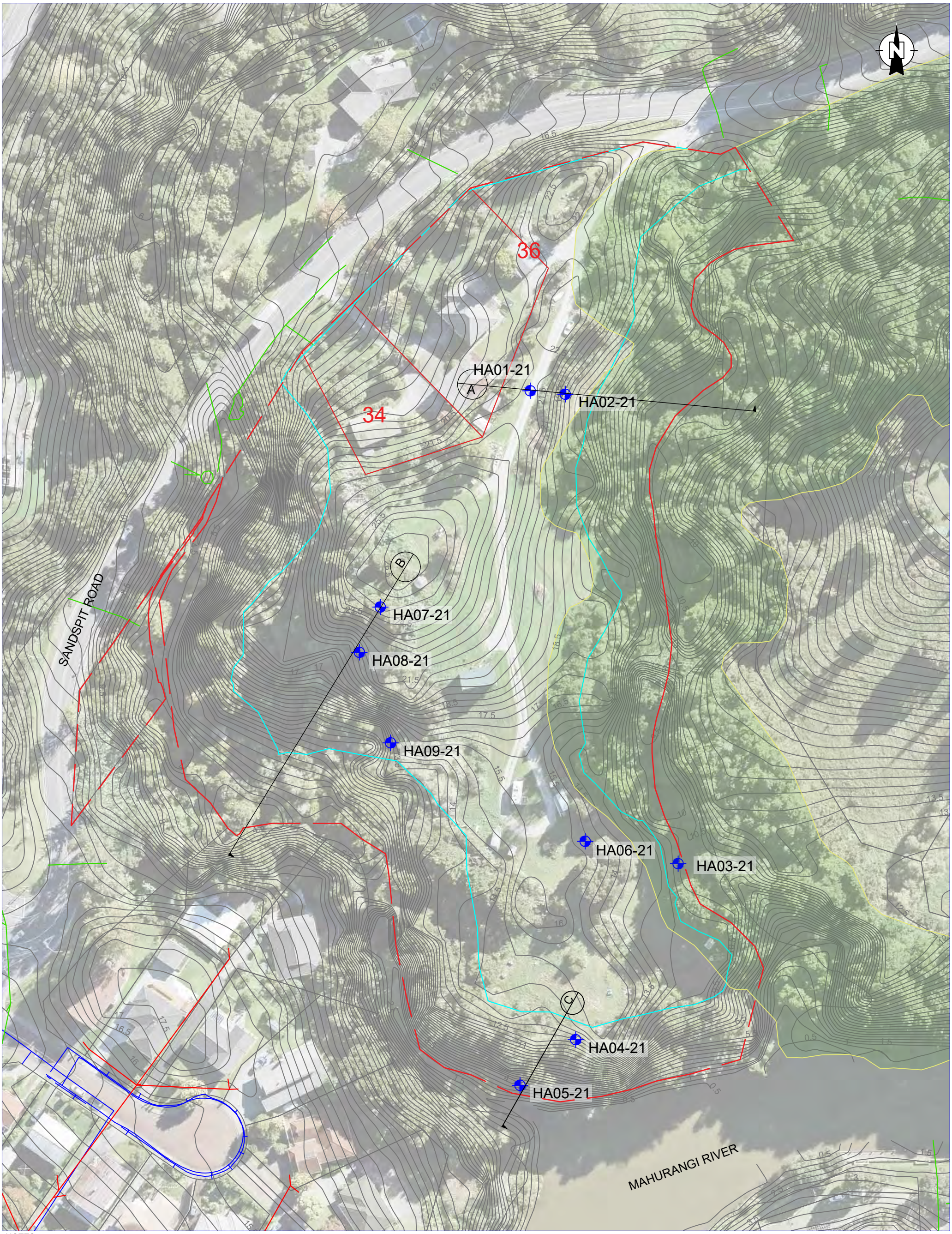
Topography is dominated by a knoll located centrally within the site with a maximum contour of approximately RL 26.5m. The east and west of the site are bound by gullies / tributary features of the Mahurangi River. The Mahurangi River runs in a west to east direction along the southern section of the site. The site is bound to the north by Sandspit Road. The eastern, western, and southern boundaries of the site are covered by bush/vegetation.

Prior to aerial photo documentation (1931), it is understood that the site was used as a lime quarry, with three kilns, a rail line and an **undefined** quarry area present in the southern portions of the site.

Based upon the investigation results, the site is underlain by Holocene Tauranga Group Alluvium, Colluvium, Mahurangi Limestone of the Northland Allochthon, and Pakiri Formation of the Waitemata Group.

Geotechnical aspects of the development are summarised as follows:

- The subsoils encountered as part of this investigation are generally consistent with published geological records. However, Tauranga Group alluvial deposits were encountered during this investigation, which are not included in the published geology for the site.
- The recent alluvial deposits found toward the east of the site are Holocene of geological age and therefore, in terms of geological age, may be susceptible to liquefaction. However, there is a low risk of liquefaction due to the the clay-rich consistency of the subsoils.
- Stability analyses were carried out for the development with a proposed cut line located at RL 18m. Results did not meet the required criteria for the proposed landform along Section A, therefore, a 10m development set-back, or an in-ground wall, or the undercutting and replacing of landslide debris, shear key and the installation of subsoil drainage, will be required here.
- Given a cut profile of around RL 18m is proposed, which will encounter Mahurangi Limestone bedrock around the central knoll, this will resolve most of the small-scale instability features present within the shallow over-burden and within an anticipated future development area here. Some areas of extremely steep slope are expected to remain immediately to the west of and below the knoll. These areas are expected to require further assessment and building setbacks.
- Shallow instability is evident around the steep banks above the streams at the southern end of the site. Very stiff transition to bedrock deposits are present at shallow depths and existing instability features are located within the Esplanade Reserve area.
- The southern portion of the site, which is bound by the tidally influenced Mahurangi River, will be subject to some degree of coastal erosion and slope instability. Although this regression may not be as severe as regression on the open coast, erosion around the steeply sloping riverbanks will still occur.
- On the basis of our visual tactile assessment, experience in the area and reference to BRANZ Report SR120A, the subsoils within this site are anticipated to fall within the high AS2870 Site Class.
- Using a zoning framework, we have mapped two main zones in specific areas across the study site relating to relative cost premium for development. The majority of the subject site has vast areas of readily developable land (low development cost areas).
- Further detailed investigations are required once a scheme plan and finalised cut/fill plans are made available.



NOTES:

1. BASE PLAN ADAPTED FROM: AUCKLAND COUNCIL GIS AND BUCKTON CONSULTING SURVEYORS LTD

1:1000 0 10 20 30 40 50 m

LEGEND:

- SITE BOUNDARY
- HA01 HAND AUGER (HA) LOCATION
- WATERMAIN
- STORMWATER LINE
- WASTEWATER LINE
- A CROSS SECTION
- 20m ESPLANADE RESERVE
- SIGNIFICANT ECOLOGICAL AREA

CMW Geosciences

CLIENT: THE KILNS LIMITED		DRAWN: TE	PROJECT No: AKL2021-0060
PROJECT: 36 SANDSPIT ROAD WARKWORTH		CHECKED: RK	DRAWING: 01
		REVISION: 0	SCALE: 1:1000
TITLE: SITE INVESTIGATION PLAN		DATE: 29/04/2021	SHEET: A3

HAND AUGER BOREHOLE LOG - HA01-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: LSW Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749133.0mE; 5970973.0mN Projection: NZTM
Elevation: 22.60m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
	0.4	Peak = 174kPa Residual = 42kPa	22.6			CL: Silty CLAY: Light greyish blue mottled brown and orange. Low plasticity. Sensitive. (Alluvium)	M		
	0.8	Peak = 150kPa Residual = 66kPa	21.8	1		CH: Silty CLAY: Brownish grey mottled orange. High plasticity. Moderately sensitive. (Alluvium)			
	1.2	Peak = 126kPa Residual = 66kPa							
	1.6	Peak = 114kPa Residual = 51kPa							
	2.0	Peak = 141kPa Residual = 66kPa	20.8	2		CH: CLAY with some silt: Greenish grey. High plasticity. Insensitive to moderately sensitive. (Alluvium) ... *from 1.80m to 1.90m, becoming mottled yellow.*		VSt	
	2.4	Peak = 153kPa Residual = 87kPa				... *from 2.30m to 2.40m, becoming mottled yellow.*	M to W		
	2.8	Peak = 168kPa Residual = 120kPa		3					
	3.2	Peak = 141kPa Residual = 78kPa				... *at 3.20m, becoming brown.*			
	3.4	Peak = 108kPa Residual = 60kPa	19.3			OL: Organic CLAY: Black. Low plasticity. Insensitive. (Alluvium)			
	3.8	Peak = 66kPa Residual = 57kPa	18.9			ML: SILT with some clay: Yellow mottled grey and orange. Low plasticity. Insensitive. (Alluvium)	W to S	St	
	4.0	Peak = >210kPa	18.7	4		ML: Clayey SILT with minor fine to coarse sand: Grey mottled black. Low plasticity. Insensitive. (Northland Allochthon)		H	
	4.4	Peak = 114kPa Residual = 87kPa	18.3			CH: CLAY with minor silt: Light grey mottled orange. High plasticity. Insensitive. (Northland Allochthon)	M to W	VSt	
	4.8	Peak = 114kPa Residual = 96kPa		5		Borehole terminated at 5.0 m			

Termination Reason: Target Depth Reached.
Shear Vane No: 1824 DCP No:
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA02-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: KvR Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749143.0mE; 5970972.5mN Projection: NZTM
Elevation: 19.00m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			19.0			ML: Clayey SILT: Dark brown mottled trace black. Low plasticity. Moderately sensitive. (Colluvium)	D to M		
	0.4	Peak = 123kPa Residual = 52kPa							
			18.4			CH: CLAY: Light grey mottled trace dark orange. High plasticity. Moderately sensitive. (Colluvium)		VSt	
	0.8	Peak = 104kPa Residual = 55kPa		1			M		
	1.2	Peak = 49kPa Residual = 25kPa						F	
	1.4	Peak = 55kPa Residual = 25kPa							
						... from 1.50m to 1.70m, becoming brownish grey.			
	1.6	Peak = 58kPa Residual = 28kPa							
						... from 1.70m to 1.80m, becoming with some orange limonite staining.			
	2.0	Peak = 52kPa Residual = 21kPa		2			M to W		
	2.4	Peak = 52kPa Residual = 25kPa						St	
	2.8	Peak = 77kPa Residual = 34kPa							
			16.1			CH: CLAY with some silt: Bluish grey. High plasticity. Insensitive. Residual soil. (Northland Allochthon)			
	3.0	Peak = 71kPa Residual = 34kPa		3					
	3.2	Peak = 80kPa Residual = 49kPa					W		
	3.6	Peak = 55kPa Residual = 37kPa							
			15.1			SP: Completely weathered bluish grey mottled white LIMESTONE: Extremely Weak. Recovered as fine to medium SAND with minor silt. Low plasticity. Insensitive. (Northland Allochthon)			
	4.0	Peak = UTP		4		*... at 3.90m, possible failure plane.*	M	H	
						Borehole terminated at 4.2 m			
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1702 DCP No: 05
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA03-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: LSW Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749177.0mE; 5970839.0mN Projection: NZTM
Elevation: 10.80m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			10.8			OL: TOPSOIL: Brown. Low plasticity.			
			10.7			(Topsoil)			
						ML: Clayey SILT with trace fine sand: Brown. Low plasticity. Moderately sensitive to sensitive. (Waitemata Group)	D		
	0.4	Peak = >200kPa Residual = 39kPa						H	
	0.8	Peak = 156kPa Residual = 45kPa					M		
						... from 0.90m to 1.10m, becoming with limonite inclusions <20mm.			
				1				VSt	
			9.7			ML: SILT with some clay and trace fine sand: Light grey mottled orange. Low plasticity. Insensitive. Friable. (Waitemata Group)			
	1.2	Peak = >210kPa							
	1.6	Peak = >210kPa						H	
	2.0	Peak = 69kPa Residual = 24kPa		2		*... at 2.00m, becoming brown.*			
								St	
	2.2	Peak = UTP					M to W		
	2.4	Peak = UTP							
	2.8	Peak = UTP				*... at 2.80m, becoming with limonite inclusions <20mm.*		H	
				3					
						Borehole terminated at 3.5 m			
				4					
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1824 DCP No:
Remarks: Groundwater not encountered. Hand auger spinning with no recovery. Unable to DCP.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA04-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: KvR Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749146.2mE; 5970787.4mN Projection: NZTM
Elevation: 13.00m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			13.0			OL: TOPSOIL: Brown. Low plasticity. (Topsoil)	D		
			12.8			ML: SILT with trace clay and minor fine sand: Light brown mottled black and light orange. Low plasticity. Insensitive. (Uncontrolled Fill)			
	0.4	Peak = >215kPa							
	0.6	Peak = >215kPa							
			12.3			ML: Fine Sandy SILT: Light brownish white mottled trace dark orange. Low plasticity. Insensitive. (Waitemata Group)		H	
	0.8	Peak = >200kPa Residual = 64kPa		1					
	1.2	Peak = >215kPa							
			11.7			SM: Silty fine SAND: Light brownish white, mottled minor orange and trace dark orange. Uniformly graded. Insensitive. (Waitemata Group)			11
									13
									12
									14
									12
							M	D	15
									12
				2					12
						... at 2.10m, becoming mottled grey.			11
									11
									11
	2.4	Peak = >215kPa	10.6			ML: Fine Sandy SILT: Light brown mottled minor orange. Low plasticity. Insensitive. (Waitemata Group)			
	2.8	Peak = >215kPa				... from 2.80m to 2.90m, becoming greyish brown mottled dark orange with limonite staining.		VSt	
						... from 2.90m to 3.40m, becoming grey mottled orange.			
	3.1	Peak = 190kPa Residual = 61kPa		3					20
						Borehole terminated at 3.4 m			20
				4					
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1702 DCP No: 5
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA05-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: LSW Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749130.0mE; 5970774.0mN Projection: NZTM
Elevation: 4.00m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
	0.4	Peak = 159kPa Residual = 81kPa	4.0	0		ML: Fine to medium Sandy SILT with trace clay: Brown. Low plasticity. Friable. (Waitemata Group)	M	VSt	
	0.8	Peak = >210kPa						H	
				1				D	16
									15
						Borehole terminated at 1.1 m			20
				2					
				3					
				4					
				5					

Dynamic Cone Penetrometer (Blows/100mm): 5 10 15

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1824 DCP No: 5
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA06-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: LSW Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749152.0mE; 5970840.0mN Projection: NZTM
Elevation: 15.00m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			15.0			OL: TOPSOIL: Brown. Low plasticity.	D		
			14.9			(Topsoil)			
						CL: Silty CLAY with trace fine sand: Brown mottled orange and dark brown. Low plasticity. Insensitive. (Waitemata Group)			
	0.4	Peak = >210kPa						H	
	0.8	Peak = >210kPa					M		
			14.1			ML: Fine to medium Sandy SILT with minor clay: Yellowish brown. Low plasticity. Insensitive. (Waitemata Group)			
				1					
	1.2	Peak = UTP				*... at 1.20m, becoming light orange.*			
	1.6	Peak = 126kPa Residual = 69kPa						VSt	
	2.0	Peak = 198kPa Residual = 48kPa		2		*... from 2.00m to 2.40m, becoming sensitive.*			
	2.4	Peak = 135kPa Residual = 126kPa	12.6			SP: Fine SAND with trace silt and trace clay: Light grey. Uniformly graded. Insensitive. (Waitemata Group)			
			12.3			CL: Silty CLAY with some fine sand: Brown mottled orange. Low plasticity. Insensitive. (Waitemata Group)			
	2.8	Peak = >210kPa						H	
				3			M to W		
	3.2	Peak = 153kPa Residual = 81kPa	11.8			ML: SILT with some clay and trace fine sand: Light brown mottled orange. Low plasticity. Insensitive. (Waitemata Group)		VSt	
	3.6	Peak = >210kPa							
	4.0	Peak = UTP		4		*... at 4.00m, becoming with limonite inclusions <5mm.*		H	
	4.4	Peak = UTP							18
									18
									15
						Borehole terminated at 4.6 m			20
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1824 DCP No: 5
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA07-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: KvR Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749096.0mE; 5970924.0mN Projection: NZTM
Elevation: 22.75m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			22.8			OL: TOPSOIL: Dark brown. Low plasticity. Some rootlets. (Topsoil)	D		
			22.6			ML: SILT with trace clay: Brownish grey mottled minor black and orange. Low plasticity. Moderately sensitive. (Northland Allochthon)	D to M	H	
	0.4	Peak = >215kPa				*... from 0.40m to 0.80m, becoming insensitive.*			
						... at 0.60m, becoming light grey mottled minor black and orange.			
						... at 0.70m, becoming with trace root fragments.			
	0.8	Peak = >200kPa Residual = 31kPa				*... from 0.80m to 1.60m, becoming sensitive*			
				1					
	1.2	Peak = 184kPa Residual = 40kPa							
	1.4	Peak = 172kPa Residual = 37kPa	21.4			ML: SILT with trace clay and some fine to medium sand: Light grey mottled minor black and orange. Low plasticity. Sensitive. (Northland Allochthon)			
	1.6	Peak = 101kPa Residual = 37kPa				*... from 1.60m to 2.80m, becoming moderately sensitive to sensitive.*			
	2.0	Peak = 187kPa Residual = 37kPa		2		*... from 2.00m to 2.10m, becoming with some orange limonite staining.*		VSt	
						... at 2.10m, becoming greyish white mottle minor orange trace black and brown.			
	2.4	Peak = 178kPa Residual = 61kPa							
			20.0			ML: SILT with trace clay and some fine to coarse sand: Greyish white mottled minor orange trace black and brown. Low plasticity. (Northland Allochthon)	M	H	
	2.8	Peak = >215kPa				*... from 2.80m to 4.00m, becoming insensitive.*			
				3					
	3.2	Peak = >215kPa				*... from 3.20m to 3.50m, becoming with orange limonite staining.*			
						... at 3.50m, becoming grey mottled minor dark orange and white trace black.			
	3.6	Peak = UTP							
	4.0	Peak = >200kPa Residual = 68kPa		4		*... at 4.00m, becoming moderately sensitive.*			
						Borehole terminated at 4.2 m			
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1702 DCP No:
Remarks: Groundwater not encountered. Hand auger spinning with no recovery. Unable to DCP.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA08-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: LSW Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749084.0mE; 5970898.0mN Projection: NZTM
Elevation: 20.40m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			20.4			OL: TOPSOIL: Brown. Low plasticity. (Topsoil)	D		
			20.3			ML: Clayey SILT: Brown mottled orange and dark brown. Low plasticity. Sensitive. (Colluvium)			
	0.4	Peak = 159kPa Residual = 39kPa					M	VSt	
	0.8	Peak = >210kPa							
			19.5	1		ML: Completely weathered grey LIMESTONE: Extremely weak. Recovered as SILT with minor clay. Low plasticity. Insensitive. (Northland Allochthon)		H	
						Borehole terminated at 1.1 m			
				2					
				3					
				4					
				5					

Dynamic Cone Penetrometer (Blows/100mm): 5, 10, 15

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1824 DCP No:
Remarks: Groundwater not encountered. Hand auger spinning with no recovery. Unable to DCP.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

HAND AUGER BOREHOLE LOG - HA09-21

Client: The Kilns Limited
Project: 36 Sandspit Road
Site Location: Warkworth
Project No.: AKL2021-0060
Date: 19/03/2021
Borehole Location: Refer to Site Plan Logged by: KvR Checked by: TE Scale: 1:25 Sheet 1 of 1

Position: 1749093.9mE; 5970872.4mN Projection: NZTM
Elevation: 13.50m Datum: AUCKHT1946 Survey Source: Handheld GPS

Groundwater	Samples & Insitu Tests: Depth	Samples & Insitu Tests: Type & Results	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: Soil symbol; soil type; colour; structure; bedding; plasticity; sensitivity; additional comments. (origin/geological unit) Rock: Colour; fabric; rock name; additional comments. (origin/geological unit))	Moisture Condition	Consistency/ Relative Density	Dynamic Cone Penetrometer (Blows/100mm)
			13.5			OL: TOPSOIL: Dark brown. Low plasticity. Some rootlets. (Topsoil)	M		
			13.3			MH: Clayey SILT: Light brown mottled trace orange, white and dark brown. High plasticity. Moderately sensitive. (Colluvium)	M to W		
	0.4	Peak = 129kPa Residual = 40kPa							
			12.9			ML: SILT with minor fine to coarse sand: Grey mottled white and trace orange. Low plasticity. Moderately sensitive to sensitive. Residual soil. (Northland Allochthon)		VSt	
	0.8	Peak = 123kPa Residual = 28kPa		1			M		
	1.2	Peak = 123kPa Residual = 40kPa	12.3			SP: Completely weathered grey mottled minor white LIMESTONE: Extremely weak. Recovered as fine SAND. Uniformly graded. Moderately sensitive. (Northland Allochthon)			
						Borehole terminated at 1.4 m			20
				2					
				3					
				4					
				5					

Termination Reason: Refusal on Hard Ground.
Shear Vane No: 1702 DCP No: 5
Remarks: Groundwater not encountered.

This report is based on the attached field description for soil and rock, CMW Geosciences - Field Logging Guide, Revision 3 - April 2018.

APPENDIX D SITE PHOTOGRAPHS

PLATE 1: Historic iron water pipes in T08

PLATE 2: Historic tram line demolition waste in T06

PLATE 3: Topsoil horizon with no mixing of surface burnt organic matter in T05

PLATE 4: Green waste and timber for burning at T01 (demarcated by tape)

PLATE 5: T10 in footprint of historic dwelling at crest of knoll

PLATE 6: Excavator at T10 on knoll containing historic dwelling footprint

PLATE 7: Septic tanks west of minor dwelling (SS2)

PLATE 8: Septic tank at 34 Sandspit Road

PLATE 9: Septic tank at 36 Sandspit Road within thick vegetation

PLATE 10: Suspected ACM panels and bags containing suspected ACM fragments at southern end of storeroom

PLATE 11: Northern car port (facing west)

PLATE 12: Northern car port from down gradient (facing east)

APPENDIX E LABORATORY TRANSCRIPTS

DIGITAL CoC SENT TO SWATI

CHAIN OF CUSTODY RECORD

☐ Sydney Laboratory ☐ Brisbane Laboratory ☐ Perth Laboratory ☐ Melbourne Laboratory

Company	Geosciences Ltd	Project №	J1568a
Address	47 Clyde Road, Browns Bay, Auckland, 0630	Project Name	36 Sandspit Road
Contact Name	Chris Davies	Project Manager	Carl O'Brien
Phone №	09 475 0222	EDD Format	
Special Directions		Sampler(s)	CD
Purchase Order		Handed over by	CD
Quote ID №		Email for Invoice	elmarie@geosciences.co.nz
		Email for Results	chris@geosciences.co.nz carl@geosciences.co.nz

Required Turnaround Time (TAT): ☐ Overnight (reporting by 9am) ☐ Same day ☐ 1 day ☐ 2 days ☐ 3 days ☑ 5 days (Standard) ☐ Other( )

№	Client Sample ID	Sampled Date/Time	Matrix	Moisture Set	Metals M8 (NZ ME)	Metals M7 (NZ ME)	Organochlorine Pesticides (NZ ME)	Polycyclic Aromatic Hydrocarbons (NZ ME)	Total Petroleum Hydrocarbons (NZ ME 1999)	Asbestos - WA guidelines	Asbestos - AS4964	Eurofins | mgt Suite B22-NZ: OCP, Metals (As,Cu,Pb) (NZ ME)	Arsenic	Boron	Lead	pH	500mL Plastic	250mL Plastic	125mL Plastic	200mL Amber Glass	40mL VOA vial	500mL PFAS Bottle	Jar (Glass or HDPE)	Other (Asbestos AS4964, WA Guidelines)	Sample Comments / Dangerous Goods Hazard Warning
1	SS1 (0-75mm)	14/01/22	S			X		X															1		
2	SS2 (500mm)	14/01/22	S			X																	1		
3	SS3 (0-75mm)	14/01/22	S			X																	1		
4	SS4 (400mm)	14/01/22	S			X																	1		
5	SS5 (500mm)	14/01/22	S			X																	1		
6	SS6 (100mm)	14/01/22	S			X																	1		
7	SS7 (500mm)	14/01/22	S			X																	1		
8	SS8 (100mm)	14/01/22	S			X																	1		
9	SS9 (100mm)	14/01/22	S			X																	1		
10	SS10 (0-75mm)	14/01/22	S			X		X															1		
11	SS11 (0-75mm)	14/01/22	S			X		X															1		
12	SS12 (0-75mm)	14/01/22	S												X				1						
13	SS13 (0-75mm)	14/01/22	S												X				1						
14	SS14 (0-75mm)	14/01/22	S												X				1						
15	SS14 (0-50mm)	14/01/22	S							X														1	
16	SS15 (0-75mm)	14/01/22	S												X				1						
17	SS15 (0-50mm)	14/01/22	S							X														1	
18	SS16 (0-75mm)	14/01/22	S												X				1						
19	T 01 (0-75mm)	13/01/22	S			X		X		X				X									1	1	
20	T 02 (0-75mm)	13/01/22	S										X	X									1		
21	T 03 (0-75mm)	13/01/22	S										X	X									1		
22	T 04 (0-75mm)	13/01/22	S										X	X									1		
23	T 05 (0-75mm)	13/01/22	S			X		X		X				X									1	1	
24	T 06 (0-75mm)	13/01/22	S					X					X	X		X							1		
25	T 07 (0-75mm)	13/01/22	S										X	X									1		
26	T 08 (0-75mm)	13/01/22	S					X					X	X		X							1		
27	T 09 (0-75mm)	13/01/22	S										X	X									1		
28	T 10 N (0-75mm)	14/01/22	S												X								1		
29	T 10 S (0-75mm)	14/01/22	S												X								1		
30	T 10 E (0-75mm)	14/01/22	S												X								1		
31	T 10 W (0-75mm)	14/01/22	S												X								1		
33	T 01 (300mm)	13/01/22	S																				1	1	HOLD COLD
	Total Counts					13		7		4			7	9	9	2			5				25	5	

Date/Time: 17/1/22 1:00PM
Chilled: (Yes) No
Temp: 8.1
Correction: +0.1
Final Temp: 8.2

Method of Shipment	☑ Courier (#) ☐ Hand Delivered ☐ Postal	Name: Chris Davies	Signature: CD	Date: 17/01/2022	Time
Eurofins | mgt Laboratory Use Only	Received By: Kyla Hlan	SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature: [signature]	Date / Time	Temperature
	Received By	SYD | BNE | MEL | PER | ADL | NTL | DRW	Signature	Date / Time	Report №: 855710

Eurofins Environment Testing Australia Pty Ltd trading as Eurofins \| mgt

Certificate of Analysis

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

Geosciences Ltd
First Floor, 47 Clyde Road
Browns Bay
Auckland NZ 0630

Attention:	Chris Davies
Report	855710-AID
Project Name	36 SANDSPIT ROAD
Project ID	J1568A
Received Date	Jan 17, 2022
Date Reported	Jan 24, 2022

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. *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. *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. *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. *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). 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). *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.*

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Project Name 36 SANDSPIT ROAD
Project ID J1568A
Date Sampled Jan 13, 2022 to Jan 14, 2022
Report 855710-AID

Client Sample ID	Eurofins Sample No.	Date Sampled	Sample Description	Result
SS14 (0-50MM)	22-Ja12656	Jan 14, 2022	Approximate Sample 528g Sample consisted of: Fine grained soil and rocks	No asbestos detected at the reporting limit of 0.001% w/w.* Organic fibre detected. No trace asbestos detected.
SS15 (0-50MM)	22-Ja12658	Jan 14, 2022	Approximate Sample 651g Sample consisted of: Fine grained soil and rocks	No asbestos detected at the reporting limit of 0.001% w/w.* Organic fibre detected. No trace asbestos detected.
T 01 (0-75MM)	22-Ja12660	Jan 13, 2022	Approximate Sample 685g Sample consisted of: Fine grained soil and rocks	No asbestos detected at the reporting limit of 0.001% w/w.* Organic fibre detected. No trace asbestos detected.
T 05 (0-75MM)	22-Ja12664	Jan 13, 2022	Approximate Sample 660g Sample consisted of: Fine grained soil and rocks	No asbestos detected at the reporting limit of 0.001% w/w.* Organic fibre detected. 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	Jan 19, 2022	Indefinite

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Company Name: Geosciences Ltd
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Project Name: 36 SANDSPIT ROAD
Project ID: J1568A

Order No.:
Report #: 855710
Phone: 0011 64 9 4760 454
Fax:

Received: Jan 17, 2022 1:00 PM
Due: Jan 24, 2022
Priority: 5 Day
Contact Name: Chris Davies

Eurofins Analytical Services Manager : Karishma Patel

Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**									
1	SS1 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12642							X	X	X
2	SS2 (500MM)	Jan 14, 2022		Soil	K22-Ja12643							X	X	
3	SS3 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12644							X	X	
4	SS4 (400MM)	Jan 14, 2022		Soil	K22-Ja12645							X	X	
5	SS5 (500MM)	Jan 14, 2022		Soil	K22-Ja12646							X	X	
6	SS6 (100MM)	Jan 14, 2022		Soil	K22-Ja12647							X	X	
7	SS7 (500MM)	Jan 14, 2022		Soil	K22-Ja12648							X	X	
8	SS8 (100MM)	Jan 14, 2022		Soil	K22-Ja12649							X	X	
9	SS9 (100MM)	Jan 14, 2022		Soil	K22-Ja12650							X	X	
10	SS10 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12651							X	X	X
11	SS11 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12652							X	X	X

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Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
12	SS12 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12653					X		X		
13	SS13 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12654					X		X		
14	SS14 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12655					X		X		
15	SS14 (0-50MM)	Jan 14, 2022		Soil	K22-Ja12656		X							
16	SS15 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12657					X		X		
17	SS15 (0-50MM)	Jan 14, 2022		Soil	K22-Ja12658		X							
18	SS16 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12659					X		X		
19	T 01 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12660		X	X				X	X	X
20	T 02 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12661	X		X				X		

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Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
21	T 03 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12662	X		X				X		
22	T 04 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12663	X		X				X		
23	T 05 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12664		X	X				X	X	X
24	T 06 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12665	X		X			X	X		X
25	T 07 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12666	X		X				X		
26	T 08 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12667	X		X			X	X		X
27	T 09 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12668	X		X				X		
28	T 10 N (0-75MM)	Jan 14, 2022		Soil	K22-Ja12669					X		X		
29	T 10 S (0-75MM)	Jan 14, 2022		Soil	K22-Ja12670					X		X		
30	T 10 E (0-75MM)	Jan 14, 2022		Soil	K22-Ja12671					X		X		
31	T 10 W (0-75MM)	Jan 14, 2022		Soil	K22-Ja12672					X		X		

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Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
32	T 01 (300MM)	Jan 13, 2022		Soil	K22-Ja12673				X					
Test Counts						7	4	9	1	9	2	29	13	7

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:

Laura Liu	Senior Analyst-Asbestos

Authorised by:

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

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

Geosciences Ltd
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Browns Bay
Auckland NZ 0630

Attention: **Chris Davies**

Report **855710-S**
Project name 36 SANDSPIT ROAD
Project ID J1568A
Received Date Jan 17, 2022

Client Sample ID			**SS1 (0-75MM)**	**SS2 (500MM)**	**SS3 (0-75MM)**	**SS4 (400MM)**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**K22-Ja12642**	**K22-Ja12643**	**K22-Ja12644**	**K22-Ja12645**
Date Sampled			**Jan 14, 2022**	**Jan 14, 2022**	**Jan 14, 2022**	**Jan 14, 2022**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons (NZ MfE)						
Acenaphthene	0.03	mg/kg	< 0.03	-	-	-
Acenaphthylene	0.03	mg/kg	< 0.03	-	-	-
Anthracene	0.03	mg/kg	< 0.03	-	-	-
Benz(a)anthracene	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene TEQ (lower bound)*	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene TEQ (medium bound)*	0.03	mg/kg	0.04	-	-	-
Benzo(a)pyrene TEQ (upper bound)*	0.03	mg/kg	0.08	-	-	-
Benzo(b&j)fluoranthene[N07]	0.03	mg/kg	< 0.03	-	-	-
Benzo(g.h.i)perylene	0.03	mg/kg	< 0.03	-	-	-
Benzo(k)fluoranthene	0.03	mg/kg	< 0.03	-	-	-
Chrysene	0.03	mg/kg	< 0.03	-	-	-
Dibenz(a.h)anthracene	0.03	mg/kg	< 0.03	-	-	-
Fluoranthene	0.03	mg/kg	< 0.03	-	-	-
Fluorene	0.03	mg/kg	< 0.03	-	-	-
Indeno(1.2.3-cd)pyrene	0.03	mg/kg	< 0.03	-	-	-
Naphthalene	0.1	mg/kg	< 0.1	-	-	-
Phenanthrene	0.03	mg/kg	< 0.03	-	-	-
Pyrene	0.03	mg/kg	< 0.03	-	-	-
p-Terphenyl-d14 (surr.)	1	%	109	-	-	-
2-Fluorobiphenyl (surr.)	1	%	93	-	-	-
Metals M7 (NZ MfE)						
Arsenic	0.1	mg/kg	0.8	14	2.0	1.6
Cadmium	0.01	mg/kg	0.08	0.13	0.24	< 0.01
Chromium	0.1	mg/kg	6.4	18	12	14
Copper	0.1	mg/kg	1.7	21	13	3.1
Lead	0.1	mg/kg	6.5	33	220	8.7
Nickel	0.1	mg/kg	1.0	2.4	2.6	3.0
Zinc	5	mg/kg	6.2	46	160	6.3
% Moisture	1	%	13	21	21	26

Client Sample ID			SS5 (500MM)	SS6 (100MM)	SS7 (500MM)	SS8 (100MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12646	K22-Ja12647	K22-Ja12648	K22-Ja12649
Date Sampled			Jan 14, 2022	Jan 14, 2022	Jan 14, 2022	Jan 14, 2022
Test/Reference	LOR	Unit				
Metals M7 (NZ MfE)						
Arsenic	0.1	mg/kg	3.0	2.3	3.9	0.9
Cadmium	0.01	mg/kg	0.04	0.10	0.04	0.03
Chromium	0.1	mg/kg	31	8.3	8.0	4.9
Copper	0.1	mg/kg	8.0	9.0	1.1	1.9
Lead	0.1	mg/kg	12	20	6.3	5.0
Nickel	0.1	mg/kg	6.6	3.2	1.0	0.8
Zinc	5	mg/kg	20	36	< 5	5.4
% Moisture	1	%	22	16	26	17

Client Sample ID			SS9 (100MM)	SS10 (0-75MM)	SS11 (0-75MM)	SS12 (0-75MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12650	K22-Ja12651	K22-Ja12652	K22-Ja12653
Date Sampled			Jan 14, 2022	Jan 14, 2022	Jan 14, 2022	Jan 14, 2022
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons (NZ MfE)						
Acenaphthene	0.03	mg/kg	-	< 0.03	< 0.03	-
Acenaphthylene	0.03	mg/kg	-	< 0.03	< 0.03	-
Anthracene	0.03	mg/kg	-	< 0.03	< 0.03	-
Benz(a)anthracene	0.03	mg/kg	-	< 0.03	< 0.03	-
Benzo(a)pyrene	0.03	mg/kg	-	< 0.03	< 0.03	-
Benzo(a)pyrene TEQ (lower bound)*	0.03	mg/kg	-	< 0.03	< 0.03	-
Benzo(a)pyrene TEQ (medium bound)*	0.03	mg/kg	-	0.04	0.04	-
Benzo(a)pyrene TEQ (upper bound)*	0.03	mg/kg	-	0.08	0.08	-
Benzo(b&j)fluoranthene[N07]	0.03	mg/kg	-	< 0.03	< 0.03	-
Benzo(g.h.i)perylene	0.03	mg/kg	-	< 0.03	< 0.03	-
Benzo(k)fluoranthene	0.03	mg/kg	-	< 0.03	< 0.03	-
Chrysene	0.03	mg/kg	-	< 0.03	< 0.03	-
Dibenz(a.h)anthracene	0.03	mg/kg	-	< 0.03	< 0.03	-
Fluoranthene	0.03	mg/kg	-	< 0.03	< 0.03	-
Fluorene	0.03	mg/kg	-	< 0.03	< 0.03	-
Indeno(1.2.3-cd)pyrene	0.03	mg/kg	-	< 0.03	< 0.03	-
Naphthalene	0.1	mg/kg	-	< 0.1	< 0.1	-
Phenanthrene	0.03	mg/kg	-	< 0.03	< 0.03	-
Pyrene	0.03	mg/kg	-	< 0.03	< 0.03	-
p-Terphenyl-d14 (surr.)	1	%	-	92	64	-
2-Fluorobiphenyl (surr.)	1	%	-	83	57	-
Metals M7 (NZ MfE)						
Arsenic	0.1	mg/kg	1.2	64	8.6	-
Cadmium	0.01	mg/kg	0.04	0.79	0.13	-
Chromium	0.1	mg/kg	9.2	32	11	-
Copper	0.1	mg/kg	3.6	41	9.6	-
Lead	0.1	mg/kg	8.1	36	41	-
Nickel	0.1	mg/kg	1.4	12	2.9	-
Zinc	5	mg/kg	7.5	830	97	-
% Moisture	1	%	19	13	22	8.6
Metals M8 (NZ MfE)						
Lead	0.1	mg/kg	-	-	-	89

Client Sample ID			SS13 (0-75MM)	SS14 (0-75MM)	SS15 (0-75MM)	SS16 (0-75MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12654	K22-Ja12655	K22-Ja12657	K22-Ja12659
Date Sampled			Jan 14, 2022	Jan 14, 2022	Jan 14, 2022	Jan 14, 2022
Test/Reference	LOR	Unit				
% Moisture	1	%	18	11	22	11
Metals M8 (NZ MfE)						
Lead	0.1	mg/kg	28	150	26	28

Client Sample ID			T 01 (0-75MM)	T 02 (0-75MM)	T 03 (0-75MM)	T 04 (0-75MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12660	K22-Ja12661	K22-Ja12662	K22-Ja12663
Date Sampled			Jan 13, 2022	Jan 13, 2022	Jan 13, 2022	Jan 13, 2022
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons (NZ MfE)						
Acenaphthene	0.03	mg/kg	< 0.03	-	-	-
Acenaphthylene	0.03	mg/kg	< 0.03	-	-	-
Anthracene	0.03	mg/kg	< 0.03	-	-	-
Benz(a)anthracene	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene TEQ (lower bound)*	0.03	mg/kg	< 0.03	-	-	-
Benzo(a)pyrene TEQ (medium bound)*	0.03	mg/kg	0.04	-	-	-
Benzo(a)pyrene TEQ (upper bound)*	0.03	mg/kg	0.08	-	-	-
Benzo(b&j)fluoranthene[N07]	0.03	mg/kg	< 0.03	-	-	-
Benzo(g.h.i)perylene	0.03	mg/kg	< 0.03	-	-	-
Benzo(k)fluoranthene	0.03	mg/kg	< 0.03	-	-	-
Chrysene	0.03	mg/kg	< 0.03	-	-	-
Dibenz(a.h)anthracene	0.03	mg/kg	< 0.03	-	-	-
Fluoranthene	0.03	mg/kg	< 0.03	-	-	-
Fluorene	0.03	mg/kg	< 0.03	-	-	-
Indeno(1.2.3-cd)pyrene	0.03	mg/kg	< 0.03	-	-	-
Naphthalene	0.1	mg/kg	< 0.1	-	-	-
Phenanthrene	0.03	mg/kg	< 0.03	-	-	-
Pyrene	0.03	mg/kg	< 0.03	-	-	-
p-Terphenyl-d14 (surr.)	1	%	108	-	-	-
2-Fluorobiphenyl (surr.)	1	%	80	-	-	-
Metals M7 (NZ MfE)						
Arsenic	0.1	mg/kg	17	-	-	-
Cadmium	0.01	mg/kg	0.10	-	-	-
Chromium	0.1	mg/kg	24	-	-	-
Copper	0.1	mg/kg	11	-	-	-
Lead	0.1	mg/kg	7.2	-	-	-
Nickel	0.1	mg/kg	1.0	-	-	-
Zinc	5	mg/kg	19	-	-	-
% Moisture	1	%	27	9.5	14	25
Metals M8 (NZ MfE)						
Arsenic	0.1	mg/kg	-	2.5	1.2	3.3
Heavy Metals						
Boron	10	mg/kg	41	< 10	< 10	< 10

Client Sample ID			T 05 (0-75MM)	T 06 (0-75MM)	T 07 (0-75MM)	T 08 (0-75MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12664	K22-Ja12665	K22-Ja12666	K22-Ja12667
Date Sampled			Jan 13, 2022	Jan 13, 2022	Jan 13, 2022	Jan 13, 2022
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons (NZ MfE)						
Acenaphthene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Acenaphthylene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Anthracene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Benz(a)anthracene	0.03	mg/kg	< 0.03	0.03	-	< 0.03
Benzo(a)pyrene	0.03	mg/kg	< 0.03	0.03	-	< 0.03
Benzo(a)pyrene TEQ (lower bound)*	0.03	mg/kg	< 0.03	0.05	-	< 0.03
Benzo(a)pyrene TEQ (medium bound)*	0.03	mg/kg	0.04	0.07	-	0.04
Benzo(a)pyrene TEQ (upper bound)*	0.03	mg/kg	0.08	0.08	-	0.08
Benzo(b&j)fluoranthene[N07]	0.03	mg/kg	< 0.03	0.10	-	< 0.03
Benzo(g.h.i)perylene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Benzo(k)fluoranthene	0.03	mg/kg	< 0.03	0.05	-	< 0.03
Chrysene	0.03	mg/kg	< 0.03	0.05	-	< 0.03
Dibenz(a.h)anthracene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Fluoranthene	0.03	mg/kg	< 0.03	0.03	-	< 0.03
Fluorene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Indeno(1.2.3-cd)pyrene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Naphthalene	0.1	mg/kg	< 0.1	< 0.1	-	< 0.1
Phenanthrene	0.03	mg/kg	< 0.03	< 0.03	-	< 0.03
Pyrene	0.03	mg/kg	< 0.03	0.03	-	< 0.03
p-Terphenyl-d14 (surr.)	1	%	97	100	-	105
2-Fluorobiphenyl (surr.)	1	%	84	81	-	92
Metals M7 (NZ MfE)						
Arsenic	0.1	mg/kg	2.3	-	-	-
Cadmium	0.01	mg/kg	0.07	-	-	-
Chromium	0.1	mg/kg	27	-	-	-
Copper	0.1	mg/kg	5.5	-	-	-
Lead	0.1	mg/kg	13	-	-	-
Nickel	0.1	mg/kg	5.4	-	-	-
Zinc	5	mg/kg	28	-	-	-
% Moisture	1	%	17	11	11	14
pH (1:5 Aqueous extract at 25°C as rec.)	0.1	pH Units	-	5.9	-	5.7
Metals M8 (NZ MfE)						
Arsenic	0.1	mg/kg	-	1.4	1.0	1.2
Heavy Metals						
Boron	10	mg/kg	< 10	< 10	< 10	< 10

Client Sample ID			T 09 (0-75MM)	T 10 N (0-75MM)	T 10 S (0-75MM)	T 10 E (0-75MM)
Sample Matrix			Soil	Soil	Soil	Soil
Eurofins Sample No.			K22-Ja12668	K22-Ja12669	K22-Ja12670	K22-Ja12671
Date Sampled			Jan 13, 2022	Jan 14, 2022	Jan 14, 2022	Jan 14, 2022
Test/Reference	LOR	Unit				
% Moisture	1	%	14	16	11	16
Metals M8 (NZ MfE)						
Lead	0.1	mg/kg	-	1200	190	410
Arsenic	0.1	mg/kg	1.6	-	-	-

Client Sample ID			T 09 (0-75MM)	T 10 N (0-75MM)	T 10 S (0-75MM)	T 10 E (0-75MM)
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**K22-Ja12668**	**K22-Ja12669**	**K22-Ja12670**	**K22-Ja12671**
Date Sampled			**Jan 13, 2022**	**Jan 14, 2022**	**Jan 14, 2022**	**Jan 14, 2022**
Test/Reference	LOR	Unit				
Heavy Metals						
Boron	10	mg/kg	< 10	-	-	-

Client Sample ID			T 10 W (0-75MM)
Sample Matrix			**Soil**
Eurofins Sample No.			**K22-Ja12672**
Date Sampled			**Jan 14, 2022**
Test/Reference	LOR	Unit	
% Moisture	1	%	18
Metals M8 (NZ MfE)			
Lead	0.1	mg/kg	1200

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
Polycyclic Aromatic Hydrocarbons (NZ MfE)	Auckland	Jan 17, 2022	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water by GC MSMS			
Metals M7 (NZ MfE)	Auckland	Jan 17, 2022	6 Months
- Method: LTM-MET-3040 Metals in Waters Soils Sediments by ICP-MS			
pH (1:5 Aqueous extract at 25°C as rec.)	Auckland	Jan 18, 2022	7 Days
- Method: LTM-GEN-7090 pH in soil by ISE			
Metals M8 (NZ MfE)	Auckland	Jan 18, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Heavy Metals	Auckland	Jan 18, 2022	28 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
% Moisture	Auckland	Jan 17, 2022	14 Days
- Method: LTM-GEN-7080 Moisture Content in Soil by Gravimetry			

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Company Name: Geosciences Ltd
Address: First Floor, 47 Clyde Road
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Project Name: 36 SANDSPIT ROAD
Project ID: J1568A

Order No.:
Report #: 855710
Phone: 0011 64 9 4760 454
Fax:

Received: Jan 17, 2022 1:00 PM
Due: Jan 24, 2022
Priority: 5 Day
Contact Name: Chris Davies

Eurofins Analytical Services Manager : Karishma Patel

Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**									
1	SS1 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12642							X	X	X
2	SS2 (500MM)	Jan 14, 2022		Soil	K22-Ja12643							X	X	
3	SS3 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12644							X	X	
4	SS4 (400MM)	Jan 14, 2022		Soil	K22-Ja12645							X	X	
5	SS5 (500MM)	Jan 14, 2022		Soil	K22-Ja12646							X	X	
6	SS6 (100MM)	Jan 14, 2022		Soil	K22-Ja12647							X	X	
7	SS7 (500MM)	Jan 14, 2022		Soil	K22-Ja12648							X	X	
8	SS8 (100MM)	Jan 14, 2022		Soil	K22-Ja12649							X	X	
9	SS9 (100MM)	Jan 14, 2022		Soil	K22-Ja12650							X	X	
10	SS10 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12651							X	X	X
11	SS11 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12652							X	X	X

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Company Name: Geosciences Ltd
Address: First Floor, 47 Clyde Road
Browns Bay
Auckland NZ 0630

Project Name: 36 SANDSPIT ROAD
Project ID: J1568A

Order No.:
Report #: 855710
Phone: 0011 64 9 4760 454
Fax:

Received: Jan 17, 2022 1:00 PM
Due: Jan 24, 2022
Priority: 5 Day
Contact Name: Chris Davies

Eurofins Analytical Services Manager : Karishma Patel

Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
12	SS12 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12653					X		X		
13	SS13 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12654					X		X		
14	SS14 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12655					X		X		
15	SS14 (0-50MM)	Jan 14, 2022		Soil	K22-Ja12656		X							
16	SS15 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12657					X		X		
17	SS15 (0-50MM)	Jan 14, 2022		Soil	K22-Ja12658		X							
18	SS16 (0-75MM)	Jan 14, 2022		Soil	K22-Ja12659					X		X		
19	T 01 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12660		X	X				X	X	X
20	T 02 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12661	X		X				X		

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Company Name: Geosciences Ltd
Address: First Floor, 47 Clyde Road
Browns Bay
Auckland NZ 0630

Project Name: 36 SANDSPIT ROAD
Project ID: J1568A

Order No.:
Report #: 855710
Phone: 0011 64 9 4760 454
Fax:

Received: Jan 17, 2022 1:00 PM
Due: Jan 24, 2022
Priority: 5 Day
Contact Name: Chris Davies

Eurofins Analytical Services Manager : Karishma Patel

Sample Detail						Arsenic	Asbestos - WA guidelines	Boron	HOLD	Lead	pH (1:5 Aqueous extract at 25°C as rec.)	Moisture Set	Metals M7 (NZ MfE)	Polycyclic Aromatic Hydrocarbons (NZ MfE)
Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
21	T 03 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12662	X		X				X		
22	T 04 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12663	X		X				X		
23	T 05 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12664		X	X				X	X	X
24	T 06 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12665	X		X			X	X		X
25	T 07 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12666	X		X				X		
26	T 08 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12667	X		X			X	X		X
27	T 09 (0-75MM)	Jan 13, 2022		Soil	K22-Ja12668	X		X				X		
28	T 10 N (0-75MM)	Jan 14, 2022		Soil	K22-Ja12669					X		X		
29	T 10 S (0-75MM)	Jan 14, 2022		Soil	K22-Ja12670					X		X		
30	T 10 E (0-75MM)	Jan 14, 2022		Soil	K22-Ja12671					X		X		
31	T 10 W (0-75MM)	Jan 14, 2022		Soil	K22-Ja12672					X		X		

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Auckland Laboratory - IANZ# 1327						X	X	X	X	X	X	X	X	X
Christchurch Laboratory - IANZ# 1290														
External Laboratory														
32	T 01 (300MM)	Jan 13, 2022		Soil	K22-Ja12673				X					
Test Counts						7	4	9	1	9	2	29	13	7

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
µg/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 5.4
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% for Speciated Phenols & 50-150% for PFAS

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.4 where no positive PFAS results have been reported have been reviewed and no data was affected.

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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							
Polycyclic Aromatic Hydrocarbons (NZ MfE)							
Acenaphthene	mg/kg	< 0.03			0.03	Pass	
Acenaphthylene	mg/kg	< 0.03			0.03	Pass	
Anthracene	mg/kg	< 0.03			0.03	Pass	
Benz(a)anthracene	mg/kg	< 0.03			0.03	Pass	
Benzo(a)pyrene	mg/kg	< 0.03			0.03	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.03			0.03	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.03			0.03	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.03			0.03	Pass	
Chrysene	mg/kg	< 0.03			0.03	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.03			0.03	Pass	
Fluoranthene	mg/kg	< 0.03			0.03	Pass	
Fluorene	mg/kg	< 0.03			0.03	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.03			0.03	Pass	
Naphthalene	mg/kg	< 0.1			0.1	Pass	
Phenanthrene	mg/kg	< 0.03			0.03	Pass	
Pyrene	mg/kg	< 0.03			0.03	Pass	
Method Blank							
Metals M7 (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	
Nickel	mg/kg	< 0.1			0.1	Pass	
Zinc	mg/kg	< 5			5	Pass	
Method Blank							
Heavy Metals							
Boron	mg/kg	< 10			10	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons (NZ MfE)							
Acenaphthene	%	74			70-130	Pass	
Acenaphthylene	%	84			70-130	Pass	
Anthracene	%	81			70-130	Pass	
Benz(a)anthracene	%	71			70-130	Pass	
Benzo(a)pyrene	%	75			70-130	Pass	
Benzo(b&j)fluoranthene	%	82			70-130	Pass	
Benzo(g.h.i)perylene	%	81			70-130	Pass	
Benzo(k)fluoranthene	%	82			70-130	Pass	
Chrysene	%	91			70-130	Pass	
Dibenz(a.h)anthracene	%	70			70-130	Pass	
Fluoranthene	%	79			70-130	Pass	
Fluorene	%	80			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	75			70-130	Pass	
Naphthalene	%	88			70-130	Pass	
Phenanthrene	%	75			70-130	Pass	
Pyrene	%	84			70-130	Pass	
LCS - % Recovery							
Metals M7 (NZ MfE)							
Arsenic	%	103			80-120	Pass	
Cadmium	%	103			80-120	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium			%	108			80-120	Pass	
Copper			%	112			80-120	Pass	
Lead			%	104			80-120	Pass	
Nickel			%	118			80-120	Pass	
Zinc			%	116			80-120	Pass	
LCS - % Recovery									
Heavy Metals									
Boron			%	103			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons (NZ MfE)				Result 1					
Benzo(g.h.i)perylene	K22-Ja11716	NCP	%	89			70-130	Pass	
Dibenz(a.h)anthracene	K22-Ja11716	NCP	%	73			70-130	Pass	
Indeno(1.2.3-cd)pyrene	K22-Ja11716	NCP	%	74			70-130	Pass	
Spike - % Recovery									
Metals M7 (NZ MfE)				Result 1					
Arsenic	K22-Ja12649	CP	%	91			75-125	Pass	
Cadmium	K22-Ja12649	CP	%	95			75-125	Pass	
Chromium	K22-Ja12649	CP	%	95			75-125	Pass	
Copper	K22-Ja12649	CP	%	95			75-125	Pass	
Lead	K22-Ja12649	CP	%	97			75-125	Pass	
Nickel	K22-Ja12649	CP	%	102			75-125	Pass	
Zinc	K22-Ja12649	CP	%	103			75-125	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Boron	K22-Ja12649	CP	%	85			75-125	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons (NZ MfE)				Result 1					
Acenaphthene	K22-Ja12651	CP	%	71			70-130	Pass	
Acenaphthylene	K22-Ja12651	CP	%	81			70-130	Pass	
Anthracene	K22-Ja12651	CP	%	84			70-130	Pass	
Benz(a)anthracene	K22-Ja12651	CP	%	80			70-130	Pass	
Benzo(a)pyrene	K22-Ja12651	CP	%	82			70-130	Pass	
Benzo(b&j)fluoranthene	K22-Ja12651	CP	%	110			70-130	Pass	
Benzo(k)fluoranthene	K22-Ja12651	CP	%	82			70-130	Pass	
Chrysene	K22-Ja12651	CP	%	89			70-130	Pass	
Fluoranthene	K22-Ja12651	CP	%	98			70-130	Pass	
Fluorene	K22-Ja12651	CP	%	76			70-130	Pass	
Naphthalene	K22-Ja12651	CP	%	75			70-130	Pass	
Phenanthrene	K22-Ja12651	CP	%	70			70-130	Pass	
Pyrene	K22-Ja12651	CP	%	99			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Boron	K22-Ja18683	NCP	%	87			75-125	Pass	
Spike - % Recovery									
Metals M7 (NZ MfE)				Result 1					
Arsenic	K22-Ja12671	CP	%	95			75-125	Pass	
Cadmium	K22-Ja12671	CP	%	89			75-125	Pass	
Chromium	K22-Ja12671	CP	%	90			75-125	Pass	
Copper	K22-Ja12671	CP	%	86			75-125	Pass	
Nickel	K22-Ja12671	CP	%	99			75-125	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Polycyclic Aromatic Hydrocarbons (NZ MfE)				Result 1	Result 2	RPD			
Acenaphthene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Acenaphthylene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Anthracene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Benz(a)anthracene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Benzo(a)pyrene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Benzo(b&j)fluoranthene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Benzo(g.h.i)perylene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Benzo(k)fluoranthene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Chrysene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Dibenz(a.h)anthracene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Fluoranthene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Fluorene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Naphthalene	K22-Ja11714	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Phenanthrene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Pyrene	K22-Ja11714	NCP	mg/kg	< 0.03	< 0.03	<1	30%	Pass	
Duplicate									
Metals M7 (NZ MfE)				Result 1	Result 2	RPD			
Arsenic	K22-Ja12648	CP	mg/kg	3.9	3.8	1.0	30%	Pass	
Cadmium	K22-Ja12648	CP	mg/kg	0.04	0.05	11	30%	Pass	
Chromium	K22-Ja12648	CP	mg/kg	8.0	8.2	2.0	30%	Pass	
Copper	K22-Ja12648	CP	mg/kg	1.1	1.1	1.0	30%	Pass	
Lead	K22-Ja12648	CP	mg/kg	6.3	6.3	1.0	30%	Pass	
Nickel	K22-Ja12648	CP	mg/kg	1.0	1.0	3.0	30%	Pass	
Zinc	K22-Ja12648	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	K22-Ja12648	CP	%	26	26	3.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Boron	K22-Ja12648	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Duplicate									
Metals M7 (NZ MfE)				Result 1	Result 2	RPD			
Arsenic	K22-Ja12660	CP	mg/kg	17	20	19	30%	Pass	
Cadmium	K22-Ja12660	CP	mg/kg	0.10	0.10	4.0	30%	Pass	
Chromium	K22-Ja12660	CP	mg/kg	24	28	13	30%	Pass	
Copper	K22-Ja12660	CP	mg/kg	11	11	4.0	30%	Pass	
Lead	K22-Ja12660	CP	mg/kg	7.2	7.2	<1	30%	Pass	
Nickel	K22-Ja12660	CP	mg/kg	1.0	1.0	<1	30%	Pass	
Zinc	K22-Ja12660	CP	mg/kg	19	20	6.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	K22-Ja12660	CP	%	27	27	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Boron	K22-Ja12660	CP	mg/kg	41	42	2.0	30%	Pass	
Duplicate									
Metals M7 (NZ MfE)				Result 1	Result 2	RPD			
Arsenic	K22-Ja12661	CP	mg/kg	2.5	2.1	17	30%	Pass	
Cadmium	K22-Ja12661	CP	mg/kg	0.08	0.08	4.0	30%	Pass	
Chromium	K22-Ja12661	CP	mg/kg	5.6	5.0	10	30%	Pass	
Copper	K22-Ja12661	CP	mg/kg	5.3	4.1	25	30%	Pass	

Duplicate									
Metals M7 (NZ MfE)				Result 1	Result 2	RPD			
Lead	K22-Ja12661	CP	mg/kg	8.2	7.3	12	30%	Pass	
Nickel	K22-Ja12661	CP	mg/kg	1.0	0.8	20	30%	Pass	
Zinc	K22-Ja12661	CP	mg/kg	9.5	7.0	30	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Boron	K22-Ja12661	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
pH (1:5 Aqueous extract at 25°C as rec.)	K22-Ja12665	CP	pH Units	5.9	5.9	1.0	30%	Pass	
Duplicate									
Metals M7 (NZ MfE)				Result 1	Result 2	RPD			
Arsenic	K22-Ja12670	CP	mg/kg	4.6	5.2	13	30%	Pass	
Cadmium	K22-Ja12670	CP	mg/kg	0.32	0.34	6.0	30%	Pass	
Chromium	K22-Ja12670	CP	mg/kg	17	19	12	30%	Pass	
Copper	K22-Ja12670	CP	mg/kg	33	36	7.0	30%	Pass	
Lead	K22-Ja12670	CP	mg/kg	190	190	5.0	30%	Pass	
Nickel	K22-Ja12670	CP	mg/kg	3.5	4.3	18	30%	Pass	
Zinc	K22-Ja12670	CP	mg/kg	190	190	1.0	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	K22-Ja12670	CP	%	11	11	3.0	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Boron	K22-Ja12670	CP	mg/kg	< 10	< 10	<1	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

Qualifier Codes/Comments

Code	Description
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised by:

Karishma Patel	Analytical Services Manager
Michael Ritchie	Senior Analyst-Inorganic (NZN)
Michael Ritchie	Senior Analyst-Organic (NZN)
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 F CONTAMINATED SOIL DISCOVERY GUIDELINES

CONTAMINATED SOIL DISCOVERY GUIDELINES (CSDG)

Reference Number: GSL/CSDG

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DISCLAIMER

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STATEMENT

These guidelines have been prepared in acknowledgement of the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011. They have been authorised by a suitably qualified and experienced practitioner (SQEP); and have been prepared with the intention of providing practices and procedures for the management of potentially contaminated land which meets the criteria of the NES and the MfE guidelines.

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1 INTRODUCTION

Contaminated land can be defined as, '*any land that has been adversely affected through the impact of human activity that has resulted in a significant alteration to the chemical, inorganic or organic characteristics of the naturally occurring soil material of the land'*.

Such a definition leaves a broad spectrum of potential physico-chemical characteristics which may apply. It is not the purpose of these guidelines to attempt to define all of the possible activities, characteristics, processes, or chemical compounds which may have an adverse impact upon naturally occurring soil material.

However, in the current field of contaminated soil investigation, disturbance, remediation and validation, and within the context of the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health* (NES) there are situations that may be uncovered, or may present themselves in other ways, where the impact of man-made activities are both hazardous, in terms of human risk, and significant, in terms of environmental risk.

It should be noted that not all hazardous and significant contamination sources can be discerned by the eye, the ear or the nose and that any suspected occurrence of soil contamination should be scientifically investigated through the most appropriate means available.

It is hoped that this document can provide some additional guidance, examples, and discussion points around the investigation and assessment of particularly 'gross' or visually, olfactory and auditory significant contamination events, sources or plumes. It should not be taken that this document can replace suitable qualifications and experience, but rather can be used as general guide to the field practical methods used to immediately assess, prepare, and undertake the safe handling and immediate containment or excavation of contaminated soil materials.

2 PURPOSE

The practices and procedures in this report are intended to provide a field-practical process for the identification, assessment and management of grossly contaminated soil that may be encountered during earth breaking activities or other sub surface soil disturbance. These processes are intended to provide guidance on health, safety and environmental risks and risk management associated with earth breaking activities when gross evidence of contamination is encountered.

The practices and procedures outlined provide for first layer risk control and are one of many stages in the applicable health, safety and environmental risk management process. It is not intended to replace site specific health and safety plans, nor can it provide for every possible eventuality encountered in the field and cannot be reasonably expected to replace significant relevant on-the-job experience.

The *Health and Safety Guidelines on the Clean-up of Contaminated Sites* developed by Occupational Safety and Health Services (OSH) provides reference to appropriate H&S measures that can be adopted for contaminated sites and this is a key reference document when dealing with contaminated materials. These guidelines do not intend to replace the

guidance provided in that document and, if in doubt, it is the more preferable guidance document on provisions for Health and Safety when operating on contaminated soil sites.

3 INADVERTENT DISCOVERY OF CONTAMINATION

It is assumed that a site which has already been identified as 'contaminated' has been assessed with respect of the inorganic or organic characteristics which exceed the applicable criteria or threshold values as defined by the relevant legislation, rules, or plans. Identified contaminated sites will therefore already have appropriate protocols in place for the ongoing assessment, investigation, remediation and validation of the areas that have been defined as contaminated and have plans and procedures in place to protect both human health and the environment.

It still remains possible however, that unknown, unidentified or even identified but under-estimated, contamination may exist on such a site, or on a supposed 'non-contaminated' site. Such unknown contamination may be encountered as underground lenses (conglomerates of contamination in a localised zone), layers (widespread zone of contamination occurring along a stratified zone), hotspots (individual occurrences in a single location not otherwise connected), columns (vertical bands of contamination) or a plume (a zone of contamination moving along or through an aquifer / underground flow path and usually associated with seasonal or permanent groundwater flow).

In the event that 'unknown contamination' is encountered then it is advisable to have available some form of reference documentation that can provide insight to the frontline staff on the immediate signs, symptoms and actions that should be identified, assessed or considered while further advice is sought.

In all events encountering unknown soil contamination, a suitably qualified and experienced practitioner (SQEP) should be contacted for further advice, assessment and investigation.

4 GENERAL PROCEDURES

Below is a summarized guide of applicable steps which should be considered if any grossly contaminated material is encountered. The contaminated soil discovery guideline factsheets at the back of the report provide further details on the explicit health, safety and environmental risks associated with particular contamination scenarios, and the procedures to follow, however, in all instances the following general procedures summarized within the headings below should be considered. The steps highlighted below should not be considered exhaustive nor considered solely in step-by-step fashion, it may be necessary to conduct one or more actions at the same time or in differing order as a result of changing circumstances 'on the ground'.

4.1. STOP

- Stop working immediately and exclude others from working in the immediate area.
- Switch off machinery, generators etc., and establish a safe zone around the area dependent upon the assumed risk.

- For example, a gas release from an old landfill can be considered potentially toxic and / or explosive and a zone of approximately 10m may be considered appropriate depending upon the scale of the event.
- A series of dark red, brown or black stains in a pit with no odorous or free liquid discharges is unlikely to be immediately hazardous and the safe zone may extend to only the excavation edges.

- Prevent ingress or egress of stormwater, rainwater or wash water and stop all further activity immediately associated with the area.
- At this stage the extent, type and risk to health as a result of contamination is unknown – proceed with care and caution.

4.2. ADVISE THE SITE MANAGER

The site manager (or designated person) is the person principally in charge of health and safety on the site. They should also be familiar with these guidelines. The following steps are generally completed by the site manager or completed on the manager's delegation.

4.3. CONTAIN

If the contamination is leaving the site, or has the potential to leave the work site, then it should be contained. At this stage, the exact nature and risk of the contamination may not be known, so appropriate care and caution should be exercised. Some or all of the following methods may be used to contain the contamination:

- Sediment fences and straw bales;
- drain covers and sandbags;
- absorbent booms, spill mats, 'kitty litter' etc. can all be utilized to protect the environment from further release; and
- If containment is not possible, immediately contact:
  - ***Auckland Pollution Hotline*** **(09) 377 3107**.

4.4. ASSESS THE RISK

Not all contaminants, or all instances of contamination, will require special provisions or procedures. Similarly, an instance of contamination may be falsely or incorrectly reported. Not all stains are contamination, or all apparent plumes of oil on a liquid surface, are man-made occurrences.

- Refer to the factsheets at the back of these guidelines.
- Make a note of any or all of the following. It may be necessary to document and record some or all of the findings, for forwarding to the SQEP, as odours may dissipate and water may dry up or soak back into the soil:
  - Appearance – staining, trickling, flowing, bubbling (gas escape), thick, sticking to tools and equipment, sliding off tools etc.

- Odour – sweet, sour, petrol-like, tar-like, sharp etc.
- Colour or colours
- Miscibility i.e. does it or does it not mix with water. Oil / solvents etc. do not mix with water and creates a coloured sheen on the water surface.

- If gross contamination is confirmed (or strongly suspected) then the appropriate measures should be put in place, dependent upon the risks concerned as defined in the factsheets. A half buried rusted drum of waste batteries will require different safety procedures to the discovery of a buried pile of asbestos cement board, for example.

4.5. CONTACT THE CLA (SQEP)

Contact the on-call contaminated land advisor – provide digital photographs if safely possible to do so. Talk to the CLA. They may advise additional steps to follow; they may be required to come to site.

4.6. RESTRICT ACCESS

Following the assessment of the risk, the safety zone can now be better defined.

- With reference to the factsheets, restrict access to the safe zone to only those members of the team that need to be there. It may be necessary in the case of potentially explosive vapour release, to cordon off a significant sized area and prevent working, or vehicular access, within that area.
- Consider the potential flow paths of vapours along trenches, down slopes, through drains etc.
- Access can be restricted through purely visual means, e.g. warning sings, via fencing or by staff management (security guard for example) or a mixture of all three based upon the site manager's assessment and the extent of the contamination.

4.7. ESTABLISH A WORKING TEAM AND PROVIDE WITH APPROPRIATE PPE

Before continuing, establish a team of competent trained individuals who can deal with the matter and ensure that they have, and are correctly wearing, the appropriate PPE for the situation at hand as defined in the factsheets. Consider the following when establishing the team:

- Experience – have they handled such a situation before?
- Competence – are they familiar with the tools, equipment, PPE and procedures that will be employed?
- Comfort – not all staff are comfortable with unknown situations. Will they be comfortable in this situation?

4.8. EXCAVATE

At some point, the contamination is likely to be removed. This may not be the case in every instance and the regulations allow for other actions such as in-situ remediation, stabilisation, encapsulation etc. and the SQEP will advise on the specific methodologies required. In certain circumstances a more detailed remedial plan may have to be compiled which will document specific goals, validations and disposal actions. The SQEP will advise on the requirements of the regulations. In most cases of localised acute instances of gross contamination, they can be safely managed immediately in the interests of protecting human health and the environment. In this case, some or all of the following processes should be followed:

- Excavation / Isolation – solid contaminants, soil, drums, refuse etc. can be excavated, by machine or by hand, directly into a covered truck or sealed skip, preventing further potential spread and isolating the contaminants for assessment and disposal;
- Vacuum extraction – contaminated water may be sucked up into a vacuum tanker, provided that there is no risk of reaction or explosion, where it can be isolated for assessment and disposal. DO NOT MIX water / liquid from more than one event in a vacuum truck;
- Separation – large separate items, such as asbestos sheet fragments, can be collected by hand, separated from the soil matrix and placed in double skinned plastic bags for appropriate disposal; and
- Absorbance – contaminated water, hydrocarbons and chemicals can all be absorbed through the use of contaminated pads, pillows and booms which can then be placed in sealed skips or bags and isolated for appropriate disposal.

4.9. DOCUMENT

Keep written documents, including digital photographs, of all measures used to contain or cleanup the contamination. This might include some or all of the following:

- Assessment measures used e.g. laboratory analysis, in-situ analysis (e.g. XRF), smell, behaviour in water (miscibility etc.), pH indicator test etc.;
- Staff involved in clean-up and experience;
- Methods used, problems encountered, discussions with SQEP;
- Complaints by third parties (e.g. odours, colour changes to local waterways etc.);
- Excavation or separation methods used, names of contractors etc.;
- Volumes extracted;
- Conditions of cartage, e.g. skip bin, covered truck, closed wheelie bins etc.
- Location of final disposal and disposal documentation e.g. tip dockets, weighbridge receipts etc.

4.10. DISPOSE

In order to ensure that all material is disposed of correctly, ensure the safe and licensed disposal of the material in accordance with the requirements outlined by the SQEP. In the majority of cases, examples of gross contamination are likely to require disposal at a licensed landfill facility e.g. Redvale Landfill or Hampton Downs Landfill. Other licensed facilities may exist that can handle potentially contaminated material, that may also be able to provide assistance.

- Contaminated liquids will not be received at landfill for disposal and must go to a licensed liquid disposal facility. Sewerage contaminated liquids can probably go directly to the nearest local sewer treatment facility, but chemical contaminated liquid will be required to go to an appropriate liquid treatment plant.
- Drums of unknown or unidentified waste may have to go to a solid / liquid hazardous waste handling plant.
- Contaminated PPE will also require appropriate disposal.
- In all instances, the receiving facility will be unlikely to receive and handle the material without some form of analysis or assessment of the composition of the waste.
- Keep all transport and disposal dockets for the final report.

4.11. REPORT

Communications and documentation will be kept during the procedures but a final report should be provided to the project manager detailing all of the steps, communications and records as required.

This report provides assurance to the regulatory authority that all the necessary steps have been followed and the matter has been adequately and professionally dealt with.

5 FACTSHEETS

5.1. PETROLEUM HYDROCARBONS

ACTIVITY

- Petroleum service station
- Vehicle workshop
- Gasworks sites

POTENTIAL CONTAMINATION

- Total Petroleum Hydrocarbons (TPHs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Benzene, Toluene, Ethylxylene, and Xylenes (BTEX)
- Heavy Metals

DESCRIPTION

Petroleum-contaminated soils have a brown / black discolouration and an 'oily' consistency. Petroleum products, such as diesel and petrol, are insoluble in water and can form oil slicks in excavated areas such as trenches. Petroleum products in soil can be detected by the characteristic odour of petrol and diesel. BTEX produces a much 'sweeter' odour similar to that of paint-thinners.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Adverse reactions to strong hydrocarbon odours are possible, e.g. headaches, blurred vision, nausea. Contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Leaked fuels can migrate into groundwater, potentially contaminating drinking water.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face respirator.

HANDLING AND DISPOSAL

Pooled hydrocarbon spills can be removed using suitable absorbent materials or collected by a suitably rated vacuum tanker. Spills can also be transferred to a sealed container by an appropriately rated vacuum pump or similar. Hydrocarbon contaminated soil can be placed in a sealed leak proof skip bin or truck for disposal at a facility authorised to receive material of that kind.

5.2. HEAVY METALS

ACTIVITY

- Metal workshop
- Metallisation works
- Electroplating industries
- Timber treatment facilities

POTENTIAL CONTAMINATION

- Heavy Metals

DESCRIPTION

Gross contamination of heavy metals in soils can cause bands of discolouration within the soil profile. Pools of discoloured water (yellow, blue, red, orange) in excavated areas, such as trenches, are indicative heavy metal contamination. Solvents used for metal preparation, like BTEX, can form 'sheen' on the surface of water and produce a 'sweet' odour similar to that of paint-thinners.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Heavy metals have the ability to leach further into soil and eventually into groundwater, potentially contaminating drinking water. A consideration should be given to the potential of pH alteration as metal finishing plants often employ acidic solutions for metal preparation.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Heavy metal-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.

5.3. DRY CLEANERS

ACTIVITY

- Dry-cleaners

POTENTIAL CONTAMINATION

- Volatile hydrocarbons (trichloroethylene, tetrachloroethylene, carbon tetrachloride)

DESCRIPTION

It is difficult to distinguish soil contamination by solvents used for dry-cleaning. However, the solvents can form a bilayer with water they are less dense than water. The odours associated with dry-cleaning agents are very distinctive and can be described as 'sickly sweet', causing dizziness and nausea.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of vapours, contact with skin, or ingestion. Depending on atmospheric conditions, dry-cleaning agents may readily evaporate. Extended exposure to dry-cleaning agents can affect the central nervous system. Gross contamination of dry-cleaning agents in soil can migrate past the water table, making remediation complex.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face respirator.

HANDLING AND DISPOSAL

Pooled hydrocarbon spills can be removed using suitable absorbent materials or collected by a suitably rated vacuum tanker. Spills can also be transferred to a sealed container by a suitably rated vacuum pump or similar. Solvent contaminated soil, including drums or containers, can be placed in a sealed leak proof skip bin for disposal at a facility authorised to receive material of that kind.

5.4. TANNERY / LEATHER PROCESSING

ACTIVITY

- Leather manufacture / treating facility

POTENTIAL CONTAMINATION

- Heavy Metals (particularly chromium)
- Solvents
- Pesticides
- Bleaching agents

DESCRIPTION

Gross contamination of chromium in soils, caused in the tanning stage of treating leather, can cause orange and blue bands of discolouration within the soil profile. Pools of discoloured water (orange, blue, green) in excavated areas, such as trenches, are indicative chromium and metal contamination.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Contaminants can be absorbed into body via inhalation of vapours and dust, contact with skin, or ingestion. Wastewater produced from the tanning process can have excessive levels of chromium and sulphides which can cause gross soil contamination if inadequately handled.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical / oil resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Pooled liquid spills can be removed by using tailor-designed absorbent materials and via tanker or pump. Contaminated soil can be placed in a sealed skip bin or covered truck for disposal at a facility authorised to receive material of that kind.

5.5. ASBESTOS

ACTIVITY

- Improper disposal of asbestos-containing building materials

POTENTIAL CONTAMINATION

- Asbestos (fibres)

DESCRIPTION

Asbestos in soil is most likely due to burial of building materials. Asbestos fibres are usually entrained in a substrate material, making identification difficult. Broken cement, floor tiles, roof shingles, insulation, heat shields, and textured ceiling tiles manufactured between the 1950s and 1980s are likely to contain asbestos.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Asbestos can be absorbed into the lungs via inhalation of fibres. A significant acute or chronic exposure can lead to mesothelioma, asbestosis and lung cancer. Buried asbestos is relatively stable; however, disturbing asbestos during excavations could lead to the production of harmful fibres.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) disposable coveralls; (2) washable PVC gloves; (4) safety glasses; (5) suitably graded full face or half face P3 respirator.

HANDLING AND DISPOSAL

KEEP DAMP to suppress fibre generation. Large fragments may be collected by hand and place in double skinned plastic bags. Asbestos-contaminated soil can be placed in a sealed skip bin for disposal at a facility authorised to receive material of that kind. Soil of this kind can also be transported via sealed doubled bags or a sealed skip bin.

5.6. REFUSE

ACTIVITY

- Inorganic / Organic refuse disposal

POTENTIAL CONTAMINATION

- Variable, dependant on the type of refuse
- Contaminants could arise from liquid waste, putrid organic waste, and any material that would normally be sent to a licensed landfill

DESCRIPTION

Refuse in soil is most likely due to burial of waste materials that should have normally been sent to landfill. Waste could include, but not limited to, paint cans, oil / hydrocarbon containers, and putrid household waste. The odour of buried refuse is likely to be extremely pungent.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Due to the variability of types of refuse and waste, it is difficult to distinguish human health and environmental risks. Individual assessment of the risks will be required.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

Handling and disposal of refuse will be dependent upon the waste material identified.

5.7. PESTICIDES

ACTIVITY

- Horticultural activity
- Pesticide manufacture

POTENTIAL CONTAMINATION

- Pesticides, including DDT, dieldrin, and other organochloride pesticides (OCPs)

DESCRIPTION

Persistent use and storage of pesticides associated with horticultural activities are the main contributors to pesticide-related contamination in soil. Illegal burial of pesticide drums and containers may be encountered on production and agricultural sites. Pesticides are often found as fine, white powders.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Pesticide contaminants can be absorbed into body via inhalation of dust, contact with skin, or ingestion. Extended exposure to organochloride pesticides can disrupt the endocrine system as well as affecting DNA. DDT and its breakdown products, DDD and DDE, are highly persistent and do not breakdown easily in soil. DDT and its isomers have the ability to magnify through the food chain (bioaccumulate).

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable coveralls; (3) chemical-resistant gloves; (4) safety glasses; (5) suitably graded half-face or full face mask or respirator.

HANDLING AND DISPOSAL

If bulk pesticide storage containers are found, the site manager must be advised. Pesticide-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.

5.8. SEWAGE

ACTIVITY

- Underground sewage tanks / pipelines

POTENTIAL CONTAMINATION

- Raw sewage
- Bacteria / pathogens (*Escherichia coli*, *Vibrio cholerae*, etc.)

DESCRIPTION

Sewage in soil is most likely due to leaking underground septic tanks and / or sewer pipelines. The odour of sewage is likely to be extremely pungent.

HUMAN HEALTH AND ENVIRONMENTAL RISKS

Pathogens in sewage-contaminated soil can be absorbed into body via contact with skin or ingestion. Exposure to raw sewage can infect a person with an array of harmful pathogens, such as E. coli, which originate from faecal matter in wastewater. Gross contamination of raw sewage can lead to eutrophication of lakes, rivers, and other receiving bodies of water.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Required PPE for handling soil of this kind: (1) chemical-resistant steel-capped boots; (2) disposable / liquid repellent coveralls; (3) chemical-resistant / waterproof gloves; (4) safety glasses; (5) suitably full face mask or face shield.

HANDLING AND DISPOSAL

If raw sewage is encountered, the site manager must be advised. Sewage-contaminated soil can be placed in a truck and covered with tarpaulin for disposal at a facility authorised to receive material of that kind.