REPORT

Tonkin+Taylor

Ground Contamination Assessment

Roxburgh Crescent

Prepared for
Palmerston North City Council
Prepared by
Tonkin & Taylor Ltd
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Distribution:

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1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by Palmerston North City Council to undertake a ground contamination investigation for eleven properties in the suburb of Hokowhitu, including 4-34 and 29-31 Roxburgh Crescent and 573-575 Ruahine Street (referred to herein as the site). The location of the site is presented in **Figure 1.1** below.

This report has been prepared in general accordance with the requirements for a DSI (Detailed Site Investigation) referred to in the NES Soil regulations[1], and as outlined in the MfE Contaminated Land Management Guideline No. 1[2].

The persons undertaking, managing, reviewing, and certifying this investigation are suitably qualified and experienced practitioners (SQEP), as required by the NES Soil and defined in the NES Soil Users' Guide (April 2012).

This investigation was undertaken in accordance with our proposal of 22 October 2019.

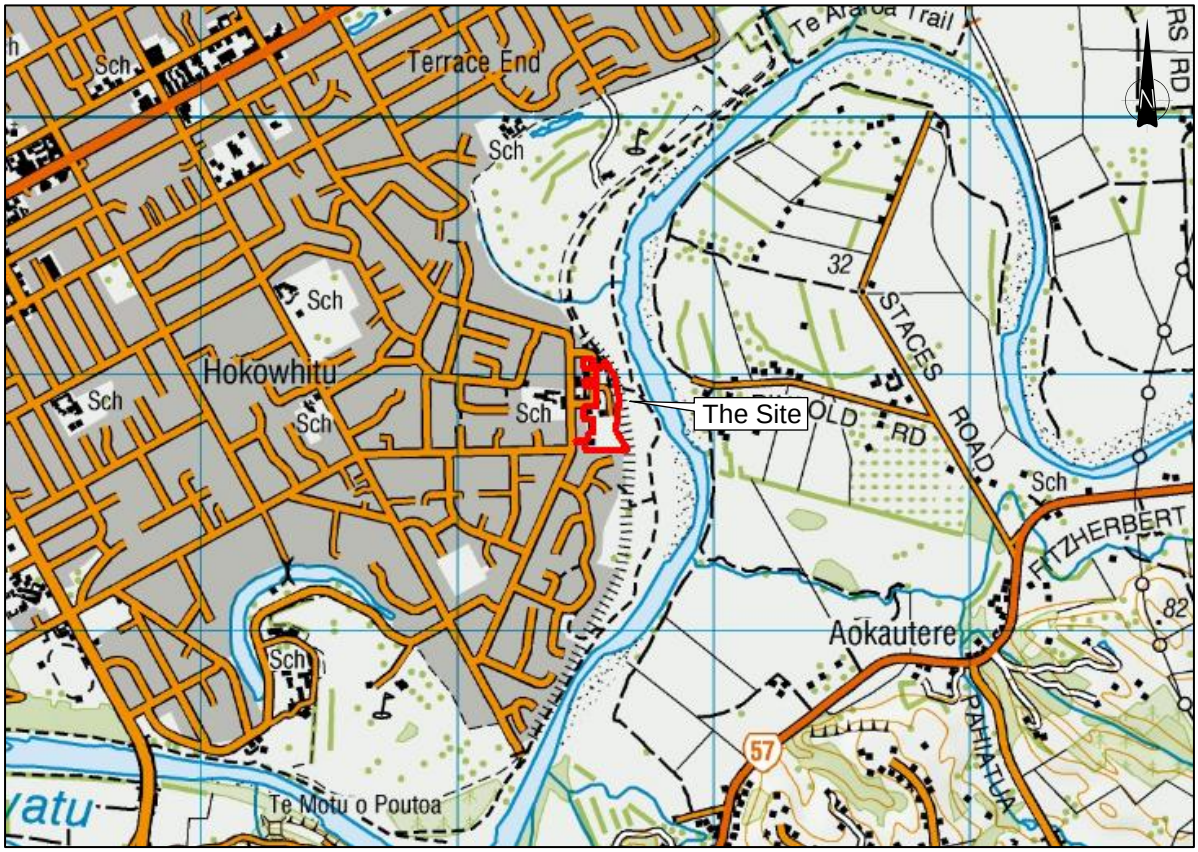


Figure 1.1: Site location plan (Topomap sourced from Land Information New Zealand[3])

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011.
[2] Ministry for the Environment, updated 2011. Contaminated land management guidelines No. 1: *Reporting on Contaminated Sites in New Zealand*.
[3]Land Information New Zealand, updated 2019. Topo50 Map Series *http://www.linz.govt.nz/topography/topo-maps/topo50/digital-images*.

1.1 Background

The present and former land uses at the site are known to have included activities which have the potential to cause land contamination. These activities are defined by the Ministry for the Environment in the Hazardous Activities and Industries List (HAIL)[4]. If an activity or industry on the HAIL is, or has occurred on a site, the NES Soil applies to proposed soil disturbance and/or land development activities.

T+T has undertaken this investigation to assess whether the HAIL activities, historic or current, at the site have resulted in ground contamination. This report also assesses the need for further investigation and resource consents with regard to ground contamination, as required under the NES Soil and other relevant regulations, for the proposed soil disturbance and land development activities.

1.2 Proposed development

We understand that the Palmerston North City Council is intending to undertake a plan change to rezone the Site from industrial to residential land use, which will allow for further residential development in the Hokowhitu area. At this stage, development plans identifying the extent of soil disturbance across the site have not been completed.

1.3 Objective and scope of work

The scope of work for this investigation included the following tasks:

- Review the previously completed Preliminary Site Investigation[5] (T+T, October 2019) containing the following:
  - Historical aerial images from the T+T library and other sources;
  - Historical and current certificates of title; and
  - Information regarding development activities and pollution incidents at the site.
- Undertake a brief site walkover inspection;
- Collect soil samples (in surface and deeper soils) in accessible areas;
- Analyse the collected samples at an accredited laboratory for metals, asbestos (semi-quantitative method), polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbons (TPH), and benzene, toluene, ethylbenzene, and xylenes (BTEX); and
- Prepare a Detailed Site Investigation (DSI) report, in general accordance with Ministry for the Environment guidelines.

This report documents our findings and comments on the potential for ground contamination at the site, in the context of the proposed development, including potential resource consent implications with regard to ground contamination.

[4] Ministry for the Environment, 2011. Hazardous Activities and Industries List. *https://www.mfe.govt.nz/land/hazardous-activities-and-industries-list-hail*

[5] Tonkin and Taylor, October 2019. *Roxburgh Crescent – Ground Contamination Desk Study (FINAL)*

2 Site description

2.1 Site identification

The site consists of eleven properties located on Roxburgh Crescent and Ruahine Street in Hokowhitu, Palmerston North. The site is bounded by the Manawatu Riverside Walkway and stop banks associated with flood protection on the eastern and north-eastern boundary.

Table 2.1: Site identification

Street Address	Legal Description	Property Area	Zoning
4-6 Roxburgh Crescent*	Lot 14 DP 25417	1,157.2 m^2	Industrial
8 Roxburgh Crescent	Lot 15 DP 25417	796.8 m^2	Industrial
10 Roxburgh Crescent	Lot 1 DP 74592	15,318.7 m^2	Industrial
12A Roxburgh Crescent (portion of)	Part Lot 2 DP 60866	1,037.2 m^2	Conservation and Amenity
21 Roxburgh Crescent	Lot 2 DP 76087	779 m^2	Industrial
22 Roxburgh Crescent	• LOTS 2 3 4 DP 19692; • LOTS 21-25 DP 25417; and • LOT 1 DP 60866.	8,477.4 m^2	Industrial
29-31 Roxburgh Crescent	Lots 31 32 DP 25417	1,212.4 m^2	Industrial
32 Roxburgh Crescent	Part Lot 1 DP 19692	713.8 m^2	Industrial
34 Roxburgh Crescent	Lot 26 DP 25417	683.9 m^2	Industrial
573-575 Ruahine Street	• Lot 1 DP 32023; • Lot 2 DP 22494; • Lot 1 DP 32973; and • Lot 6 DP 17578.	2,132.7 m^2	Industrial
Waterloo Park (portion of)	Part Lot 44 DP 22620	1,481.3 m^2	Recreation
Total Site Area			**33,790.4 m^2**

*Not visited during this investigation due to access being restricted by property owner

2.2 Site condition

A contaminated land specialist completed a site walkover inspection on 14 November 2019. Relevant observations made at the time of the inspection are summarised below. Key site features are shown in selected photographs (Photo 1 to Photo 12) which are included in **Appendix A**.

The T+T staff member was accompanied by Mr Kelvin Fohren (site operator), along with Mr Aaron Harding and Mr Tamati Blundell (underground service locators), during the walkover and the following includes a summary of site observations:

The property is currently used for a range of industrial activities and contains the following features:

- The ground is generally flat across the properties within the site extent and is a combination of paved and unpaved areas;
- The Roxburgh Crescent roadway runs from north to south through the middle of the site, curving west at both the northern and southern ends before connecting with Ruahine Street;
- The Higgins site is an operational transport depot with a high volume of vehicle and machinery movements between the workshops, product storage facilities and vehicle wash facilities (see Photograph 1);
- There was little activity at 29-31 Roxburgh Crescent at the time of the site visit, but it was evident that it is used as a storage facility for building materials and had vehicle access around the building (see Photograph 2);
- 21 Roxburgh Crescent was observed to be fully paved and is currently used as a staff parking area for Higgins with drainage running through the middle of the property (see Photograph 3);
- 573-575 Ruahine Street is occupied by an operating engineering workshop with large workshop buildings, an office building, a shipping container, and assorted machinery and equipment across the site (see Photograph 4);
- The occupier at 573-575 Ruahine Street indicated that there was previously an underground storage tank near one of the buildings on the southern portion of the property, it was not confirmed whether the tank has been removed;
- The buildings observed across the site were of an age that there is a potential for asbestos containing material (ACM) to be present in building materials;
- A number of scrapped vehicles in a deteriorating condition and empty drums were present on the south west portion of the Higgins site (see Photograph 5);
- Paint storage in shipping containers and associated equipment were present on the south west portion of the Higgins site (see Photograph 6);
- Storage of diesel in an underground storage tank with an associated dispenser for vehicle refuelling and three large above ground storage tanks containing bitumen product were present on the Higgins site (see Photographs 7 and 8);
- The immediate area containing the three above ground bitumen tanks is bunded and there is an interceptor located in the middle of the Higgins site (see Photograph 9);
- Vegetation was sparse across all properties visited during the walkover and mainly consisted of grasses and weeds (see Photograph 10), there were a number of large trees forming a shelter belt along the south and south eastern boundary of the Higgins site. Some planter boxes were present at the front of the Higgins site and the vegetation within appeared to be in a good condition. The portion of Waterloo park that was visited was fully covered in grass and other vegetation, including large trees;
- Discolouration and staining of site surfaces apparent were present on both paved and unpaved areas of the Higgins sites and the other properties. There were areas at 29-31 Roxburgh Crescent that appeared to have been used as burning areas. Two drums containing materials to be burnt were observed in the south west corner of the site (see Photograph 11);
- A large pile of waste bitumen material (referred to as 'hot mix tailings' by contractor) was present in the middle of the Higgins site, adjacent to TP9. Scrap metal, empty drums and other waste material were also stored on various areas of the Higgins site;
- There was a large volume of water ponded in the middle of the Higgins site in the location of a building that had been removed/demolished between 2015-2017 (see Photograph 12);

- The Manawatu River is located approximately 120 m from the western boundary of the Higgins site, there is a recreational area including a public walkway and a flood protection stop bank between the site and the riverbank;
- Winchester School is located on the western side of Ruahine Street, adjacent to the southern intersection with Roxburgh Crescent;
- There are a number of residential properties on Ruahine Street and on Roxburgh Crescent closer to Ruahine Street; and
- The Reformed Church of Palmerston North is located on Ruahine Street and is adjacent to 21 Roxburgh Crescent.

2.3 Surrounding land use

The land uses in the area surrounding the site include:

- North – Recreation and Flood Protection area consisting of the Manawatu Riverside Walkway, stop bank, and beyond, the Manawatu River;
- South – Recreation/Residential area consisting of a small section of Waterloo Park and beyond, residential properties off Tilbury Avenue;
- East – Recreation and Flood Protection area consisting of the Manawatu Riverside Walkway, stop bank, and beyond, the Manawatu River; and
- West – Residential area consisting of Ruahine Street, residential properties, the Reformed Church of Palmerston North, and Winchester School which is located directly adjacent to the intersection of Roxburgh Crescent and Ruahine Street.

2.4 Geology

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

2.4.1 Published geology

The published geology beneath the site is described by Lee and Begg[6] to be underlain by Holocene river deposits consisting of alluvial gravel, sand, silt, mud and clay with localised peat. The location of the site in the context of the regional geology is presented on **Figure 2.1** below:

[6] Lee and Begg, 2002. Geology of the Wairarapa Area. Institute of Geological and Nuclear Sciences 1:250 000 geological map 11. 1 sheet + 66 p. Lower Hutt, New Zealand: Institute of Geological and Nuclear Sciences Limited.

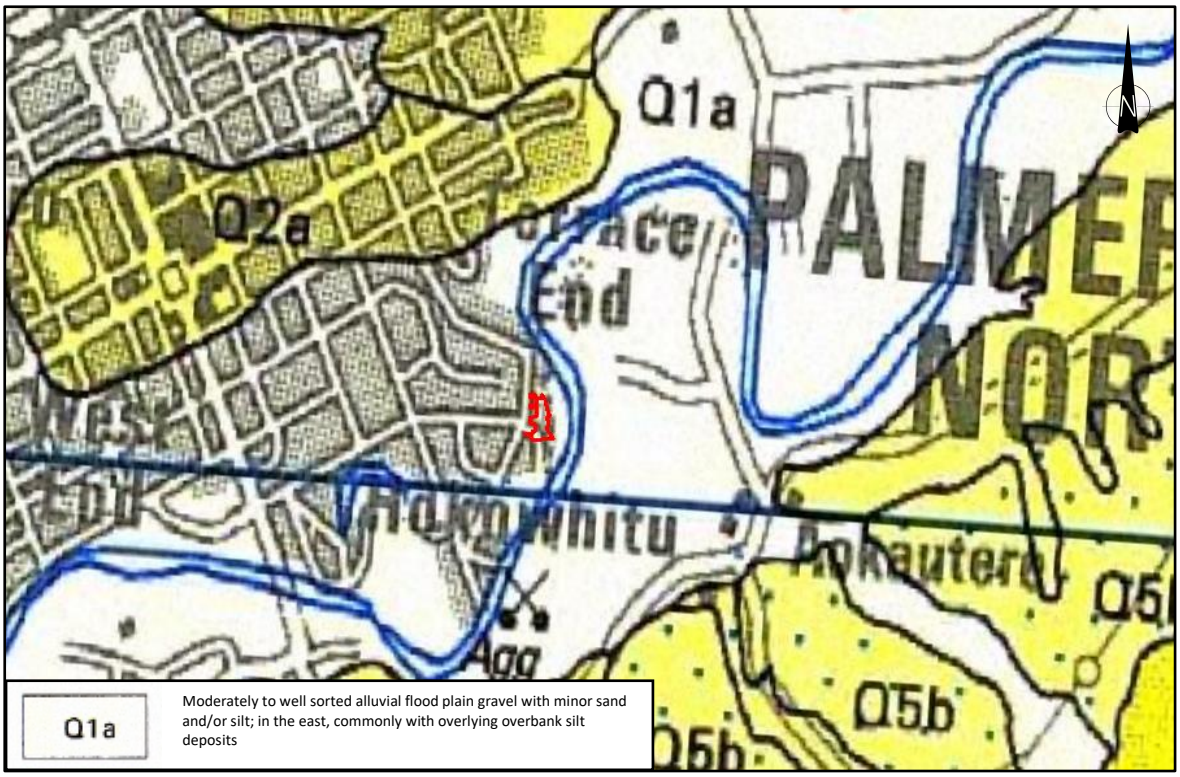


Figure 2.1: Published geology of the Hokowhitu Area (source: Lee and Begg, 2002) as per footnote[6].

2.4.2 Site geological information

The soil profile obtained from both the geotechnical investigation[7] conducted in February 2019 and the data collected during the current investigation, is shown in **Table 2.2**. Further description of the site soils is contained within the T+T geotechnical report.

Table 2.2: Observed soil profile

Depth below ground level to top of layer (m bgl*)	Unit thickness (m)	Geological unit	Description
0-0.5 m bgl	0.4/0.6 m	Fill	Sandy GRAVEL, with minor silt, fine to course gravels, rounded to angular, grey/brown. Inclusions of brick fragments, wood fragments, bitumen pieces, anthropogenic waste, in some locations.
0.5-1.5 m bgl	0.8-1.1 m	Natural	Silty fine to medium SAND, with trace clay, brown grey, moist.

*m bgl – metres below ground level

[7] Tonkin + Taylor, February 2019. *Geotechnical Investigation and Liquefaction Assessment* prepared for the Palmerston North City Council.

2.5 Hydrogeology and hydrology

Based on the observed site topography groundwater is expected to flow in an easterly direction towards the Manawatu River. Groundwater was encountered at approximately 8 m bgl at the site during the T+T geotechnical investigation.

The shallow and deeper groundwater below the level of the site is expected to discharge to the Manawatu River, located approximately 120 m east of the site (refer **Figure 1.1)**.

3 Site history

The site history is detailed in T+T's previous PSI[5]. The following provides a summary; however, the reader is referred to the PSI for further detail, if required.

The PSI reviewed historical information relating to the site that was collected from a variety of sources including council property files and historical aerial images. The information indicated that the site was predominantly pasture and vacant land with few buildings before the early 1950s, after which various industrial activities started on the site. Extensive development commenced from the 1950's and the aerial images from 1966 and 1986 show a number of buildings for workshops, storage sheds and factories present. The PSI noted that market gardening activities were observed in the 1986 aerial image, further review of this image suggests that the activity may be a plantation or a nursery for larger trees, possibly pine trees.

The PSI also noted a number of other activities, such as the bulk storage of hazardous substances including fuels and bitumen products, landfilling and engineering workshops, which have been undertaken across the site throughout its recent history. **Table 4.1** below includes the HAIL activities identified in the PSI and additional HAIL activities identified in the DSI.

In addition to the historical aerial images reviewed during the previous investigation, a 1956 aerial image has been sourced from the PNCC mapping service[8] Appendix B. The 1956 image shows the site to be mostly in pasture/vacant in the northern portion with a stand of trees in the shape of a square outline in the location of the current Higgins office building. The buildings towards the middle of the site appear to be the same as those currently used by Higgins as the laboratory and a workshop/storage shed. The image shows vehicle movement around these buildings and also an access track towards the southern portion of the site, where there is storage of what appears to be poles and ending near the small shed that can be seen on the western boundary of the site. The remainder of the site is vacant except for the south western portion where it bounds with 573-575 Ruahine Street, where what appears to be shrubbery has been planted. The Ruahine Street property is occupied by two shed/workshop buildings and is unpaved, there is storage of what appears to be timber in racks beyond the buildings to the north.

Further details regarding the site history is included in T+T's previous PSI report[5].

[8] Palmerston North City Council, 2019. *Land & Property Map Viewer - https://geosite.pncc.govt.nz/MapViewer/?map=cb2b06a88392471a849340b277438064*

4 Site characteristation

This section characterises the likely and potential contamination status of the site based on the available information as presented in T+T's previous PSI[5] and summarised in **Section 3** of this report.

4.1 Potential for contamination

This investigation has identified that HAIL activities were (or are likely to have been) undertaken at the site. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in **Table 4.1** below.

Table 4.1: Potential for contamination

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
4-6 Roxburgh Crescent			
Motor vehicle workshop	Hydrocarbons including PAHs, solvents, and metals contained in waste oil	This property is occupied by a motor vehicle workshop (Viper Classics) which undertakes maintenance and repair works on classic cars. Services include; engine works, panel beating and painting.	F4
Asbestos building materials	Asbestos fibres, debris or fines	Due to the age of the buildings on this property there is a potential for ACM to have been used during construction.	I and E1
Lead-Based Paint	Lead	Structures have been present on the site and surrounds when lead-based paints were in use. Lead may have been released during maintenance or weathering causing soil contamination.	I
Higgins Site (8, 10, 12A, 22 Roxburgh Crescent)			
Placement of imported fill and waste stockpiling	Unknown but a broad range of contaminants possible depending on whether offsite material was sourced. If sourced from other industrial areas then typical contaminants could include metals, polycyclic aromatic hydrocarbons (PAH) and asbestos.	Filling appears to have occurred on the southern portion of the site now occupied by the Higgins vehicle wash and truck parking/access way facilities. The fill material visible in the 1986 aerial image appears to have been stockpiled in this area and there are now visible depressions indicating the fill material has been buried on the site. The material may have been levelled across the site and used as the current platform. On site currently there are areas where waste is stockpiled prior to offsite disposal, at the time of this site investigation a large stockpile of bitumen 'hot mix' was held awaiting disposal at an appropriate facility.	I

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Storage tanks or drums for fuels, chemicals or liquid waste	Wide range of chemicals (organic and inorganic), and biological hazards	Drums containing solvents are currently stored on the Higgins site, empty drums are stored in various areas across the site. A large number of drums can be seen to be stored on the boundary adjacent to 565 Ruahine Street in the 1986 aerial image. There is a hazardous substances store present on the site.	A17
Scrap yards including automotive dismantling, wrecking or scrap metal yards	Metals, petroleum hydrocarbons (particularly lube oils), solvents used for cleaning, and PCBs	There are a number of wrecked vehicles stored on the south western portion of the site.	G4
Asphalt or bitumen manufacture or bulk storage	Petroleum hydrocarbons and PAH	Three large storage tanks containing bitumen products are stored towards the centre of the Higgins site.	E2
Motor vehicle workshops	Hydrocarbons including PAHs, solvents, and metals contained in waste oil	Maintenance and repairs are predominantly undertaken on vehicles and machinery in the buildings towards the northern portion of the Higgins site.	F4
Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances	Hydrocarbons including PAHs, solvents, and metals contained in waste oil	The activities occurring on the Higgins site; i.e. refuelling and storage of hazardous substances, meet the definition of a transport depot/yard within the HAIL.	F8
Commercial analytical laboratory sites	Wide range of organic and inorganic compounds including solvents, acids, metals, and mercury	The Higgins yard contains an IANZ accredited commercial analytical laboratory that analyses soils, aggregates and asphalt/bitumen products.	A3
Electrical transformers including the manufacturing, repairing or disposing of electrical transformers or other heavy electrical equipment	Polychlorinated biphenyls (PCBs), hydrocarbons, copper, tin, lead, and mercury	There is an electrical distribution transformer within the site boundary, in front of the laboratory building, at the southern corner of Roxburgh Crescent.	B2

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Spray use for pastoral weed and pest control between 1970 and 1975	Arsenic, lead, copper, mercury; wide range of organic compounds including acidic herbicides, organophosphates, and organochlorines (e.g. endosulfan on golf and bowling greens)	Plantation of trees visible on southern portion of 10 Roxburgh Crescent, referred to in the PSI as a market garden activity, could possibly be a plantation of larger trees such as pines. If pesticide sprays were used in the area, it is possible that there are concentrations of contaminants, in shallow soils, associated with historical use of sprays containing persistent organochlorine compounds used prior to the late 1970s.	A10
Asbestos building materials	Asbestos fibres, debris or fines	Due to the age of the present and the demolished/removed buildings (pre-2000) associated with the Higgins site they have the potential to contain asbestos products.	I and E1
Lead-Based Paint	Lead	Structures have been present on the site and surrounds when lead-based paints were in use. Lead may have been released during maintenance or weathering causing soil contamination.	I
29-31 Roxburgh Crescent			
Asbestos building materials	Asbestos fibres, debris or fines	The larger building on the construction yard is constructed of asbestos building products. There is potential for asbestos to be wide spread across site due to the nature of activities on site and vehicle movements surrounding the building.	I and E1
Lead-Based Paint	Lead	Structures have been present on the site and surrounds when lead-based paints were in use. Lead may have been released during maintenance or weathering causing soil contamination.	I
573-575 Ruahine Street			
Engineering workshops with metal fabrication	Metals and oxides of iron, nickel, copper, chromium, magnesium and manganese; range of organic compounds used for cleaning including BTEX, solvents	The business occupying this property, G.A. Zander Ltd, provides heavy vehicle and general engineering services.	D5
Motor vehicle workshop	Hydrocarbons including PAHs, solvents, and metals contained in waste oil	The business occupying this property, G.A. Zander Ltd, provides heavy vehicle and general engineering services.	F4
Storage tanks or drums for fuels, chemicals or liquid waste	Wide range of chemicals (organic and inorganic), and biological hazards	The occupier indicated that a fuel storage tank has previously been in use on the site. The shipping container on site appears to be used as a hazardous substance store.	A17

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Asbestos building materials	Asbestos fibres, debris or fines	Due to the age of the present and the demolished/removed buildings (pre-2000) they have the potential to contain asbestos products.	I and E1
Lead-Based Paint	Lead	Structures have been present on the site and surrounds when lead-based paints were in use. Lead may have been released during maintenance or weathering causing soil contamination.	I

5 Intrusive Investigation

5.1 Investigation design and methodology

As described in the preceding sections, the site has been subject to a number of HAIL activities. These activities are within the area proposed to be rezoned and on this basis, soil samples were collected from eighteen (18) targeted locations across the entire site, as shown in the sample location plan, included in **Appendix C**, and detailed in **Table 5.1** below.

Table 5.1: Sample locations and rationale

Sample Location ID	Location	Depth (m bgl)	Soil samples analysed (m bgl)
TP1	General coverage of Higgins yard, near to office building.	1.2 Target depth	0.1, 0.7
TP2	General coverage of Higgins yard, near to workshop building.	1.1 Target depth	0.1, 0.4
TP3	Adjacent to bitumen tanks.	1.5 Target depth	0.1, 0.5, 0.9 Bulk sample collected at 1.2
TP4	Down-gradient of diesel tank.	1.3 Target depth	0.1, 0.4
TP5	**Not collected due to proximity to services**. General site coverage, near to electrical transformer.	-	-
TP6	General coverage of Higgins yard, area previously occupied by former workshop.	0.7 Wall collapse	0.1, 0.4
TP7	General coverage of Higgins yard, area of former building which was removed/demolished between 2015-2017.	1.1 Target depth	0.1, 0.5
TP8	General coverage of Higgins yard, location of fill material visible in 1986 aerial image.	1.5 Target depth	0.1, 0.4, 1.2
TP9	Area of former drum storage (visible in 1986 aerial image) and near to current disposal area.	1.0 Target depth	0.1, 0.4, 0.8
TP10	General coverage of former plantation area, near to current Higgins paint store and storage of scrapped vehicles.	1.3 Target depth	0.1, 0.5
TP11	Approximate area of former petrol AST.	1.5 Target depth	0.1, 0.5, 1.5
SS1	General coverage of construction yard.	0.2	0.1, 0.2
SS2	General coverage of construction yard.	0.2	0.1, 0.2
SS3	General coverage of construction yard.	0.2	0.1, 0.2
SS4	General coverage of construction yard.	0.2	0.1, 0.2
SS5	General coverage of engineering workshop.	0.2	0.1, 0.2
SS6	General coverage of engineering workshop.	0.2	0.1, 0.2
SS7	General coverage of former plantation area.	0.2	0.1, 0.2
SS8	General coverage of former plantation area.	0.2	0.1, 0.2

Soil samples were collected using test pitting and hand excavation techniques. Sampling equipment was decontaminated using potable water with Decon90 (a phosphate free detergent) and then rinsed with potable water between samples.

In total forty (40) samples were collected and submitted to an accredited laboratory. In addition, one bulk sample in the form of a fragment of fibre board was collected and analysed for asbestos presence/absence in bulk material.

The analytical suite for the samples is described below:

- All forty (40) samples were analysed for metals (arsenic, cadmium, copper, chromium, lead nickel and zinc);
- Twenty-nine (29) samples were analysed for asbestos content (semi-quantitative method), sample numbers are below the BRANZ guideline numbers due to a location being inaccessible and the locations being selected via targeted method for an interim screening at this plan change phase. Further investigation in areas where asbestos has been identified will increase sample density;
- Twelve (12) samples were analysed for TPH, PAH, and BTEX;
- Nine (9) samples were analysed for organochlorine pesticides (OCP); and
- Five (5) samples were analysed for volatile organic compounds (VOC).

Samples were selected from depths between 0.1 m bgl to 1.5 m bgl (within fill material and slightly deeper than natural ground levels encountered in prior geotechnical investigation[7]) to assess the material in varying layers encountered.

The analytical suite for all samples was determined by the activities undertaken at, or near to, the location of the sample location and to assess the potential contaminants associated with the identified HAIL activities and data gaps described in previous sections.

Samples were not collected from 21 Roxburgh Crescent as no HAIL activities have been identified on this property.

5.2 Field observations

The subsurface material encountered across the sample locations comprised the following:

- A sandy/silty gravel layer between 0.3 m – 0.9 m thick was observed in all test pit locations;
- Natural sand and silts were observed underlying the fill and gravelly material to the termination of test pitting depths at 0.7 – 1.5 m;
- The wall of TP6 collapsed at 0.7 m bgl due to the presence of large cobbles (due to the size and number of the cobbles, it was possibly a former soak pit), this test pit also contained fill material consisting of a horseshoe and brick pipe fragments;
- Trace waste material consisting of brick fragments, bitumen pieces and wood fragments was encountered from surface level to a maximum of 0.9 m bgl in two test pits (TP8 and TP11) and brick fragments were present in surface soils in SS7;
- A gas/solvent odour was detected from 0.4-0.6 m bgl in TP9, which is in the location of the former drum storage in the 1986 aerial image. The area is now within a disused gravel/aggregate storage area. Recently, this area has been used as a disposal area and fill material including; concrete sample rods (from the laboratory), wood fragments, brick fragments, a steel sheet, an aluminium can, asphalt pieces and iron fragments. Water ingress was seen at the top of the silty sand layer at 0.6 m bgl, this location was flooded due to heavy rain in the days prior to the day of sampling. The ponded water was pumped from the area prior to beginning the test pitting;

- Waste material was encountered in TP3 from 0.5 – 1.3 m bgl. The material included dark black pieces with a heavy hydrocarbon odour, wood fragments, burnt material (charcoal), pipe fragments, wire pieces, brick fragments and white ceramic/glass pieces. A fibre cement fragment was found at 1.2 m bgl. Trace charcoal/ash fragments were also found from 0.3 – 0.6 m bgl in TP2;
- Surface sample locations at 29-31 Roxburgh Crescent (SS1-SS4) encountered similar material (sandy gravels with rootlets), SS1 contained brick and glass fragments in the top 0.1 m. There were nails and debris in the area surrounding SS4;
- The material encountered at the two locations (SS5 and SS6) from 573-575 Ruahine Street was found to be similar to the remainder of the site. There was evidence of localised ponding at SS5; and
- SS7 and SS8, collected in the section of Waterloo Park adjacent to the southern boundary of the Higgins yard, encountered a silty topsoil; trace brick fragments were noted in SS7 at 0 – 0.1 m bgl.

5.3 Soil sampling procedures

Soil samples were retrieved in general accordance with MfE Contaminated Land Management Guideline No. 5[12] as follows:

- Soil samples were collected from test pit and surface sample locations with freshly gloved hands and were placed into laboratory-prepared sample jars. The jars were stored under chilled conditions prior to being sent via courier to R J Hill Laboratories in Hamilton and Christchurch (asbestos samples only);
- The field equipment that had the potential to contact with the sample (trowel and spade) was decontaminated between samples using potable water and Decon90 (a phosphate-free detergent) followed by a clean water rinse;
- Soil samples were obtained at varying depths from 0.1 to 1.5 m bgl from all sample locations;
- The materials encountered were logged in general accordance with the NZ Geotechnical Society guidance and were assessed for odour and any evidence of contamination; and
- Samples were submitted to IANZ accredited R J Hill Laboratories (Hamilton and Christchurch), under chain of custody documentation.

5.4 Data Quality

5.4.1 Sample Handling and Holding Times

The chain of custody records show that the samples were submitted to R J Hill Laboratories Limited within the generally accepted holding times for these analytes.

5.4.2 Laboratory Quality Control

R J Hill Laboratories Limited is accredited by IANZ and as such are expected to comply with the accreditation requirements that include the confirmation of validity and suitability of results. Any breaches in laboratory control would be expected to be notified at the time of release of the analytical results. No breaches were reported.

5.5 Analytical results

A summary of the analytical results for the soil samples is presented, in comparison to the relevant assessment criteria, in the Results Summary Table, included in **Appendix D**. The assessment criteria were selected in accordance with the requirements of the regulatory framework, in particular, in accordance with the MfE Methodology[9]. Residential land use criteria were used to provide a conservative screening assessment for the potential use of the site as a residential development. Laboratory transcripts are provided in **Appendix E**.

Key findings of the analytical results are:

- Asbestos fibres/friable asbestos (AF/FA) were reported at concentrations above or at the human health criteria[10] (0.011% w/w, 0.003% w/w and <0.001% w/w versus the criterion of 0.001% w/w), in the shallow samples collected from locations SS1, SS2, and SS3. Asbestos was also found to be present within the fragment of fibre board found in TP3 at 1.2 m bgl. Asbestos was not detected in any of the other samples analysed;
- One or more contaminants was detected in all shallow soil samples analysed, as detailed below. However, other than asbestos (described above), lead at TP3, and arsenic in the surface samples collected from SS4 (0.1 m bgl and 0.2 m bgl), all samples results were below the relevant criteria for the protection of human health:
  - PAH compounds were detected in all but two of the selected samples;
  - No organochlorine pesticides were detected in any of the samples analysed;
  - Metals in nineteen (19) of the collected samples (both shallow and at depth) were found to be above the predicted background concentrations for the area[11] (Landcare Research, 2016); and
  - 1,2,4 Trimethylbenzene, which can be used as a solvent and paint thinner, was detected in one sample collected at TP9 at a depth of 0.4 m bgl.
- PAH results for two the samples collected in the sandy silt layer (>0.4 m bgl) collected during this investigation suggest that the natural soils in some areas may have been impacted by the identified HAIL activities.

Further discussion of the implications of these findings is provided in **Section 6** below.

5.6 Preliminary conceptual site model

A conceptual model, as defined by the Ministry for the Environment in the contaminated land management guidelines[12], sets out known and potential sources of contamination, potential exposure pathways, and potential receptors. For there to be an effect from the proposed activity there has to be a contamination source and a mechanism (pathway) for contamination to affect human health or the environment (receptor).

A preliminary conceptual site model has been developed for the wider site and is included in the PSI[5].

The ground conditions encountered on the wider site have been detailed below and separated by the properties visited within the text below:

[9] Ministry for the Environment, 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.
[10] BRANZ, 2017. New Zealand Guidelines for Assessing and Managing Asbestos in Soil. Wellington
[11] Landcare Research Limited, 2016. PBC - Predicted Background Soil Concentrations, New Zealand, https://lris.scinfo.org.nz/layer/48470-pbc-predicted-background-soil-concentrations-new-zealand/
[12] Ministry for the Environment, updated 2011, *Contaminated Land Management Guidelines No. 5 Site Investigation and Analysis of Soils*

The ground condition encountered across the site were relatively consistent, comprising:

- Fill: Sandy gravels, with fragments of brick and hotmix (generally 0.2 m thick; 0.4 m to 0.7 m at the Higgins), contaminated with metals, PAH, and hydrocarbons generally below residential criteria, but some metals above Landfill Class A criteria;
  - Waste material (with occasional ACM fragments) was encountered in middle of the Higgins site (22 Roxburgh Cres) to 0.5-1.3 m depth, the horizontal extent of this material will require delineation during further investigations;
  - Waste material (with occasional nails, glass and brick fragments) was encountered across 29-31 Roxburgh Crescent to 0.2 m depth, the laboratory results for asbestos were above the human health criteria. The horizontal extent of this material will require delineation during further investigations; and
  - In Waterloo park the fill comprised topsoil (up to 0.2 m thick) with occasional brick fragments and gravels. Contamination was below residential criteria.
- Natural: sandy silt.

6 Regulatory implications

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

- NES Soil;
- Health and Safety at Work (Asbestos) Regulations (2016)[13];
- The Horizons Regional Council's One Plan; and
- The Palmerston North City Council District Plan.

The NES Soil and District Plan consider issues relating to land use and the protection of human health while the Regional Plan has regard to issues relating to the protection of the general environment, including ecological receptors. The need, or otherwise, for contamination related resource consents for the site redevelopment has been evaluated against these regulatory requirements.

6.1 NES Soil

6.1.1 Applicability

The NES Soil came into effect on 1 January 2012. This legislation sets out nationally consistent planning controls appropriate to district and city councils for assessing contaminants in soil with regard to human health. As a result, the NES Soil prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil.

The NES Soil applies to specific activities on land where a HAIL activity has, or is more likely than not to have, occurred. Activities covered under the NES Soil include soil disturbance, soil sampling, fuel systems removal, subdivision and land use change.

The following **Table 6.1**, as provided in the NES Soil Users Guide (April 2012), confirms the NES Soil will apply to the site.

[13] Health and Safety at Work (Asbestos) Regulations, administered by the Ministry of Business, Innovation, and Employment, February 2016

Table 6.1: PSI checklist

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

6.1.2 NES Soil activity status

An assessment against the relevant permitted activity standards of the NES Soil is provided in **Table 6.2**.

Based on our understanding of the proposed rezoning from industrial to residential, the proposed works do not meet the provisions of a Permitted Activity under the NES Soil Regulation 8(3)(4) and will require a resource consent under the NES Soil.

As soil contamination in some of the collected samples exceeds the human health guideline values, redeveloping and subdividing the site for a residential land use will likely be a Restricted Discretionary Activity, under the NES Soil, in the specific 'pieces of land' containing elevated contaminants within the wider site.

Table 6.2: NES Soil Permitted Activity assessment for soil disturbance

NES Soil – Soil disturbance permitted activity conditions (Regulation 8(3))	Assessment
Implementation of controls to minimise exposure of humans to mobilised contaminants.	CAN COMPLY - Controls will be in place to prevent mobilisation of contamination.
The soil must be reinstated to an erosion free state within one month of completing the land disturbance.	CAN COMPLY - The area of land disturbance will be reinstated to an erosion free state on completion of the development works.
The volume of the disturbance of the piece of land must be no more than 25 m^3 per 500 m^2.	CAN'T DETERMINE COMPLIANCE BASED ON CURRENT INFORMATION - The volume of disturbance required for future redevelopment is currently unknown and may be calculated as 1,690 m^3 based on the entire site area (33,790 m^2). This calculation may need to be updated in future once the extent of the area to be redeveloped has been confirmed.

NES Soil – Soil disturbance permitted activity conditions (Regulation 8(3))	Assessment
Soil must not be taken away unless it is for laboratory testing or, for all other purposes combined, a maximum of 5 m^3 per 500 m^2 of soil may be taken away per year.	CAN'T DETERMINE COMPLIANCE BASED ON CURRENT INFORMATION - the volume of disposal required for future redevelopment is currently unknown, however based on the extent of the three identified priority areas it is 340 m^3. This calculation may need to be updated in future Once the extent of the area to be redeveloped has been confirmed.
Soil taken away must be disposed of at an appropriately licensed facility.	CAN'T DETERMINE COMPLIANCE BASED ON CURRENT INFORMATION - Soil removed from site will likely be disposed to an appropriate facility.
The duration of land disturbance must be no longer than two months.	CAN'T DETERMINE COMPLIANCE BASED ON CURRENT INFORMATION - The duration of the earthworks is currently unknown.
The integrity of a structure designed to contain contaminated soil or other contaminated materials must not be compromised.	NOT APPLICABLE - as there are no structures containing contamination within the area subject to land disturbance.

6.2 Health and Safety at Work (Asbestos) Regulations

The Health and Safety at Work (Asbestos) Regulations (2016) were enacted on 4 April 2016, herein referred to as the Asbestos Regulations.

In order to help achieve compliance with the Asbestos Regulations, WorkSafe New Zealand has prepared an Approved Code of Practice (ACoP): Management and Removal of Asbestos (September 2016). The ACoP refers readers to the "New Zealand Guidelines for Assessing and Managing Asbestos in Soil" (herein referred to as the Asbestos-in-Soil Guidelines) which were published in November 2017 by BRANZ Ltd[14].

Based on the results of the sampling completed during this investigation, disturbance of at least some of the site soils at 29-31 Roxburgh Crescent may be Class B works in accordance with the BRANZ asbestos in soil guidelines. Concentrations of FA/AF in soils encountered on site (0.011% w/w and 0.003% w/w) exceed the human health guideline value of 0.001% w/w.

While the existing site data is sufficient to inform the current plan change process, further investigations to confirm the extent of asbestos in soils at 29-31 Roxburgh Crescent is recommended prior to any soil disturbance work and prior to the potential redevelopment to a residential use.

The key requirements of the Asbestos-in-Soil guidelines, as determined by the concentration of asbestos fibres/fines or fragments that are present in the soils are provided in **Figure 6.1** below from the 2017 BRANZ guidelines[10].

[14] New Zealand Guidelines for Assessing and Managing Asbestos in Soil, prepared by BRANZ Ltd, November 2017

<table>
<tr><th>Scenario</th><th>PPE</th><th>Respiratory protective equipment (RPE)*</th><th>Dust/asbestos fibre suppression</th><th>Decontamination facilities</th></tr>
<tr><td>Class A: friable

>1% w/w FA and/ or AF in soil</td><td rowspan="3">Disposable coveralls rated type 5, category 3, nitrile gloves, steel toe capped gumboots or safety footwear with disposable overshoes.</td><td>Full-face P3 respirator with particulate filter. Consider increasing to power-assisted if required.</td><td rowspan="2">Water and asbestos-encapsulating polymer emulsion product applied before starting work and during as required.

Consider adding a surfactant to water for amphibole fibres (brown and blue).</td><td>Basic disposable wet decontamination tent or trailer. Consider powered and plumbed decontamination unit if project scale warrants.</td></tr>
<tr><td>Class B: non-friable

>0.01% w/w FA and/or AF in soil

>1% w/w ACM</td><td>Half-face P3 respirator with particulate filter. Consider increasing to full-face if friable ACM present.</td><td rowspan="2">Basic disposable decontamination tent and foot wash.</td></tr>
<tr><td>Asbestos-related work

>0.001% w/w FA and/or AF in soil

>0.01% w/w ACM</td><td>Disposable P2 dust mask.</td><td rowspan="2">Water via localised points. Addition of surfactants and polymers where the location is sensitive (such as adjacent to busy centres, schools).

Temporary cover of contaminated area awaiting remediation.</td></tr>
<tr><td>Unlicensed asbestos work

≤0.001% w/w FA and/or AF in soil

≤0.01% w/w ACM</td><td>No asbestos-specific PPE if air monitoring confirms asbestos below 0.01 f/ml.</td><td>No asbestos-specific RPE if SQEP confirms unlikely to exceed trace levels in air monitoring (0.01 f/ml) and/or if air monitoring confirms asbestos below 0.01 f/ml.</td><td>Foot wash and used PPE collection area.</td></tr>
</table>

*Refer to Part C section 14 of the ACOP and AS/NZS 1715:2009 for more information on RPE selection.

Table 6. Primary mitigation control requirements for work involving asbestos.

Figure 6.1: Table 6 from the 2017 BRANZ Asbestos-in-Soils Guidelines detailing mitigation control requirements for asbestos related work

6.3 Regional Plan

The Horizons Regional Council's One Plan sets out rules relating to the discharge of contaminants to land and water which will need to be considered once the redevelopment plans have been finalised.

6.4 District Plan applicability

As noted in **Section 6** the NES Soil now prevails over the rules in the District Plan, except where the rules permit or restrict effects that are not dealt with in the NES Soil.

As the rules in the District Plan do not deal with any effects that are not dealt with in the NES Soil, with respect to managing contaminants in soil to protect human health the provisions of the District Plan have not been considered further in this assessment.

6.5 Disposal Assessment

Based on the results of the investigations to date, disposal of some soils during the redevelopment works in particular areas across the wider site, will need occur at a facility licenced to receive asbestos contaminated soils and soils containing contaminants (metals, PAH, TPH and VOC).

The results of this investigation show that contaminant levels (PAH, metals, VOC and TPH) are above the predicted background concentrations and therefore they do not meet the definition for disposal at a cleanfill facility.

Eight of the collected samples also exceed the Class A disposal criteria for selected metals (copper, lead and zinc). Further analysis of samples will be required as well as discussions with the landfill operator prior to disposal at a Class A facility.

6.6 Development Implications

As HAIL activities will continue to operate on the site, we recommend that further intrusive investigations be undertaken once the activities have ceased and prior to residential redevelopment.

An indication of areas requiring further investigation has been included in the plan included in **Appendix F**.

7 Conclusions

Tonkin & Taylor Ltd (T+T) has been commissioned by the Palmerston North City Council to undertake a ground contamination investigation for eleven properties in the suburb of Hokowhitu, including 4-34 and 29-31 Roxburgh Crescent and 573-575 Ruahine Street, to assess the need for consents under the NES Soil and regional plan rules, and support the plan change to rezone the site from industrial to residential.

The key findings of the investigation are summarised below:

- A number of activities included in the MfE HAIL are currently, or have been historically, undertaken across the site;
- Analytical results from soil samples collected in the investigation show elevated concentrations of contaminants. However, the majority of the results are below human health criteria for residential land use;
- Concentrations of metals exceeding human health criteria were found in two locations, one location on 8-22 Roxburgh Crescent and one location at 29-31 Roxburgh Crescent;
- Asbestos was found in samples collected from two locations at 29-31 Roxburgh Crescent to be above the guideline value for human health;
- The presence of contaminants in the majority of samples indicates that clean fill disposal will not be appropriate. Further assessment will be required to determine appropriate disposal options; and
- The existing site data is sufficient to inform the current plan change process. However, as HAIL activities will continue to operate on the site, and there will be a need to confirm the extent of asbestos in soils at 29-31 Roxburgh Crescent, we recommend that further intrusive investigations be undertaken once the activities have ceased and prior to residential redevelopment.

Summary of regulatory implications:

- The NES Soil will apply to the site if residential redevelopment is undertaken as HAIL activities have been, and are currently occurring on the site and subdivision and soil disturbance will likely be required during the redevelopment phase; and
- Due to the presence of asbestos, controls will be required during soil disturbance and redevelopment works in accordance with the Asbestos Regulations.

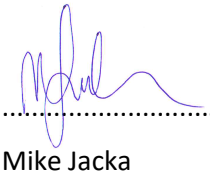
8 Applicability

This report has been prepared for the exclusive use of our client Palmerston North City Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

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

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
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Kasey Pitt	Mike Jacka
Contaminated Land Consultant	Project Director

19-Mar-20

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Appendix A: Site photographs

Photograph 1: General Higgins site showing onsite activities

Photograph 2: General site condition, 29-31 Roxburgh Crescent

Photograph 3: General site condition, 21 Roxburgh Crescent

Photograph 4: General site condition, 573-575 Ruahine Street

Photograph 5: Example of scrapped vehicles and empty drums on Higgins site

Photograph 6: Containers containing paint and road marking store

Photograph 7: Vehicle refuelling at Higgins site

Photograph 8: Large bitumen storage tanks on Higgins site (third tank not visible, behind tank to left of image)

Photograph 9: Bunding surrounding bitumen storage tanks

Photograph 10: Example of sparse vegetation at 29-31 Roxburgh Crescent, SS4 location (similar to what was observed at 573-575 Ruahine Street)

Photograph 11: Drums used for burning at 29-31 Roxburgh Crescent

Photograph 12: Ponding of water observed in the middle of the Higgins site

Appendix B: 1956 aerial image

Figure Appendix B.1: 1956 Aerial Image of Hokowhitu Area – sourced from Palmerston North City Council Map Viewer

Appendix C: Sample location plan

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PROJECT No.	1012456	
DESIGNED	KAPI	Dec.19
DRAWN	ZALO	Dec.19
CHECKED	JCOA	Dec.19
APPROVED	MEJ	DATE Mar-20

CLIENT **PALMERSTON NORTH CITY COUNCIL**

PROJECT **ROXBURGH CRESCENT**

TITLE GROUND CONTAMINATION ASSESSMENT SAMPLE LOCATIONS

SCALE (A3) AS SHOWN FIG No. F1 REV A

Appendix D: Results summary table

Sample ID	NES Soil - Residential 10% Produce[1]	NES Soil - Commercial/Industrial[1]	Landcare Research Predicted Background Concentrations [2]	Class A Landfill Screening Criteria [3]	Max	TP1 0.1	TP1 0.7	TP2 0.1	TP2 0.4	TP3 0.1	TP3 0.5	TP3 0.9	Bulk 1 TP3 1.2	TP4 0.1	TP4 0.4	TP6 0.1	TP6 0.4	TP7 0.1	TP7 0.5	TP8 0.1	TP8 0.4	TP8 1.2	TP9 0.1	TP9 0.4	TP9 0.8	TP10 0.1	TP10 0.5
Date						19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	18-Nov-19	18-Nov-19	18-Nov-19	18-Nov-19	18-Nov-19	18-Nov-19	18-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	18-Nov-19	18-Nov-19
Laboratory Number						2278663.23		2278663.21	2278663.22	2278663.18	2278663.19	2278663.20		2278663.16	2278663.17	2278663.11	2278881.12	2278881.9	2278663.10	2278881.1	2278881.2	2278881.3	2278881.13	2278881.14	2278881.15	2278881.7	2278881.8
						2278881.23	2278663.24	2278881.21	2278881.22	2278881.18	2278881.19	2278881.20	2279150.1	2278881.16	2278881.17	2278881.11			2278881.10								
Sample Depth (m bgl)						0.1	0.7	0.1	0.4	0.1	0.5	0.9	1.2	0.1	0.4	0.1	0.4	0.1	0.5	0.1	0.4	1.2	0.1	0.4	0.8	0.1	0.5
Geological Unit (field)						Sandy GRAVEL	SAND	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	CLAY	Sandy SILT	Sandy GRAVEL	Sandy GRAVEL	Sandy SILT	Sandy GRAVEL	Sandy GRAVEL
Asbestos in Soil																											
Asbestos Presence/Absence	-	-	-	-	-	Asbestos NOT detected	-	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	-	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected
Asbestos Form	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos as ACM w/w%	0.01%[4]	0.02%[4]	-	-	<LoR	<LoR	-	<LoR	<LoR	<LoR	<LoR	<LoR	-	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR
Asbestos as AF/FA w/w%	0.001%[4]	0.001%[4]	-	-	0.011	<LoR	-	<LoR	<LoR	<LoR	<LoR	<LoR	-	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR	<LoR
Bulk Asbestos																											
Sample Category	-	-	-	-	-	-	-	-	-	-	-	-	Fibre Cement	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asbestos Presence/Absence	-	-	-	-	-	-	-	-	-	-	-	-	Detected - Amosite (Brown Asbestos) and Chrysotile (White	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																											
Total Recoverable Arsenic	20	70	9.97	100	24	4	< 2	3	2	3	4	5	-	2	2	6	16	3	3	3	5	2	6	3	3	4	3
Total Recoverable Cadmium	3	1,300	0.33	20	0.54	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.13	0.17	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	460	6,300	56.88	100	45	12	9	10	11	11	12	11	-	11	11	11	11	12	11	12	15	11	22	12	11	12	11
Total Recoverable Copper	>10,000	>10,000	48.14	100	880	9	5	8	6	7	15	22	-	7	6	7	7	8	6	8	13	5	22	11	7	14	6
Total Recoverable Lead	210	3,300	25.83	100	240	19	5.5	12.1	7.7	10.4	110	240	-	8.8	8.9	8.9	15.8	11.6	7.6	11.3	64	6.4	25	14.9	7.2	52	8.6
Total Recoverable Nickel	400[5]	6,000[5]	35.15	200	16	11	9	10	9	10	10	6	-	10	10	10	9	11	10	10	11	10	15	9	10	11	10
Total Recoverable Zinc	8,000[5]	40,0000[5]	97.97	200	550	51	34	43	40	41	169	178	-	38	41	41	64	144	72	50	140	36	174	96	38	55	41
Organochlorine Pesticides in Soil *																											
4,4'-DDE	-	-	-	500	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total DDT Isomers	70	1,000	-	500	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin	2.6	160	-	8	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons in Soil																											
1-Methylnaphthalene	180[6]	-	-	-	0.051	-	-	< 0.011	< 0.012	< 0.011	< 0.011	< 0.012	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	< 0.012	**0.051**	< 0.012	-	-
2-Methylnaphthalene	38[6]	-	-	-	0.071	-	-	< 0.011	< 0.012	< 0.011	< 0.011	< 0.012	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.012**	**0.071**	< 0.012	-	-
Acenaphthylene		-	-	-	0.089			< 0.011	< 0.012	< 0.011	**0.07**	**0.025**	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.089**	**0.042**	< 0.012	-	-
Acenaphthene	3,500[6]	-	-	-	0.032	-	-	< 0.011	< 0.012	< 0.011	< 0.011	< 0.012	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.032**	**0.02**	< 0.012	-	-
Anthracene	refer BAPeq	-	-	-	0.138	-	-	< 0.011	< 0.012	< 0.011	**0.094**	**0.045**	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.138**	**0.038**	< 0.012	-	-
Benzo[a]anthracene	refer BAPeq	-	-	-	1.16	-	-	< 0.011	< 0.012	< 0.011	**0.47**	**0.24**	-	< 0.010	**0.043**	< 0.011	**0.017**	-	-	-	-	-	**1.16**	**0.27**	< 0.012	-	-
Benzo[a]pyrene (BAP)	refer BAPeq	-	-	-	1.42	-	-	**0.016**	**0.014**	< 0.011	**0.58**	**0.27**	-	< 0.010	**0.043**	**0.012**	**0.023**	-	-	-	-	-	**1.42**	**0.36**	< 0.012	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	refer BAPeq	-	-	-	1.81	-	-	**0.02**	**0.019**	**0.012**	**0.76**	**0.35**	-	< 0.010	**0.055**	< 0.011	**0.025**	-	-	-	-	-	**1.81**	**0.49**	< 0.012	-	-
Benzo[e]pyrene	-	-	-	-	0.59	-	-	**0.011**	< 0.012	< 0.011	**0.3**	**0.134**	-	< 0.010	**0.021**	< 0.011	**0.011**	-	-	-	-	-	**0.59**	**0.197**	< 0.012	-	-
Benzo[g,h,i]perylene	-	-	-	-	0.72	-	-	**0.023**	< 0.012	**0.014**	**0.36**	**0.188**	-	< 0.010	**0.027**	< 0.011	**0.013**	-	-	-	-	-	**0.72**	**0.25**	< 0.012	-	-
Benzo[k]fluoranthene	refer BAPeq	-	-	-	0.7	-	-	< 0.011	< 0.012	< 0.011	**0.3**	**0.14**	-	< 0.010	**0.025**	< 0.011	**0.012**	-	-	-	-	-	**0.7**	**0.172**	< 0.012	-	-
Chrysene	refer BAPeq	-	-	-	1.05	-	-	< 0.011	< 0.012	< 0.011	**0.5**	**0.23**	-	< 0.010	**0.034**	< 0.011	**0.017**	-	-	-	-	-	**1.05**	**0.27**	< 0.012	-	-
Dibenzo[a,h]anthracene	refer BAPeq	-	-	-	0.143	-	-	< 0.011	< 0.012	< 0.011	**0.059**	**0.029**	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.143**	**0.05**	< 0.012	-	-
Fluoranthene	refer BAPeq	-	-	-	2.1	-	-	< 0.011	**0.019**	< 0.011	**0.83**	**0.44**	-	< 0.010	**0.081**	0.016	**0.037**	-	-	-	-	-	**2.1**	**0.52**	< 0.012	-	-
Fluorene	2,300[6]	-	-	-	0.059	-	-	< 0.011	< 0.012	< 0.011	**0.011**	< 0.012	-	< 0.010	< 0.012	< 0.011	< 0.011	-	-	-	-	-	**0.059**	**0.041**	< 0.012	-	-
Indeno(1,2,3-c,d)pyrene	refer BAPeq	-	-	-	1.19	-	-	**0.021**	**0.012**	**0.012**	**0.55**	**0.26**	-	< 0.010	**0.038**	< 0.011	**0.015**	-	-	-	-	-	**1.19**	**0.35**	< 0.012	-	-
Naphthalene	58[7]	(190)[8]	-	200	0.07	-	-	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06	-	< 0.05	< 0.06	< 0.06	< 0.06	-	-	-	-	-	< 0.06	**0.07**	< 0.06	-	-
Perylene	-	-	-	-	0.4	-	-	< 0.011	< 0.012	< 0.011	**0.169**	**0.112**	-	< 0.010	**0.015**	< 0.011	< 0.011	-	-	-	-	-	**0.4**	**0.11**	< 0.012	-	-
Phenanthrene	-	-	-	-	0.4	-	-	< 0.011	< 0.012	< 0.011	**0.26**	**0.132**	-	< 0.010	**0.038**	< 0.011	**0.013**	-	-	-	-	-	**0.4**	**0.21**	< 0.012	-	-
Pyrene	1,600[7]	NA[8]	-	-	2.9	-	-	**0.013**	**0.017**	< 0.011	**0.89**	**0.42**	-	< 0.010	**0.076**	**0.013**	**0.034**	-	-	-	-	-	**2.9**	**0.89**	< 0.012	-	-
Benzo[a]pyrene Equivalence	10	35	-	300	2.1	-	-	< 0.03	< 0.03	< 0.03	**0.87**	**0.41**	-	< 0.03	**0.07**	< 0.03	**0.03**	-	-	-	-	-	**2.1**	**0.55**	< 0.03	-	-
Total Petroleum Hydrocarbons in Soil																											
C7 - C9	120[7]	120[8]	-	-	0	-	-	< 8	< 8	< 8	< 8	< 8	-	< 8	< 8	< 8	< 8	-	-	-	-	-	< 8	< 8	< 8	-	-
C10 - C14	(470)[7]	(1,500)[8]	-	-	85	-	-	< 20	< 20	< 20	< 20	< 20	-	< 20	< 20	< 20	< 20	-	-	-	-	-	**41**	**85**	< 20	-	-
C15 - C36	NA[7]	NA[8]	-	-	1250	-	-	**59**	< 40	**153**	**154**	**57**	-	**64**	< 40	< 40	< 40	-	-	-	-	-	**950**	**1250**	< 40	-	-
Total hydrocarbons (C7 - C36)	-	-	-	-	1340	-	-	< 70	< 70	**156**	**161**	< 70	-	< 70	< 70	< 70	< 70	-	-	-	-	-	**990**	**1340**	< 70	-	-
BTEX																											
Benzene	1.1[7]	3.0[8]	-	10	<LoR	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.14	< 0.16	-	-	-	-	-	< 0.17	< 0.16	< 0.18	-	-
Toluene	(68)[7]	(94)[8]	-	2,000	<LoR	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.3	< 0.3	-	-	-	-	-	< 0.3	< 0.3	< 0.3	-	-
Ethylbenzene	(53)[7]	(180)[8]	-	1,000	<LoR	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.3	< 0.3	-	-	-	-	-	< 0.3	< 0.3	< 0.3	-	-
m&p-Xylene	(48)[7]	(150)[8]	-	2,000	<LoR	-	-	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	-	< 0.10	< 0.10	< 0.3	< 0.4	-	-	-	-	-	< 0.4	< 0.4	< 0.4	-	-
o-Xylene	(48)[7]	(150)[8]	-	2,000	<LoR	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.3	< 0.3	-	-	-	-	-	< 0.3	< 0.3	< 0.3	-	-
Volatile Organic Compounds*																											
1,2,4-Trimethylbenzene	62[9]	260[9]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	< 0.3	< 0.3	-	-	-	-	-	< 0.3	**0.5**	< 0.3	-	-

Notes:

880	Exceeds upper limit of background soil concentrations
240	Exceeds applicable human health criteria (residential)
0.11	Exceeds applicable human health criteria (commercial)
110	Exceeds Class A Landfill Acceptance Criteria

All values in mg/kg unless otherwise indicated (asbestos results)
<LoR indicates result below laboratory level of reporting
BOLD indicates above laboratory levels of reporting for compounds without published background concentrations
* Only those OCP and VOC compounds which recorded concentrations above the laboratory levels of detection have been reported
(190) indicates values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons

1 - Criteria from MfE, 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health (unless otherwise stated).

2 - Upper limit of background concentrations from Landcare Research, 2016. Predicted background soil concentrations for Mudstone Pakihi.

3 - Criteria from MfE, 2004. Landfill Waste Acceptance Criteria and Landfill Classification.

4 - BRANZ Ltd, 2017. New Zealand Guidelines for Assessing and Managing Asbestos in Soil.

5 - ASC NEPM Toolbox – Update February 2014 - http://www.nepc.gov.au/nepms/assessment-site-contamination/toolbox.

6 - USEPA Regional Screening Levels - http://www.epa.gov/risk/risk-based-screening-table-generic-tables. Standard residential use used to assess conservatively assess both high density residential and recreational uses. Criteria adjusted for 1 in 100,000 risk and hazard quotient of 1 where required.

7 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011. Sandy soils at <1 m depth. Soil acceptance criteria for a residential use.

8 - MfE 1999. Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Revised 2011. Sandy soils at <1 m depth. Soil acceptance criteria for a commercial/industrial use.

9 - US EPA, Regional Screening Levels for Chemical Contaminants at Superfund Sites (US EPA regions 3, 6 and 9 (accessed Oct 2012)).

Sample ID	NES Soil - Residential 10% Produce[1]	NES Soil - Commercial/Industrial[1]	Landcare Research Predicted Background Concentrations [2]	Class A Landfill Screening Criteria [3]	Max	TP11 0.1	TP11 0.5	TP11 1.5	SS1 0.1	SS1 0.2	SS2 0.1	SS2 0.2	SS3 0.1	SS3 0.2	SS4 0.1	SS4 0.2	SS5 0.1	SS5 0.2	SS6 0.1	SS6 0.2	SS7 0.1	SS7 0.2	SS8 0.1	SS8 0.2
Date						18-Nov-19	18-Nov-19	18-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19	19-Nov-19
Laboratory Number						2278663.4 2278881.4	2278663.5 2278881.5	2278663.6 2278881.6	2278663.25 2278881.24	2278663.26	2278663.27 2278881.25	2278663.28	2278663.29 2278881.26	2278663.30	2278663.31 2278881.27	2278663.32	2278663.33 2278881.28	2278663.34	2278664.35 2278881.29	2278665.36	2278663.37	2278663.38	2278663.39	2278663.40
Sample Depth (m bgl)						0.1	0.5	1.5	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.1	0.2
Geological Unit (field)						Sandy GRAVEL	Sandy GRAVEL	SAND	Silty GRAVEL	Silty GRAVEL	Silty GRAVEL	Silty GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Sandy GRAVEL	Silty TOPSOIL	Gravelly SILT	Silty TOPSOIL	Gravelly SILT
Asbestos in Soil																								
Asbestos Presence/Absence	-	-	-	-	-	Asbestos NOT detected	Asbestos NOT detected	Asbestos NOT detected	Asbestos detected; Amosite (Brown Asbestos) and Chrysotile (White Asbestos)	-	Asbestos detected; Amosite (Brown Asbestos) and Chrysotile (White Asbestos)	-	Asbestos detected; Chrysotile (White Asbestos)	-	Asbestos NOT detected	-	Asbestos NOT detected	-	Asbestos NOT detected	-	-	-	-	-
Asbestos Form	-	-	-	-	-	-	-	-	ACM Debris and Loose Fibres	-	ACM Debris	-	ACM Debris	-	-	-	-	-	-	-	-	-	-	-
Asbestos as ACM w/w%	0.01%[4]	0.02%[4]	-	-	<LoR	<LoR	<LoR	<LoR	< 0.001	-	<0.001	-	<0.001	-	<LoR	-	<LoR	-	<LoR	-	-	-	-	-
Asbestos as AF/FA w/w%	0.001%[4]	0.001%[4]	-	-	0.011	<LoR	<LoR	<LoR	0.011	-	0.003	-	<0.001	-	<LoR	-	<LoR	-	<LoR	-	-	-	-	-
Bulk Asbestos																								
Sample Category	-	-	-	-	-	-	-	-																
Asbestos Presence/Absence	-	-	-	-	-	-	-	-																
Metals																								
Total Recoverable Arsenic	20	70	9.97	100	24	5	4	2	7	5	7	4	8	10	24	22	14	9	3	3	6	5	3	3
Total Recoverable Cadmium	3	1,300	0.33	20	0.54	< 0.10	< 0.10	< 0.10	0.29	0.11	0.27	< 0.10	0.12	0.11	0.19	< 0.10	0.47	0.54	< 0.10	< 0.10	0.16	0.11	0.10	< 0.10
Total Recoverable Chromium	460	6,300	56.88	100	45	12	12	11	19	13	15	11	15	17	25	12	45	37	11	14	15	14	11	11
Total Recoverable Copper	>10,000	>10,000	48.14	100	880	8	10	5	30	11	11	7	13	13	26	9	880	47	7	9	13	12	9	8
Total Recoverable Lead	210	3,300	25.83	100	240	10.7	33	7	113	33	52	13.7	22	71	141	21	83	124	6.1	5.7	46	32	18.2	17.4
Total Recoverable Nickel	400[5]	6,000[5]	35.15	200	16	9	11	10	12	11	11	10	11	11	10	10	16	15	6	7	15	14	9	9
Total Recoverable Zinc	8,000[5]	40,0000[5]	97.97	200	550	63	46	37	550	156	175	57	380	210	360	63	230	280	45	56	121	86	70	64
Organochlorine Pesticides in Soil *																								
4,4'-DDE	-	-	-	500	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total DDT Isomers	70	1,000	-	500	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dieldrin	2.6	160	-	8	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons in Soil																								
1-Methylnaphthalene	180[6]	-	-	-	0.051	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	38[6]	-	-	-	0.071	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthylene		-	-	-	0.089	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Acenaphthene	3,500[6]	-	-	-	0.032	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anthracene	refer BAPeq	-	-	-	0.138	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]anthracene	refer BAPeq	-	-	-	1.16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene (BAP)	refer BAPeq	-	-	-	1.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	refer BAPeq	-	-	-	1.81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[e]pyrene	-	-	-	-	0.59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[g,h,i]perylene	-	-	-	-	0.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[k]fluoranthene	refer BAPeq	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chrysene	refer BAPeq	-	-	-	1.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dibenzo[a,h]anthracene	refer BAPeq	-	-	-	0.143	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoranthene	refer BAPeq	-	-	-	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluorene	2,300[6]	-	-	-	0.059	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	refer BAPeq	-	-	-	1.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	58[7]	(190)[8]	-	200	0.07	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Perylene	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenanthrene	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	1,600[7]	NA[8]	-	-	2.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene Equivalence	10	35	-	300	2.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Petroleum Hydrocarbons in Soil																								
C7 - C9	120[7]	120[8]	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C10 - C14	(470)[7]	(1,500)[8]	-	-	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C15 - C36	NA[7]	NA[8]	-	-	1250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total hydrocarbons (C7 - C36)	-	-	-	-	1340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BTEX																								
Benzene	1.1[7]	3.0[8]	-	10	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toluene	(68)[7]	(94)[8]	-	2,000	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethylbenzene	(53)[7]	(180)[8]	-	1,000	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
m&p-Xylene	(48)[7]	(150)[8]	-	2,000	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
o-Xylene	(48)[7]	(150)[8]	-	2,000	<LoR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Volatile Organic Compounds*																								
1,2,4-Trimethylbenzene	62[9]	260[9]	-	-	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

880	Exceeds upper limit of background soil concentrations
240	Exceeds applicable human health criteria (residential)
0.11	Exceeds applicable human health criteria (commercial)
110	Exceeds Class A Landfill Acceptance Criteria

All values in mg/kg unless otherwise indicated (asbestos results)
<LoR indicates result below laboratory level of reporting
BOLD indicates above laboratory levels of reporting for compounds without published background concentrations
* Only those OCP and VOC compounds which recorded concentrations above the laboratory levels of detection have been reported
(190) indicates values exceed threshold likely to correspond to formation of residual separate phase hydrocarbons

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9 - US EPA, Regional Screening Levels for Chemical Contaminants at Superfund Sites (US EPA regions 3, 6 and 9 (accessed Oct 2012)).

Appendix E: Laboratory transcripts

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
101C Waterloo Road
Hornby
Christchurch 8042 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2278881	A2Pv2
Contact:	Kasey Pitt	**Date Received:**	21-Nov-2019	
	C/- Tonkin & Taylor	**Date Reported:**	28-Nov-2019	**(Amended)**
	PO Box 2083	**Quote No:**	102396	
	Wellington 6140	**Order No:**	1012456	
		Client Reference:	1012456	
		Submitted By:	Kasey Pitt	

Sample Type: Soil

Sample Name:		TP8 0.1 18-Nov-2019	TP8 0.4 18-Nov-2019	TP8 1.2 18-Nov-2019	TP11 0.1 18-Nov-2019	TP11 0.5 18-Nov-2019
Lab Number:		2278881.1	2278881.2	2278881.3	2278881.4	2278881.5
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	875.6	527.6	618.6	1,019.3	938.5
Dry Weight	g	820.0	469.2	575.9	960.6	889.5
Moisture	%	6	11	7	6	5
Sample Fraction >10mm	g dry wt	226.1	165.9	3.0	185.6	260.8
Sample Fraction <10mm to >2mm	g dry wt	341.3	157.7	0.6	404.2	381.9
Sample Fraction <2mm	g dry wt	250.8	143.3	571.9	369.5	246.0
<2mm Subsample Weight	g dry wt	55.9	58.7	57.9	59.7	56.6
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP11 1.5 18-Nov-2019	TP10 0.1 18-Nov-2019	TP10 0.5 18-Nov-2019	TP7 0.1 18-Nov-2019	TP7 0.5 18-Nov-2019
Lab Number:		2278881.6	2278881.7	2278881.8	2278881.9	2278881.10
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	775.8	914.8	831.2	907.2	622.5
Dry Weight	g	687.8	874.6	775.2	869.6	529.2
Moisture	%	11	4	7	4	15

Sample Type: Soil						
Sample Name:		TP11 1.5 18-Nov-2019	TP10 0.1 18-Nov-2019	TP10 0.5 18-Nov-2019	TP7 0.1 18-Nov-2019	TP7 0.5 18-Nov-2019
Lab Number:		2278881.6	2278881.7	2278881.8	2278881.9	2278881.10
Sample Fraction >10mm	g dry wt	< 0.1	205.2	285.2	297.4	43.6
Sample Fraction <10mm to >2mm	g dry wt	< 0.1	464.0	299.6	378.0	64.0
Sample Fraction <2mm	g dry wt	686.3	200.8	189.5	193.1	420.6
<2mm Subsample Weight	g dry wt	52.4	57.6	59.6	57.4	54.7
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP6 0.1 18-Nov-2019	TP6 0.4 18-Nov-2019	TP9 0.1 19-Nov-2019	TP9 0.4 19-Nov-2019	TP9 0.8 19-Nov-2019
Lab Number:		2278881.11	2278881.12	2278881.13	2278881.14	2278881.15
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	963.3	800.1	956.6	918.6	753.4
Dry Weight	g	935.0	717.4	862.6	840.3	638.9
Moisture	%	3	10	10	9	15
Sample Fraction >10mm	g dry wt	411.4	140.6	249.2	229.0	< 0.1
Sample Fraction <10mm to >2mm	g dry wt	331.2	94.0	366.0	362.6	< 0.1
Sample Fraction <2mm	g dry wt	191.1	481.5	244.9	247.8	636.8
<2mm Subsample Weight	g dry wt	56.5	58.8	54.6	56.2	55.0
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP4 0.1 19-Nov-2019	TP4 0.4 19-Nov-2019	TP3 0.1 19-Nov-2019	TP3 0.5 19-Nov-2019	TP3 0.9 19-Nov-2019
Lab Number:		2278881.16	2278881.17	2278881.18	2278881.19	2278881.20
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.
Description of Asbestos Form		-	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
As Received Weight	g	1,011.6	779.5	932.7	1,075.7	756.1
Dry Weight	g	982.8	679.4	907.6	1,017.3	654.8
Moisture	%	3	13	3	5	13
Sample Fraction >10mm	g dry wt	410.2	< 0.1	155.6	547.0	20.0
Sample Fraction <10mm to >2mm	g dry wt	388.1	2.2	502.7	282.2	207.4
Sample Fraction <2mm	g dry wt	182.5	676.2	246.3	187.1	424.5
<2mm Subsample Weight	g dry wt	58.2	56.4	51.8	56.3	57.0

Sample Type: Soil						
Sample Name:		TP4 0.1 19-Nov-2019	TP4 0.4 19-Nov-2019	TP3 0.1 19-Nov-2019	TP3 0.5 19-Nov-2019	TP3 0.9 19-Nov-2019
Lab Number:		2278881.16	2278881.17	2278881.18	2278881.19	2278881.20
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001

Sample Name:		TP2 0.1 19-Nov-2019	TP2 0.4 19-Nov-2019	TP1 0.1 19-Nov-2019	SS1 0.1 19-Nov-2019	SS2 0.1 19-Nov-2019
Lab Number:		2278881.21	2278881.22	2278881.23	2278881.24	2278881.25
Asbestos Presence / Absence		Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	Amosite (Brown Asbestos) and Chrysotile (White Asbestos) detected.	Amosite (Brown Asbestos) and Chrysotile (White Asbestos) detected.
Description of Asbestos Form		-	-	-	ACM Debris and Loose Fibres	ACM Debris
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	0.011	0.003
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	0.011	0.003
As Received Weight	g	1,093.3	766.7	1,000.7	982.3	984.0
Dry Weight	g	1,070.3	653.7	970.3	890.3	920.7
Moisture	%	2	15	3	9	6
Sample Fraction >10mm	g dry wt	467.4	< 0.1	347.2	398.8	318.0
Sample Fraction <10mm to >2mm	g dry wt	352.0	4.5	340.7	319.6	393.8
Sample Fraction <2mm	g dry wt	250.2	646.3	281.5	169.7	206.8
<2mm Subsample Weight	g dry wt	58.6	55.9	51.6	58.4	52.6
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	< 0.00001
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	< 0.00001	< 0.00001	< 0.00001	0.10195	0.02303

Sample Name:		SS3 0.1 19-Nov-2019	SS4 0.1 19-Nov-2019	SS5 0.1 19-Nov-2019	SS6 0.1 19-Nov-2019	
Lab Number:		2278881.26	2278881.27	2278881.28	2278881.29	
Asbestos Presence / Absence		Chrysotile (White Asbestos) detected.	Asbestos NOT detected.	Asbestos NOT detected.	Asbestos NOT detected.	-
Description of Asbestos Form		ACM Debris	-	-	-	-
Asbestos in ACM as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
Asbestos as Fibrous Asbestos as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
Asbestos as Asbestos Fines as % of Total Sample*	% w/w	< 0.001	< 0.001	< 0.001	< 0.001	-
As Received Weight	g	929.4	837.7	794.6	972.7	-
Dry Weight	g	812.6	752.7	650.8	867.7	-
Moisture	%	13	10	18	11	-
Sample Fraction >10mm	g dry wt	113.2	300.5	90.3	73.8	-
Sample Fraction <10mm to >2mm	g dry wt	310.3	246.8	264.2	120.8	-
Sample Fraction <2mm	g dry wt	387.6	204.0	294.6	671.8	-
<2mm Subsample Weight	g dry wt	50.5	53.3	53.6	56.6	-
Weight of Asbestos in ACM (Non-Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	-

Sample Type: Soil						
Sample Name:		SS3 0.1 19-Nov-2019	SS4 0.1 19-Nov-2019	SS5 0.1 19-Nov-2019	SS6 0.1 19-Nov-2019	
Lab Number:		2278881.26	2278881.27	2278881.28	2278881.29	
Weight of Asbestos as Fibrous Asbestos (Friable)	g dry wt	< 0.00001	< 0.00001	< 0.00001	< 0.00001	-
Weight of Asbestos as Asbestos Fines (Friable)*	g dry wt	0.00010	< 0.00001	< 0.00001	< 0.00001	-

Glossary of Terms

• Loose fibres (Minor) - One or two fibres/fibre bundles identified during analysis by stereo microscope/PLM.
• Loose fibres (Major) - Three or more fibres/fibre bundles identified during analysis by stereo microscope/PLM.
• ACM Debris (Minor) - One or two small (<2mm) pieces of material attached to fibres identified during analysis by stereo microscope/PLM.
• ACM Debris (Major) - Large (>2mm) piece, or more than three small (<2mm) pieces of material attached to fibres identified during analysis by stereo microscope/PLM.
• Unknown Mineral Fibres - Mineral fibres of unknown type detected by polarised light microscopy including dispersion staining. The fibres detected may or may not be asbestos fibres. To confirm the identities, another independent analytical technique may be required.
• Trace - Trace levels of asbestos, as defined by AS4964-2004.
For further details, please contact the Asbestos Team.

Please refer to the BRANZ New Zealand Guidelines for Assessing and Managing Asbestos in Soil.
https://www.branz.co.nz/asbestos

The following assumptions have been made:

1. Asbestos Fines in the <2mm fraction, after homogenisation, is evenly distributed throughout the fraction
2. The weight of asbestos in the sample is unaffected by the ashing process.

Results are representative of the sample provided to Hill Laboratories only.

Analyst's Comments

Amended Report: This certificate of analysis replaces an earlier report issued on 27 Nov 2019 at 2:24 pm
Reason for amendment: At the request of the client, the sample date for sample # 13 has been amended.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Wgt of Asbestos as Asbestos Fines in <10mm >2mm Fraction*	Measurement on analytical balance, from the <10mm >2mm Fraction. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.00001 g dry wt	1-29
New Zealand Guidelines Semi Quantitative Asbestos in Soil			
As Received Weight	Measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1-29
Dry Weight	Sample dried at 100 to 105°C, measurement on balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g	1-29
Moisture	Sample dried at 100 to 105°C. Calculation = (As received weight - Dry weight) / as received weight x 100.	1 %	1-29
Sample Fraction >10mm	Sample dried at 100 to 105°C, 10mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1-29
Sample Fraction <10mm to >2mm	Sample dried at 100 to 105°C, 10mm and 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1-29
Sample Fraction <2mm	Sample dried at 100 to 105°C, 2mm sieve, measurement on analytical balance. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.1 g dry wt	1-29
Asbestos Presence / Absence	Examination using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including 'Dispersion Staining Techniques'. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	-	1-29
Description of Asbestos Form	Description of asbestos form and/or shape if present.	-	1-29

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Weight of Asbestos in ACM (Non-Friable)	Measurement on analytical balance, from the >10mm Fraction. Weight of asbestos based on assessment of ACM form. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-29
Asbestos in ACM as % of Total Sample*	Calculated from weight of asbestos in ACM and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-29
Weight of Asbestos as Fibrous Asbestos (Friable)	Measurement on analytical balance, from the >10mm Fraction. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-29
Asbestos as Fibrous Asbestos as % of Total Sample*	Calculated from weight of fibrous asbestos and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-29
Weight of Asbestos as Asbestos Fines (Friable)*	Measurement on analytical balance, from the <10mm Fractions. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.00001 g dry wt	1-29
Asbestos as Asbestos Fines as % of Total Sample*	Calculated from weight of asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-29
Combined Fibrous Asbestos + Asbestos Fines as % of Total Sample*	Calculated from weight of fibrous asbestos plus asbestos fines and sample dry weight. New Zealand Guidelines for Assessing and Managing Asbestos in Soil, November 2017.	0.001 % w/w	1-29

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

John Keneth Paglingayen
Bachelor of Applied Science
Laboratory Technician - Asbestos

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2279150	A2Pv1
Contact:	Kasey Pitt	**Date Received:**	21-Nov-2019	
	C/- Tonkin & Taylor	**Date Reported:**	22-Nov-2019	
	PO Box 2083	**Quote No:**	102396	
	Wellington 6140	**Order No:**	1012456	
		Client Reference:	1012456	
		Submitted By:	Kasey Pitt	

Sample Type: Building Material

Sample Name	Lab Number	Sample Category	Sample Weight on receipt	Asbestos Presence / Absence	Description of Asbestos in Non Homogeneous Samples
Bulk 1 TP3 1.2	2279150.1	Fibre Cement	11.78	Amosite (Brown Asbestos) and Chrysotile (White Asbestos) detected. Organic fibres detected.	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Building Material

Test	Method Description	Default Detection Limit	Sample No
Asbestos in Bulk Material			
Sample Category	Assessment of sample type. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	-	1
Sample Weight on receipt	Sample weight. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch.	0.01 g	1
Asbestos Presence / Absence	Examination using Low Powered Stereomicroscopy followed by 'Polarised Light Microscopy' including 'Dispersion Staining Techniques'. Analysed at Hill Laboratories - Asbestos; 101c Waterloo Road, Christchurch. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	0.01%	1
Description of Asbestos in Non Homogenous Samples	Form, dimensions and/or weight of asbestos fibres present. AS 4964 (2004) - Method for the Qualitative Identification of Asbestos in Bulk Samples.	-	1

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

John Keneth Paglingayen
Bachelor of Applied Science
Laboratory Technician - Asbestos

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Certificate of Analysis

Client:	Tonkin & Taylor	**Lab No:**	2278663	SPv1
Contact:	Kasey Pitt C/- Tonkin & Taylor PO Box 2083 Wellington 6140	**Date Received:**	20-Nov-2019	
		Date Reported:	25-Nov-2019	
		Quote No:	102396	
		Order No:	1012456	
		Client Reference:	1012456	
		Submitted By:	Kasey Pitt	

Sample Type: Soil

Sample Name:		TP8 0.1 19-Nov-2019	TP8 0.4 18-Nov-2019	TP8 1.2 18-Nov-2019	TP11 0.1 18-Nov-2019	TP11 0.5 18-Nov-2019
Lab Number:		2278663.1	2278663.2	2278663.3	2278663.4	2278663.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	80	93
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	5	2	5	4
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	12	15	11	12	12
Total Recoverable Copper	mg/kg dry wt	8	13	5	8	10
Total Recoverable Lead	mg/kg dry wt	11.3	64	6.4	10.7	33
Total Recoverable Nickel	mg/kg dry wt	10	11	10	9	11
Total Recoverable Zinc	mg/kg dry wt	50	140	36	63	46
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	-	< 0.013	< 0.011
alpha-BHC	mg/kg dry wt	-	-	-	< 0.013	< 0.011
beta-BHC	mg/kg dry wt	-	-	-	< 0.013	< 0.011
delta-BHC	mg/kg dry wt	-	-	-	< 0.013	< 0.011
gamma-BHC (Lindane)	mg/kg dry wt	-	-	-	< 0.013	< 0.011
cis-Chlordane	mg/kg dry wt	-	-	-	< 0.013	< 0.011
trans-Chlordane	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	-	-	< 0.04	< 0.04
2,4'-DDD	mg/kg dry wt	-	-	-	< 0.013	< 0.011
4,4'-DDD	mg/kg dry wt	-	-	-	< 0.013	< 0.011
2,4'-DDE	mg/kg dry wt	-	-	-	< 0.013	< 0.011
4,4'-DDE	mg/kg dry wt	-	-	-	< 0.013	< 0.011
2,4'-DDT	mg/kg dry wt	-	-	-	< 0.013	< 0.011
4,4'-DDT	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Total DDT Isomers	mg/kg dry wt	-	-	-	< 0.08	< 0.07
Dieldrin	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endosulfan I	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endosulfan II	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endosulfan sulphate	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endrin	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endrin aldehyde	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Endrin ketone	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Heptachlor	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Heptachlor epoxide	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Hexachlorobenzene	mg/kg dry wt	-	-	-	< 0.013	< 0.011
Methoxychlor	mg/kg dry wt	-	-	-	< 0.013	< 0.011

Sample Type: Soil						
Sample Name:		TP11 1.5 18-Nov-2019	TP10 0.1 18-Nov-2019	TP10 0.5 18-Nov-2019	TP7 0.1 18-Nov-2019	TP7 0.5 18-Nov-2019
Lab Number:		2278663.6	2278663.7	2278663.8	2278663.9	2278663.10
Individual Tests						
Dry Matter	g/100g as rcvd	90	95	88	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	2	4	3	3	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	11	12	11	12	11
Total Recoverable Copper	mg/kg dry wt	5	14	6	8	6
Total Recoverable Lead	mg/kg dry wt	7.0	52	8.6	11.6	7.6
Total Recoverable Nickel	mg/kg dry wt	10	11	10	11	10
Total Recoverable Zinc	mg/kg dry wt	37	55	41	144	72
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
alpha-BHC	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
beta-BHC	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
delta-BHC	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
cis-Chlordane	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
trans-Chlordane	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	< 0.04	< 0.04	< 0.04	-	-
2,4'-DDD	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
4,4'-DDD	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
2,4'-DDE	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
4,4'-DDE	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
2,4'-DDT	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
4,4'-DDT	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Total DDT Isomers	mg/kg dry wt	< 0.07	< 0.07	< 0.07	-	-
Dieldrin	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endosulfan I	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endosulfan II	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endrin	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endrin aldehyde	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Endrin ketone	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Heptachlor	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-
Methoxychlor	mg/kg dry wt	< 0.011	< 0.011	< 0.011	-	-

Sample Name:		TP6 0.1 18-Nov-2019	TP6 0.4 18-Nov-2019	TP9 0.1 19-Nov-2019	TP9 0.4 19-Nov-2019	TP9 0.8 19-Nov-2019
Lab Number:		2278663.11	2278663.12	2278663.13	2278663.14	2278663.15
Individual Tests						
Dry Matter	g/100g as rcvd	97	89	87	90	85
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	6	16	6	3	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	11	11	22	12	11
Total Recoverable Copper	mg/kg dry wt	7	7	22	11	7
Total Recoverable Lead	mg/kg dry wt	8.9	15.8	25	14.9	7.2
Total Recoverable Nickel	mg/kg dry wt	10	9	15	9	10
Total Recoverable Zinc	mg/kg dry wt	41	64	174	96	38
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	14.9	4.5	< 0.3
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	< 0.012	0.051	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.011	0.012	0.071	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.011	0.089	0.042	< 0.012

Sample Type: Soil						
Sample Name:		TP6 0.1 18-Nov-2019	TP6 0.4 18-Nov-2019	TP9 0.1 19-Nov-2019	TP9 0.4 19-Nov-2019	TP9 0.8 19-Nov-2019
Lab Number:		2278663.11	2278663.12	2278663.13	2278663.14	2278663.15
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.011	< 0.011	0.032	0.020	< 0.012
Anthracene	mg/kg dry wt	< 0.011	< 0.011	0.138	0.038	< 0.012
Benzo[a]anthracene	mg/kg dry wt	< 0.011	0.017	1.16	0.27	< 0.012
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.012	0.023	1.42	0.36	< 0.012
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	0.03	2.1	0.55	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	0.03	2.1	0.54	< 0.03
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.011	0.025	1.81	0.49	< 0.012
Benzo[e]pyrene	mg/kg dry wt	< 0.011	0.011	0.59	0.197	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.011	0.013	0.72	0.25	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	0.012	0.70	0.172	< 0.012
Chrysene	mg/kg dry wt	< 0.011	0.017	1.05	0.27	< 0.012
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.011	0.143	0.050	< 0.012
Fluoranthene	mg/kg dry wt	0.016	0.037	2.1	0.52	< 0.012
Fluorene	mg/kg dry wt	< 0.011	< 0.011	0.059	0.041	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.011	0.015	1.19	0.35	< 0.012
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	< 0.06	0.07	< 0.06
Perylene	mg/kg dry wt	< 0.011	< 0.011	0.40	0.110	< 0.012
Phenanthrene	mg/kg dry wt	< 0.011	0.013	0.40	0.21	< 0.012
Pyrene	mg/kg dry wt	0.013	0.034	2.9	0.89	< 0.012
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	< 20	< 20	41	85	< 20
C15 - C36	mg/kg dry wt	< 40	< 40	950	1,250	< 40
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	990	1,340	< 70
BTEX in VOC Soils by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.14	< 0.16	< 0.17	< 0.16	< 0.18
Ethylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Toluene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
m&p-Xylene	mg/kg dry wt	< 0.3	< 0.4	< 0.4	< 0.4	< 0.4
o-Xylene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Halogenated Aliphatics in VOC Soils by Headspace GC-MS						
Bromomethane (Methyl Bromide)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Carbon tetrachloride	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Chloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Chloromethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2-Dibromo-3-chloropropane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,2-Dibromoethane (ethylene dibromide, EDB)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Dibromomethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,3-Dichloropropane	mg/kg dry wt	< 0.3	< 0.4	< 0.4	< 0.4	< 0.4
Dichlorodifluoromethane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1-Dichloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2-Dichloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,1-Dichloroethene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
cis-1,2-Dichloroethene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
trans-1,2-Dichloroethene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Dichloromethane (methylene chloride)	mg/kg dry wt	< 3	< 4	< 4	< 4	< 4
1,2-Dichloropropane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,1-Dichloropropene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
cis-1,3-Dichloropropene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
trans-1,3-Dichloropropene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Hexachlorobutadiene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

Sample Type: Soil						
Sample Name:		TP6 0.1 18-Nov-2019	TP6 0.4 18-Nov-2019	TP9 0.1 19-Nov-2019	TP9 0.4 19-Nov-2019	TP9 0.8 19-Nov-2019
Lab Number:		2278663.11	2278663.12	2278663.13	2278663.14	2278663.15
Halogenated Aliphatics in VOC Soils by Headspace GC-MS						
1,1,1,2-Tetrachloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,1,2,2-Tetrachloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Tetrachloroethene (tetrachloroethylene)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,1,1-Trichloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,1,2-Trichloroethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Trichloroethene (trichloroethylene)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Trichlorofluoromethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2,3-Trichloropropane	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
1,1,2-Trichlorotrifluoroethane (Freon 113)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Vinyl chloride	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Haloaromatics in VOC Soils by Headspace GC-MS						
Bromobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,3-Dichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4-Chlorotoluene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Chlorobenzene (monochlorobenzene)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2-Dichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,4-Dichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
2-Chlorotoluene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2,3-Trichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2,4-Trichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,3,5-Trichlorobenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Monoaromatic Hydrocarbons in VOC Soils by Headspace GC-MS						
n-Butylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
tert-Butylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Isopropylbenzene (Cumene)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
4-Isopropyltoluene (p-Cymene)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
n-Propylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
sec-Butylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Styrene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
1,2,4-Trimethylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	0.5	< 0.3
1,3,5-Trimethylbenzene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Ketones in VOC Soils by Headspace GC-MS						
2-Butanone (MEK)	mg/kg dry wt	< 30	< 40	< 40	< 40	< 40
4-Methylpentan-2-one (MIBK)	mg/kg dry wt	< 6	< 7	< 7	< 7	< 7
Acetone	mg/kg dry wt	< 30	< 40	< 40	< 40	< 40
Methyl tert-butylether (MTBE)	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Trihalomethanes in VOC Soils by Headspace GC-MS						
Bromodichloromethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Bromoform (tribromomethane)	mg/kg dry wt	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chloroform (Trichloromethane)	mg/kg as rcvd	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Dibromochloromethane	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Other VOC in Soils by Headspace GC-MS						
Carbon disulphide	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Naphthalene	mg/kg dry wt	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

Sample Name:		TP4 0.1 19-Nov-2019	TP4 0.4 19-Nov-2019	TP3 0.1 19-Nov-2019	TP3 0.5 19-Nov-2019	TP3 0.9 19-Nov-2019
Lab Number:		2278663.16	2278663.17	2278663.18	2278663.19	2278663.20
Individual Tests						
Dry Matter	g/100g as rcvd	96	88	97	88	85
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	2	2	3	4	5

Sample Type: Soil						
Sample Name:		TP4 0.1 19-Nov-2019	TP4 0.4 19-Nov-2019	TP3 0.1 19-Nov-2019	TP3 0.5 19-Nov-2019	TP3 0.9 19-Nov-2019
Lab Number:		2278663.16	2278663.17	2278663.18	2278663.19	2278663.20
Heavy Metals, Screen Level						
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.13	0.17
Total Recoverable Chromium	mg/kg dry wt	11	11	11	12	11
Total Recoverable Copper	mg/kg dry wt	7	6	7	15	22
Total Recoverable Lead	mg/kg dry wt	8.8	8.9	10.4	110	240
Total Recoverable Nickel	mg/kg dry wt	10	10	10	10	6
Total Recoverable Zinc	mg/kg dry wt	38	41	41	169	178
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Toluene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	0.5	< 0.3	6.2	3.0
1-Methylnaphthalene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	< 0.011	< 0.012
2-Methylnaphthalene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	< 0.011	< 0.012
Acenaphthylene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	0.070	0.025
Acenaphthene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	< 0.011	< 0.012
Anthracene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	0.094	0.045
Benzo[a]anthracene	mg/kg dry wt	< 0.010	0.043	< 0.011	0.47	0.24
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.010	0.043	< 0.011	0.58	0.27
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	0.07	< 0.03	0.87	0.41
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	0.07	< 0.03	0.86	0.40
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.010	0.055	0.012	0.76	0.35
Benzo[e]pyrene	mg/kg dry wt	< 0.010	0.021	< 0.011	0.30	0.134
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.010	0.027	0.014	0.36	0.188
Benzo[k]fluoranthene	mg/kg dry wt	< 0.010	0.025	< 0.011	0.30	0.140
Chrysene	mg/kg dry wt	< 0.010	0.034	< 0.011	0.50	0.23
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	0.059	0.029
Fluoranthene	mg/kg dry wt	< 0.010	0.081	< 0.011	0.83	0.44
Fluorene	mg/kg dry wt	< 0.010	< 0.012	< 0.011	0.011	< 0.012
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.010	0.038	0.012	0.55	0.26
Naphthalene	mg/kg dry wt	< 0.05	< 0.06	< 0.06	< 0.06	< 0.06
Perylene	mg/kg dry wt	< 0.010	0.015	< 0.011	0.169	0.112
Phenanthrene	mg/kg dry wt	< 0.010	0.038	< 0.011	0.26	0.132
Pyrene	mg/kg dry wt	< 0.010	0.076	< 0.011	0.89	0.42
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	< 8	< 8	< 8
C10 - C14	mg/kg dry wt	< 20	< 20	< 20	< 20	< 20
C15 - C36	mg/kg dry wt	64	< 40	153	154	57
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	156	161	< 70

Sample Name:		TP2 0.1 19-Nov-2019	TP2 0.4 19-Nov-2019	TP1 0.1 19-Nov-2019	TP1 0.7 19-Nov-2019	SS1 0.1 19-Nov-2019
Lab Number:		2278663.21	2278663.22	2278663.23	2278663.24	2278663.25
Individual Tests						
Dry Matter	g/100g as rcvd	97	85	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	2	4	< 2	7
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	0.29
Total Recoverable Chromium	mg/kg dry wt	10	11	12	9	19
Total Recoverable Copper	mg/kg dry wt	8	6	9	5	30
Total Recoverable Lead	mg/kg dry wt	12.1	7.7	19.0	5.5	113

Sample Type: Soil						
Sample Name:		TP2 0.1 19-Nov-2019	TP2 0.4 19-Nov-2019	TP1 0.1 19-Nov-2019	TP1 0.7 19-Nov-2019	SS1 0.1 19-Nov-2019
Lab Number:		2278663.21	2278663.22	2278663.23	2278663.24	2278663.25
Heavy Metals, Screen Level						
Total Recoverable Nickel	mg/kg dry wt	10	9	11	9	12
Total Recoverable Zinc	mg/kg dry wt	43	40	51	34	550
BTEX in Soil by Headspace GC-MS						
Benzene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Toluene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Ethylbenzene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
m&p-Xylene	mg/kg dry wt	< 0.10	< 0.10	-	-	-
o-Xylene	mg/kg dry wt	< 0.05	< 0.05	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Total of Reported PAHs in Soil	mg/kg dry wt	< 0.3	< 0.3	-	-	-
1-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
2-Methylnaphthalene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Acenaphthene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Anthracene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.016	0.014	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	< 0.03	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	0.020	0.019	-	-	-
Benzo[e]pyrene	mg/kg dry wt	0.011	< 0.012	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	0.023	< 0.012	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Chrysene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Fluoranthene	mg/kg dry wt	< 0.011	0.019	-	-	-
Fluorene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	0.021	0.012	-	-	-
Naphthalene	mg/kg dry wt	< 0.06	< 0.06	-	-	-
Perylene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Phenanthrene	mg/kg dry wt	< 0.011	< 0.012	-	-	-
Pyrene	mg/kg dry wt	0.013	0.017	-	-	-
Total Petroleum Hydrocarbons in Soil						
C7 - C9	mg/kg dry wt	< 8	< 8	-	-	-
C10 - C14	mg/kg dry wt	< 20	< 20	-	-	-
C15 - C36	mg/kg dry wt	59	< 40	-	-	-
Total hydrocarbons (C7 - C36)	mg/kg dry wt	< 70	< 70	-	-	-

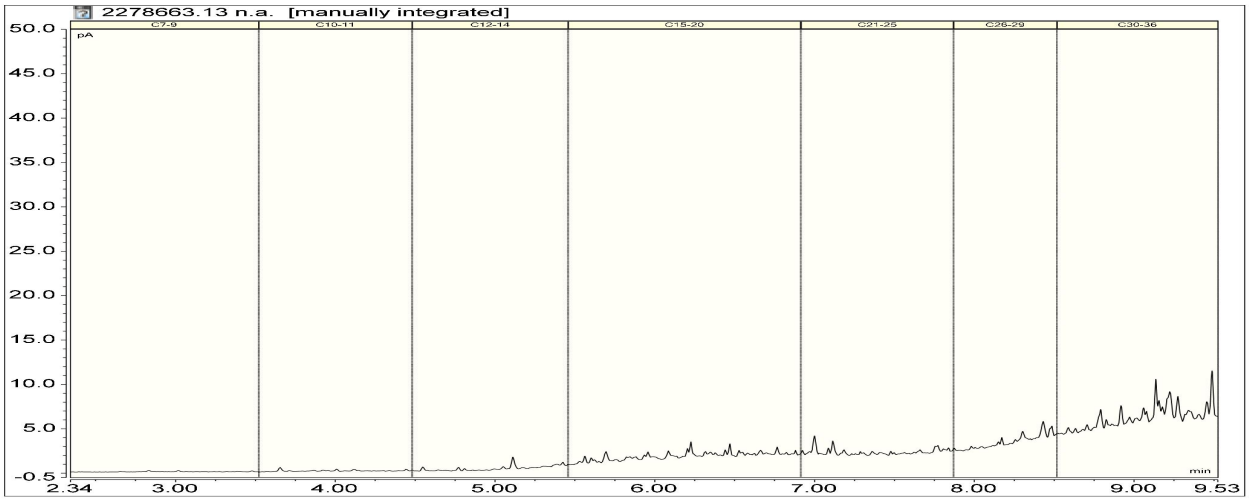
Sample Name:		SS1 0.2 19-Nov-2019	SS2 0.1 19-Nov-2019	SS2 0.2 19-Nov-2019	SS3 0.1 19-Nov-2019	SS3 0.2 19-Nov-2019
Lab Number:		2278663.26	2278663.27	2278663.28	2278663.29	2278663.30
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	7	4	8	10
Total Recoverable Cadmium	mg/kg dry wt	0.11	0.27	< 0.10	0.12	0.11
Total Recoverable Chromium	mg/kg dry wt	13	15	11	15	17
Total Recoverable Copper	mg/kg dry wt	11	11	7	13	13
Total Recoverable Lead	mg/kg dry wt	33	52	13.7	22	71
Total Recoverable Nickel	mg/kg dry wt	11	11	10	11	11
Total Recoverable Zinc	mg/kg dry wt	156	175	57	380	210

Sample Name:		SS4 0.1 19-Nov-2019	SS4 0.2 19-Nov-2019	SS5 0.1 19-Nov-2019	SS5 0.2 19-Nov-2019	SS6 0.1 19-Nov-2019
Lab Number:		2278663.31	2278663.32	2278663.33	2278663.34	2278663.35

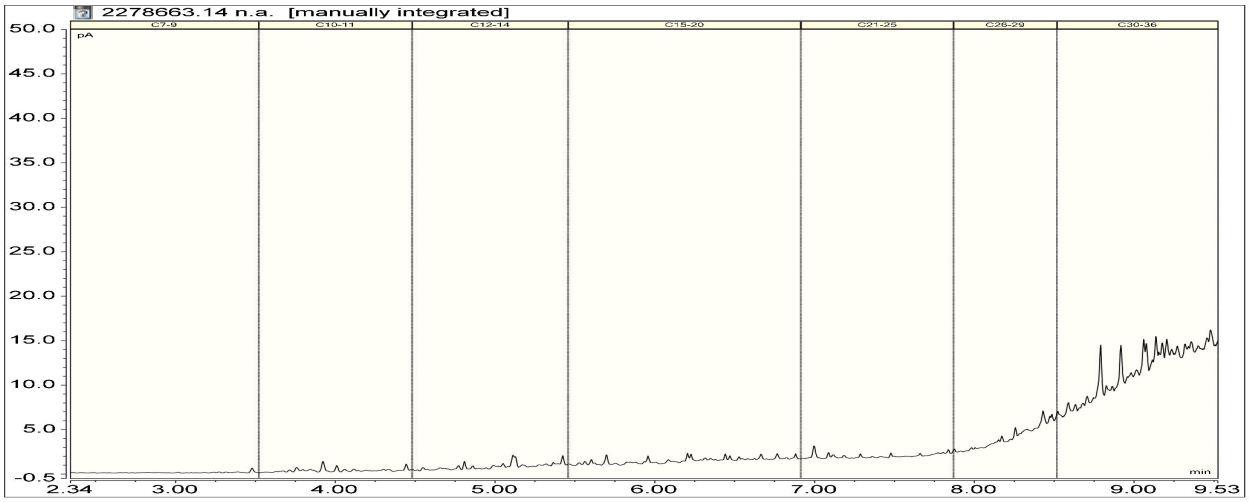
Sample Type: Soil						
Sample Name:		SS4 0.1 19-Nov-2019	SS4 0.2 19-Nov-2019	SS5 0.1 19-Nov-2019	SS5 0.2 19-Nov-2019	SS6 0.1 19-Nov-2019
Lab Number:		2278663.31	2278663.32	2278663.33	2278663.34	2278663.35
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	24	22	14	9	3
Total Recoverable Cadmium	mg/kg dry wt	0.19	< 0.10	0.47	0.54	< 0.10
Total Recoverable Chromium	mg/kg dry wt	25	12	45	37	11
Total Recoverable Copper	mg/kg dry wt	26	9	880	47	7
Total Recoverable Lead	mg/kg dry wt	141	21	83	124	6.1
Total Recoverable Nickel	mg/kg dry wt	10	10	16	15	6
Total Recoverable Zinc	mg/kg dry wt	360	63	230	280	45

Sample Name:		SS6 0.2 19-Nov-2019	SS7 0.1 19-Nov-2019	SS7 0.2 19-Nov-2019	SS8 0.1 19-Nov-2019	SS8 0.2 19-Nov-2019
Lab Number:		2278663.36	2278663.37	2278663.38	2278663.39	2278663.40
Individual Tests						
Dry Matter	g/100g as rcvd	-	79	89	76	85
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	6	5	3	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.16	0.11	0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	14	15	14	11	11
Total Recoverable Copper	mg/kg dry wt	9	13	12	9	8
Total Recoverable Lead	mg/kg dry wt	5.7	46	32	18.2	17.4
Total Recoverable Nickel	mg/kg dry wt	7	15	14	9	9
Total Recoverable Zinc	mg/kg dry wt	56	121	86	70	64
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
alpha-BHC	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
beta-BHC	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
delta-BHC	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
gamma-BHC (Lindane)	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
cis-Chlordane	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
trans-Chlordane	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Total Chlordane [(cis+trans)* 100/42]	mg/kg dry wt	-	< 0.04	< 0.04	< 0.04	< 0.04
2,4'-DDD	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
4,4'-DDD	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
2,4'-DDE	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
4,4'-DDE	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
2,4'-DDT	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
4,4'-DDT	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Total DDT Isomers	mg/kg dry wt	-	< 0.08	< 0.07	< 0.08	< 0.07
Dieldrin	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endosulfan I	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endosulfan II	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endosulfan sulphate	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endrin	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endrin aldehyde	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Endrin ketone	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Heptachlor	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Heptachlor epoxide	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Hexachlorobenzene	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012
Methoxychlor	mg/kg dry wt	-	< 0.013	< 0.011	< 0.013	< 0.012

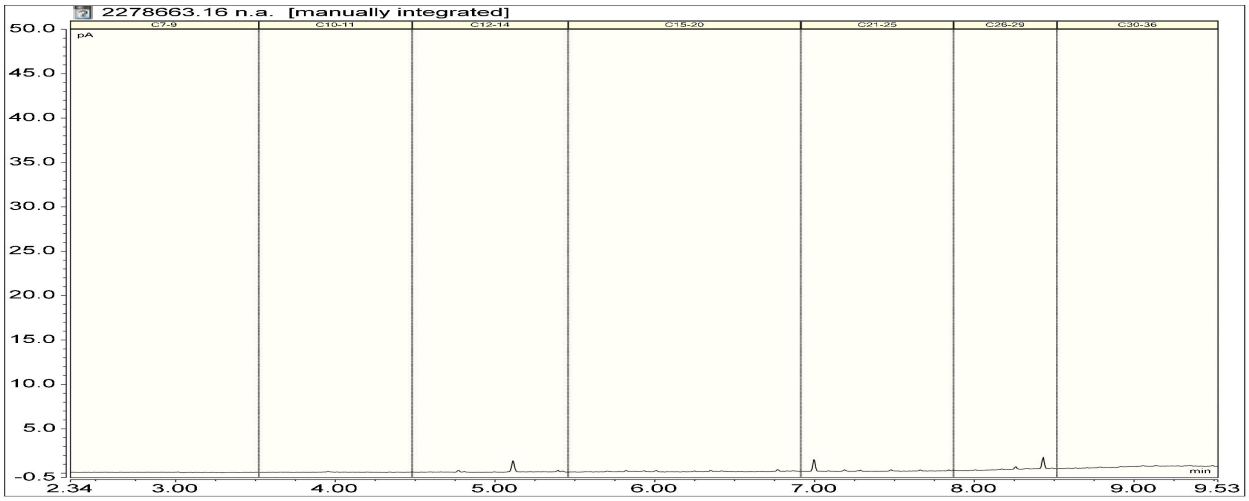
2278663.13
TP9 0.1 19-Nov-2019
Client Chromatogram for TPH by FID



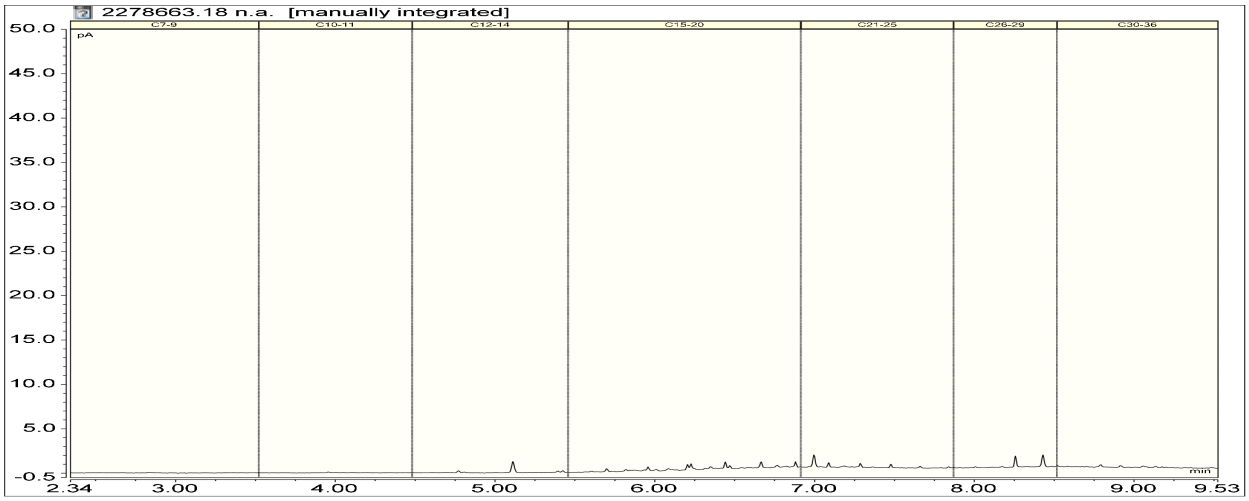
2278663.14
TP9 0.4 19-Nov-2019
Client Chromatogram for TPH by FID



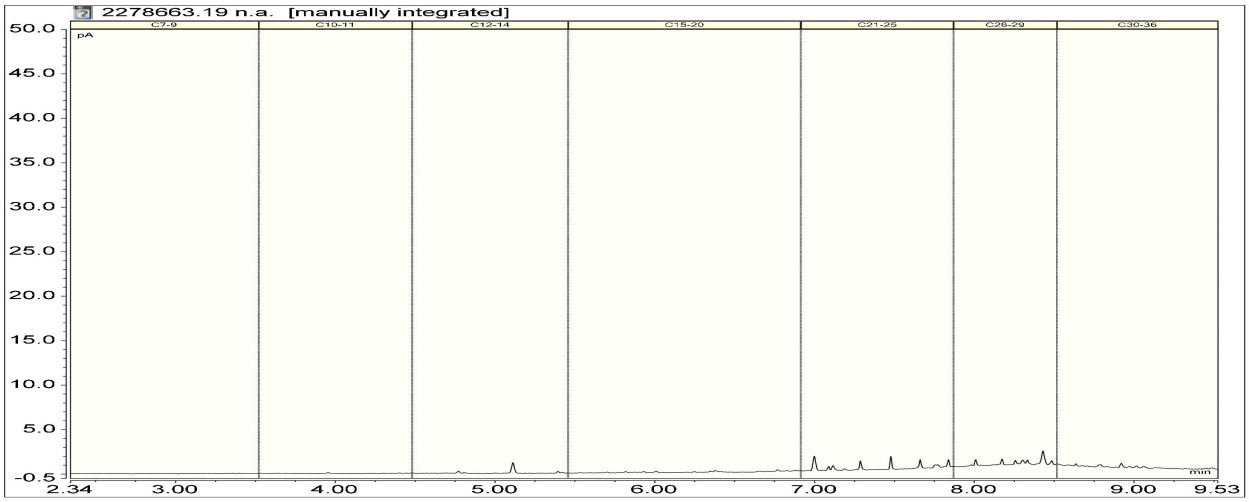
2278663.16
TP4 0.1 19-Nov-2019
Client Chromatogram for TPH by FID



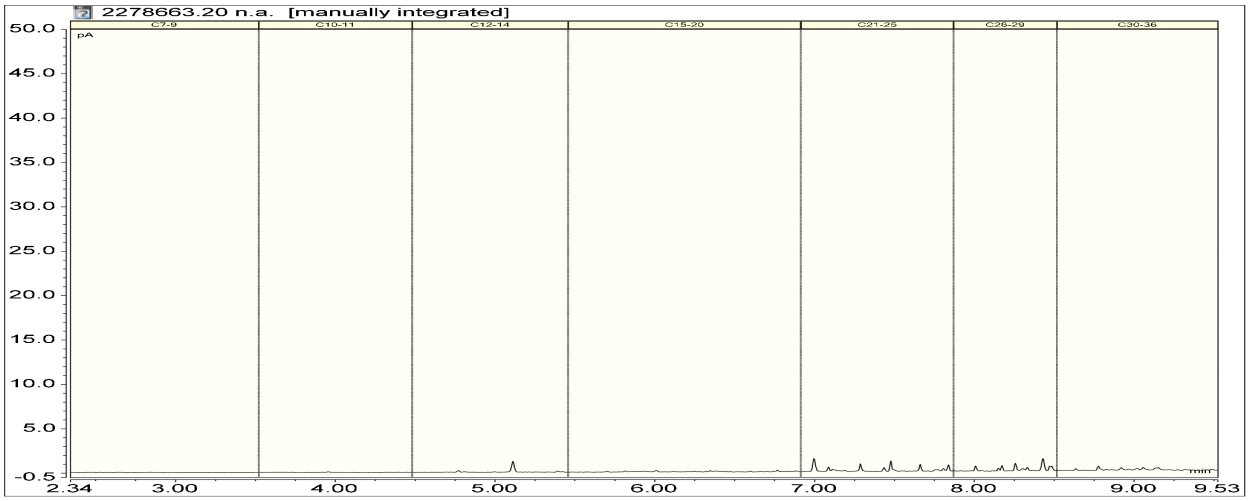
2278663.18
TP3 0.1 19-Nov-2019
Client Chromatogram for TPH by FID



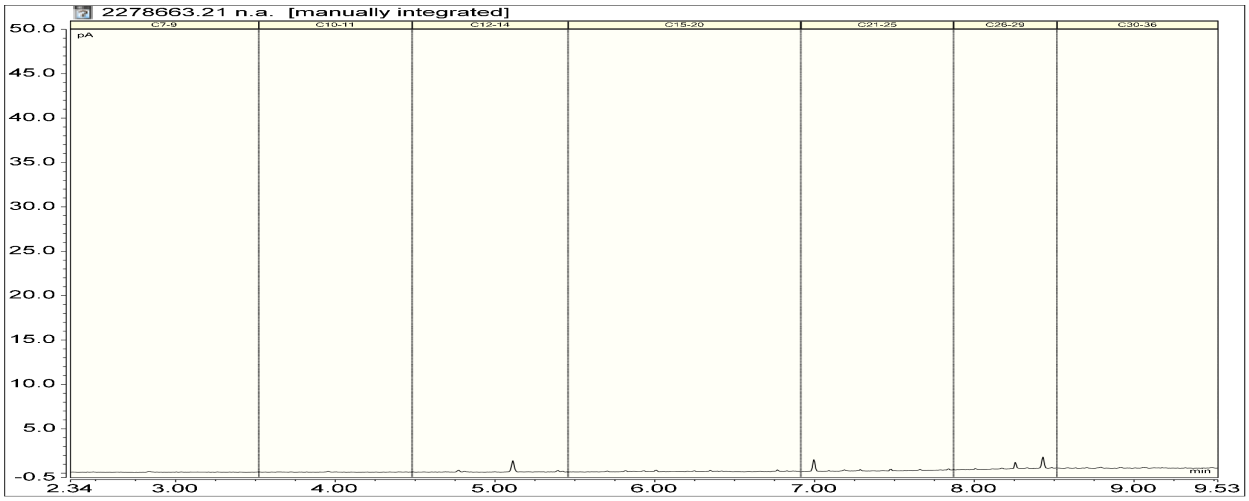
2278663.19
TP3 0.5 19-Nov-2019
Client Chromatogram for TPH by FID



2278663.20
TP3 0.9 19-Nov-2019
Client Chromatogram for TPH by FID



2278663.21
TP2 0.1 19-Nov-2019
Client Chromatogram for TPH by FID



Analyst's Comments

Only plastic containers was supplied for the sample 2278663/13,16 &17 Please note that glass containers should be used for TPHP/VOC/BTEX analysis to avoid loss of volatile's and possible plastic contamination.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Sample No
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-40
Total of Reported PAHs in Soil	Sonication extraction, SPE cleanup, GC-MS SIM analysis.	0.3 mg/kg dry wt	11-22
TPH Oil Industry Profile + PAHscreen	Sonication in DCM extraction, SPE cleanup, GC-FID & GC-MS analysis. Tested on as received sample. US EPA 8015B/MfE Petroleum Industry Guidelines [KBIs:5786,2805,10734;2695]	0.002 - 60 mg/kg dry wt	11-15
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	1-40
BTEX in Soil by Headspace GC-MS	Solvent extraction, Headspace GC-MS analysis US EPA 8260B. Tested on as received sample [KBIs:5782,26687,3629]	0.05 - 0.10 mg/kg dry wt	16-22
Organochlorine Pesticides Screening in Soil	Sonication extraction, SPE cleanup, dual column GC-ECD analysis (modified US EPA 8082). Tested on as recieved sample	0.010 - 0.06 mg/kg dry wt	4-8, 37-40
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.002 - 0.3 mg/kg dry wt	16-22
Total Petroleum Hydrocarbons in Soil	Sonication extraction in DCM, Silica cleanup, GC-FID analysis US EPA 8015B/MfE Petroleum Industry Guidelines. Tested on as received sample [KBIs:5786,2805,10734]	8 - 60 mg/kg dry wt	16-22
TPH + PAH + BTEX profile	Sonication extraction, SPE cleanup, GC & GC-MS analysis	0.002 - 60 mg/kg dry wt	16-22
Volatile Organic Compounds Screening in Soil by Headspace GC-MS	Sonication extraction, Headspace, GC-MS SIM analysis. Tested on as received sample [KBIs:31662,37857,37921]	-	11-15
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	4-8, 11-22, 37-40

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from; Benzo(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1.0 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	11-22
Benzo[a]pyrene Toxic Equivalence (TEF)	Benzo[a]pyrene Toxic Equivalence (TEF) calculated from; Benzo[a]pyrene x 1.0 + Benzo(a)anthracene x 0.1 + Benzo(b) fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.0 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	11-22

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.

Graham Corban MSc Tech (Hons)
Client Services Manager - Environmental

Appendix F: Site plan identifying areas requiring further investigation

T:\Wellington\TT Projects\1012456\WorkingMaterial\CAD\FIG\1012456-F1_2.dwg 2020-Jan-14 9:18:37 AM Plotted By: ZANE LOGOPATI

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PROJECT No.	1012456	
DESIGNED	KAPI	Dec.19
DRAWN	ZALO	Dec.19
CHECKED	JCOA	Dec.19
APPROVED	MEJ	DATE Mar-20

CLIENT **PALMERSTON NORTH CITY COUNCIL**

PROJECT **ROXBURGH CRESCENT**

TITLE GROUND CONTAMINATION ASSESSMENT
FURTHER INVESTIGATION AREAS

SCALE (A3) AS SHOWN FIG No. F2 REV A

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