Soil Contamination Risk
Detailed Site Investigation Report

27 Hamptons Road,
Prebbleton

November 2018

Malloch Environmental Ltd

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Asbestos Surveys • Soil Contamination Investigations • Environmental Planning

QUALITY CONTROL AND CERTIFICATION SHEET

Client: Selwyn District Council

Date of issue: 21 November 2018

Report written by:

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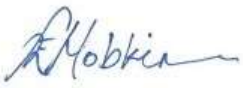
(2 years contaminated land experience)

Signed: 

Report reviewed and certified as a Suitably Qualified and Experienced Practitioner by:

Nicola Peacock, Principal Environmental Engineer, NZCE, CEnvP
(10 years contaminated land experience within 26 years environmental experience)

Signed: 

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APPENDICES

1 Executive Summary

The subject site involves two adjacent lots with the street address 27 Hamptons Road, Prebbleton. Selwyn District Council intend to develop the site for a recreational sports field use. This will involve disturbance of soils. The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS) require an assessment of the likelihood of soil contamination being present. It is noted also that Malloch Environmental Ltd is obligated to consider the requirements of Section 10 of the Health and Safety at Work (Asbestos) Regulations 2016. This report details the work undertaken to assess the risks.

A Preliminary Site Investigation undertaken by Malloch Environmental Ltd in 2015 revealed that the site has confirmed HAIL activities occurring now and/or in the past, with a historic farm working area including pre-1955 buildings likely to have had lead paint on them in the past, and coal ash having been applied to the horse training track and surround area, posing a risk of soil contamination having occurred. Since that time there has also been some burning of rubbish in various locations around the house and yard area.

Soil sampling was carried out on a judgmental basis, sampling areas identified as having a risk of contamination. Results have shown lead contamination is present around the dwelling and farm working yard area. Within these contaminated areas, two sample locations had lead levels exceeding the 'recreational' Soil Guideline Value (SGV). Prior to using this area for any proposed recreational activities, it is recommended that remediation of some form is carried out. Potential remedial options could include excavating and removing to an authorised disposal facility or to an onsite managed bund or similar, soil mixing, or capping with the likes of car parking. Whilst only a small area has lead levels above the 'recreational' SGV, there is a larger area affected by contamination and care must be taken to ensure appropriate disposal locations are selected for any soil being removed from the house and yard area during any future development works.

The results from the larger area containing the horse track showed no evidence of soil contamination from the track ash above the recreational SGV, and indeed most results were close to expected background concentrations. This larger area is considered suitable for recreational use with no further investigations required. In terms of planning status at the time of writing of this report, the NESCS does apply to the site and resource consent as a restricted discretionary activity is required.

2 Objectives of the Investigation

This report has been prepared in accordance with the Ministry for the Environment's "Contaminated Land Management Guidelines No 1: Reporting on Contaminated Sites in New Zealand". This report includes all requirements for a Stage 2 Detailed Site Investigation Report. The objectives include determining the extent and type of any contamination present that would pose a risk to human health.

3 Scope of Work Undertaken

The scope of the work undertaken has included:

- Review of previous Malloch Environmental Ltd investigations
- On site soil sampling
- Analysis of results
- Preparation of report in accordance with MfE guidelines

4 Site Identification

The site is located at 27 Hamptons Road, Prebbleton as shown on the plan in **Figure 1** below. The site is legally described as Lot 2 DP 365486 and RS 39793, and has a total area of approximately 22,002 m².

Figure 1 – Location Plan

5 Site Description and Surrounding Environment

The subject site is flat farmland divided into paddocks with a residential dwelling, associated sheds and outbuildings on the Hamptons Rd frontage. There is a horse training track formed around the majority of the site with access from the north-eastern corner to the neighbouring property. The subject site is defined by existing roads, hedges and fences. It is bounded by Hamptons Road, Birchs Road and Leadleys Road on the north, west and southern boundaries. The Little River Rail Trail is adjacent the western boundary on Birches Road. There are high voltage power lines crossing the south-eastern corner of the site. The surrounding area is similar farmland and horse training uses. Prebbleton Township is located approximately 600m to the north of the subject site.

6 Geology and Hydrology

The ECan GIS describes the soils as Wakanui deep silty loam, Flaxton deep silty loam and Temuka deep silty loam over clay. Wells in the area indicate that top soils are underlain by 7–9m of clay and clay bound gravels with a layer of peat below this and then sandy gravels. Soil trace elements are 'Regional yellow grey earth'.

The site is over the unconfined/semi confined aquifer system and ground water levels are around 3-4m deep. The direction of ground water flow is generally in a south-easterly direction. An open creek (Knights Creek) runs directly through the centre of the subject site and an open drain (Kings Drain) runs along the western boundary.

7 Summary of Previous Investigations

A Preliminary Site Investigation was completed by Malloch Environmental Ltd in September 2015. It reviewed information from historical aerial photographs, the ECan Listed Land Use Register (LLUR), the ECan resource consents database, the LINZ NZ Orchard database and the Selwyn District Council property files. Two HAIL (Hazardous Activities and Industries List) activities were identified to have occurred on the site:

> *G5. Waste disposal to land (excluding where biosolids have been used as soil conditioners)*

Parts of Lot 2 DP 365486 have been used as a horse training track since the mid-2000s. There is a resource consent for the use of coal ash to surface this track and the aerial photographs show this and coal ash being stored on site. Contaminants of concern include heavy metals and hydrocarbons (PAH).

> *I. Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment*

The northern part of Lot 2 DP 365486 has had buildings sited on it since before 1955, which is during the period when the use of lead based paints was common. There is a high risk that lead paint has been used on those buildings. Any natural deterioration or intentional removal, prior to the modern-day risk mitigating methods, may have caused contamination of the soil. In addition, there is considered to be a risk of contamination of the soils in this area with more than 60 years of use as the historic farm working area. Contaminants of concern include heavy metals and polyaromatic hydrocarbons.

The report recommended a Detailed Site Investigation, in terms of the Ministry for the Environments Contaminated Land Management Guidelines, be undertaken on the identified risk areas. The risk areas are shown on **Figure 2** below.

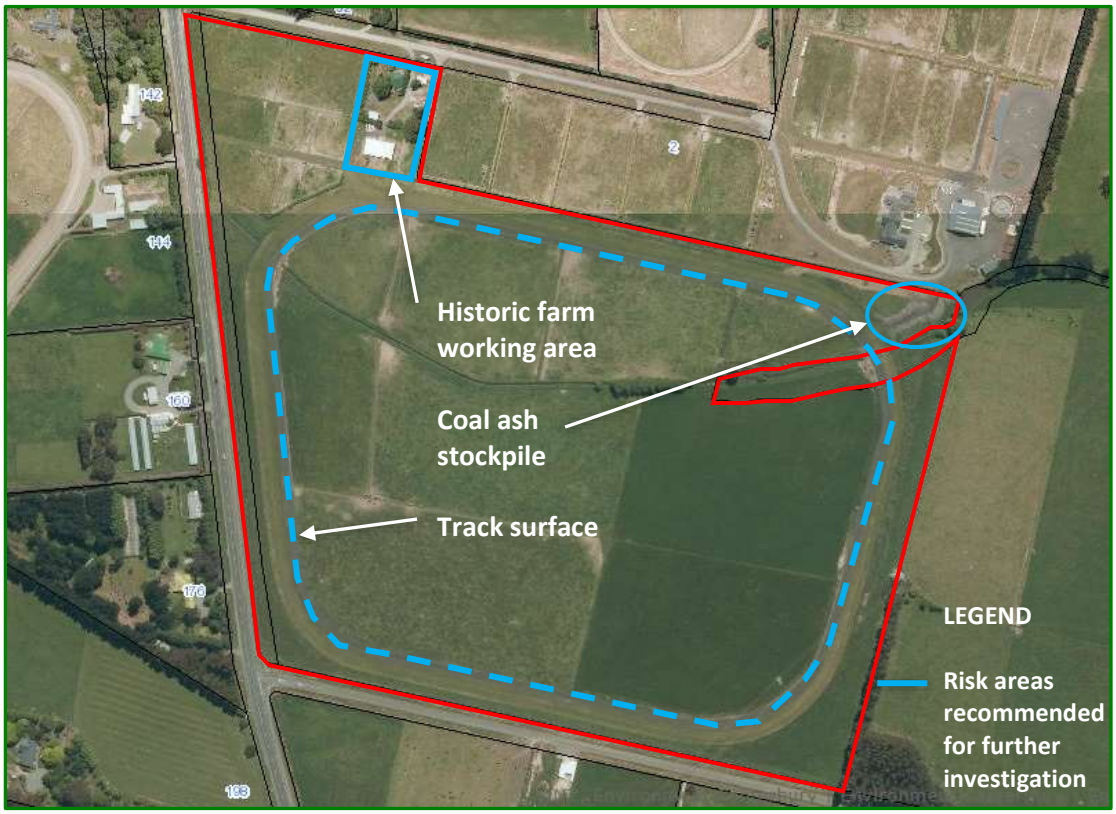

Figure 2 – Risk Areas Plan

8 Basis for Soil Guideline Values (SGV)

8.1 Activity Description

This report has been written for the following proposed activities:

- Future change of use of the land for recreational use
- Earth disturbing activities associated with the development of the site for the above use.

8.2 Zoning

The subject site is currently zoned Inner Plains Rural Zone.

8.3 Soil Guideline Values

Human health soil contaminant standards for a group of 12 priority contaminants were derived under a set of five land-use scenarios and are legally binding under The Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Health) Regulations 2011 (NES). These standards have been applied where applicable. The regulations describe these as Soil Contaminant Standards. For contaminants other than the 12 priority contaminants, the hierarchy as set out in the Ministry for the Environment Contaminated Land Management Guidelines No 2 has been followed. These are generally described as Soil Guideline Values. For simplicity, this report uses the terminology Soil Guideline Values (SGV) when referring to the appropriate soil contaminant standard or other derived

value from the hierarchy. For soil, guideline values are predominantly risk based, in that they are typically derived using designated exposure scenarios that relate to different land uses. For each exposure scenario, selected pathways of exposure are used to derive guideline values. These pathways typically include soil ingestion, inhalation and dermal adsorption. The guideline values for the appropriate land use scenario relate to the most critical pathway.

The land-use scenarios applicable for this site would be 'recreational' and 'commercial/industrial/outdoor maintenance workers' as a proxy for construction workers disturbing soils.

9 Sampling and Analysis Plan and Sampling Methodology

A judgemental sampling strategy was used to determine whether any soil contamination exists within the risk areas identified by the 2015 PSI. In addition, a site inspection was carried out prior to sampling to identify any additional risk areas.

Four samples, T1 to T4, were taken from the surface of the horse training track. Two samples, T5 and T6, were taken from the track ash stockpile to the north-east of the training track. A section of the track through the yard area also appeared to consist of track ash so this was sampled as T7. Two composite samples were analysed by Hill Laboratory for heavy metals including mercury, and PAHs (polycyclic aromatic hydrocarbons). Two soak pits were noted beside the track in the south-east corner. One was filled with broken clean concrete, the other river boulders. Neither pit appeared to contain rubbish items or any suspected asbestos containing materials. No sampling was carried out.

Photo 1: Soak pit filled with boulders

Photo 2: Soak pit filled with concrete

During sampling Knights Creek was inspected. The water appeared clean and no rubbish items were seen.

Photo 3: Knights Creek

Three burn piles were identified within the farm working area. Each pile was XRF tested and sampled at the surface. At BP1 the burn pile was on top of the concrete floor of the demolished stables, therefore the soils below were protected. BP2 was a very small circle with no obvious rubbish items. At BP3 the burn pile was on a training circle with underlying track ash. The partially burnt items included a bed frame and mattress. The sample from BP3 was submitted to Hill Laboratories and analysed for heavy metals including mercury and PAHs.

Photo 4: Burn pile within the training circle

Around the dwelling a general methodology of taking a reading approximately 0.5m away from the building and taking readings progressively further away from the building until the XRF indicated that any contaminants were below the recreational SGVs was used. Surface soils were XRF tested and sampled in six sample locations around the dwelling. Two sample locations were also XRF tested and sampled at 250mm depth to determine the depth of contamination. Six samples, including one duplicate, were submitted to Hill Laboratory for heavy metal analysis.

Surface soils at six sample locations were XRF tested and sampled around the existing sheds, inside a lean-to with an earth floor and around the location of an older shed present on a 1940's aerial photograph. Two samples were submitted to Hill Laboratory for heavy metal analysis.

As it was proposed to use the XRF for the majority of heavy metal testing and the device reads 23 metals, the contaminants to focus on were narrowed down to those likely to be present based on the risk profile and the limitations of the XRF. The results from the XRF for arsenic,

chromium, copper, lead, nickel and zinc were all analysed in detail, but only reported if above the limit of detection. For each sample location and depth, three XRF tests were performed over an approximate 10cm^2 area.

No evidence of potential asbestos contining materials was seen on the exterior of any of the buildings or burn piles at the time of the sampling, so no soils were tested for asbestos.

See **Appendix A** for the sample location plans.

10 Field Quality Assurance and Quality Control

The Contaminated Land Management Guidelines No 5, Ministry for the Environment was followed for all aspects of the investigation. Field quality control and decontamination procedures were followed. Samples were taken using a stainless-steel trowel or fresh disposable nitrile gloves. All equipment was decontaminated between samples using Decon 90 and rinsed with tap water.

Samples were collected in laboratory supplied containers and immediately placed in chilled bins. Following sampling, the samples were delivered to Hill Laboratory under chain-of-custody documentation.

11 Laboratory Quality Assurance and Quality Control

All laboratory tested samples were submitted to Hill Laboratories in Christchurch for analysis. Hill Laboratories hold IANZ accreditation. As part of holding accreditation the laboratory follows appropriate testing and quality control procedures.

The laboratory report included the following comment on the quality of two of the results:
Carbon particulates were observed in the matrix of sample 2057742.17 and this has absorbed most of the System Monitoring Compound Benzo[a]pyrene-d12 in the PAH analysis, whereby the recovery was 36%. Therefore, the results presented for these analytes may not represent the actual concentration in the sample. Carbon particulates were also observed in the matrix of sample 2057742.18 and this has absorbed most of the System Monitoring Compounds in the PAH analysis, whereby the recovery for Fluoranthene-d10 and Benzo[a]pyrene-d12 was 52% and 9% respectively. Therefore, the results presented for these analytes may not represent the actual concentration in the sample.

12 XRF Quality Assurance Measures

The XRF used was a Thermo Scientific Niton XL2 GOLDD. The manufacturer's instructions were followed in the use of the device. Calibration samples were tested prior to each day's testing and compared with the manufacturers specifications, and silicon blank readings were taken approximately every 20 samples to ensure there was no contamination of the XRF window.

The US EPA Method 6200 - Field Portable X-ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment (2007) was used as guidance for the use of the XRF and quality assurance measures. This method recommends that 5% of XRF tests should be verified through lab testing. Approximately 50% of the samples were laboratory tested for seven heavy metals.

A regression analysis was unable to be performed on the arsenic XRF readings and laboratory results due to the high number of readings below the limit of detection. A regression analysis was performed on the lead XRF readings and laboratory results to determine a statistical R^2 error result. This analysis gave an R^2 value of 0.9113 which is above the minimum acceptable

value of 0.70. The regression analysis suggests that XRF results below 503.5 mg/kg could be expected to be below the recreational SGV of 880 mg/kg for lead. **Figure 3** below shows the graphed results.

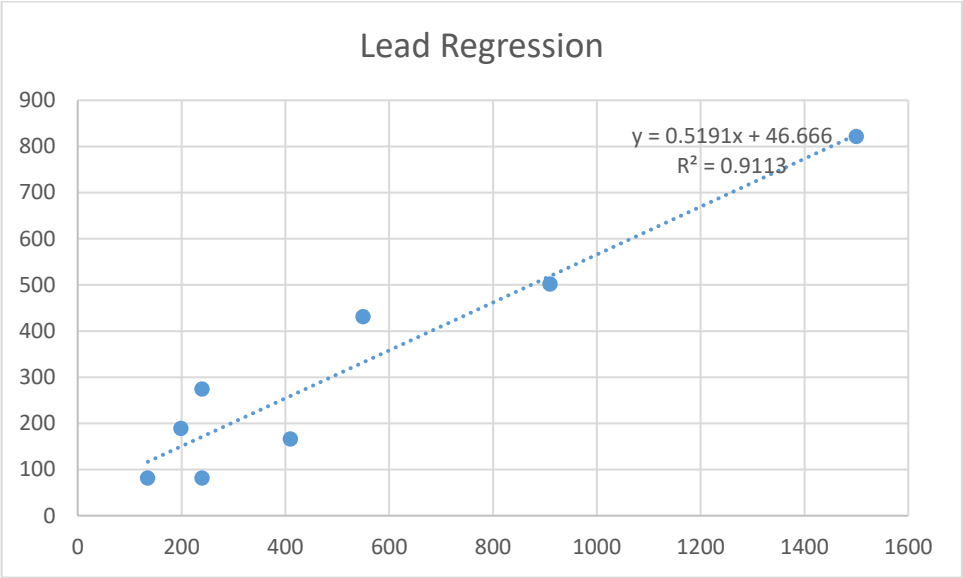

Figure 2 – Regression Analysis Graph

13 Results Analysis and Summary

13.1 Track Ash Area

The laboratory results showed no contaminants exceeding the recreational soil guideline value (SGV). The nickel concentration in the composite sample of T5, T6 and T7 is slightly above the ecological receptor guideline value. Arsenic, cadmium, chromium, copper and nickel were above the expected background values.

The PAH analysis detected trace amounts of 1-Methylnaphthalene, 2-Methylnaphthalene and Phenanthrene were detected in both composite samples. There are no recreational SGVs for these compounds however the phenanthrene levels were able to be compared with a residential SGV and many times below. The report for the PAH analysis indicated the results for some compounds may not represent the actual concentrations in the sample. The compounds are included in the BaP equivalent calculation. The worst recovery was only 9% for Benzo[a]pyrene in the composite of T5, T6 and T7. The BaP equivalent result was <0.03 mg/kg for both composite samples. This is approximately 1,333 times lower than the recreational SGV of 40 mg/kg. It is not considered possible that the samples contained a BaP equivalent concentration high enough to exceed the SGV if full recovery of the compounds had been possible.

13.2 Dwelling and Working Area

The XRF and laboratory results showed lead concentrations above the recreational soil guideline values (SGV) at two sample locations. The highest reading was from SS3.1 with a lead concentration of 1,500 mg/kg.

The concentration of zinc was above the ecological receptor guideline at seven locations, lead was above the ecological receptor guideline at two locations and nickel was above the ecological receptor guideline at one location. However, as the dwelling and working area are

distant from Knights Creek this is not considered to pose a risk. Concentrations of arsenic, cadmium, chromium, copper, lead and zinc were above expected background levels for soils in the area.

The PAH analysis of BP3, from one of the burn piles, detected only traces of 1-Methylnaphthalene, 2-Methylnaphthalene and Phenanthrene.

A table of XRF results is shown in **Appendix B** and a table of laboratory results is shown in **Appendix C**. Copies of the Laboratory Reports are included in **Appendix D**.

14 Site Characterisation and Conclusion

The laboratory results from the coal ash in the horse training track area showed no evidence of soil contamination above the recreational SGV, and indeed most results were close to expected background concentrations. It is considered highly unlikely that there will be a risk to human health if this area of the site is used for recreational activities and is suitable for recreational use with no further investigations required.

Two samples from the dwelling and farm working area exceeded the recreational SGV for lead. This could pose a risk to human health if this area of the site is used for recreational activities. The results from the rest of the dwelling and farm working area were all below the relevant recreational SGV. The following conceptual site models address the potential risks associated with the two small lead contaminated areas:

Conceptual Site Model				
Source	***Pathways***		***Receptor***	***Risk Assessment***
Two areas of lead contamination with levels of lead up to 1,500mg/kg	**Human**	Dermal contact, ingestion and inhalation	Future site occupiers / land users	Moderate risk to human health in a recreational use
			Workers involved in soil disturbance at the site	Low risk to human health as the levels are well below the commercial / outdoor worker SGVs
	Ecological	Infiltration through soils to groundwater	Groundwater is 3 – 4m deep at the site	Low risk as contaminants are likely limited to the top 300mm layer of soils
		Surface runoff to waterways	No open water features run over or near contaminated area	Low risk of contaminated soils entering surface waters in rainfall events during soil disturbance activities

Prior to using this area for any proposed recreational activities it is recommended that remediation of some form is carried out. Potential remedial options could include excavating and removing to an authorised disposal facility or to an onsite managed bund or similar, soil mixing, or capping with the likes of car parking. Whilst only a small area has lead levels above the 'recreational' SGV, there is a larger area affected by contamination and care must be taken

to ensure appropriate disposal locations are selected for any soil being removed from the house and yard area during any future development works.

15 Planning Status

In terms of the NESCS section 5 (7) states that the land is considered to be covered if an activity or industry described in the HAIL is being undertaken on it; or has been undertaken on it; or it is more likely than not that an activity is being or has been undertaken on it. Section 6 describes the methods for determining whether the land is as described in section 7. Method 6 (3) is to rely on a Preliminary Site Investigation. The Preliminary Site Investigation found that there is evidence of HAIL activities having occurred on the site. Subsequent soil sampling has shown that contamination exceeding the standards in regulation 7 does exist on the site.

In terms of planning status at the time of writing of this report, the NESCS does apply to the site and a resource consent as a restricted discretionary activity under the NESCS is required.

16 Limitations

Malloch Environmental Limited has performed services for this project in accordance with current professional standards for environmental site assessments, and in terms of the client's financial and technical brief for the work. Any reliance on this report by other parties shall be at such party's own risk. It does not purport to completely describe all the site characteristics and properties. Where data is supplied by the client or any third party, it has been assumed that the information is correct, unless otherwise stated. Malloch Environmental Limited accepts no responsibility for errors or omissions in the information provided. Should further information become available regarding the conditions at the site, Malloch Environmental Limited reserves the right to review the report in the context of the additional information.

Opinions and judgments expressed in this report are based on an understanding and interpretation of regulatory standards at the time of writing and should not be construed as legal opinions. As regulatory standards are constantly changing, conclusions and recommendations considered to be acceptable at the time of writing, may in the future become subject to different regulatory standards which cause them to become unacceptable. This may require further assessment and/or remediation of the site to be suitable for the existing or proposed land use activities. There is no investigation that is thorough enough to preclude the presence of materials at the site that presently or in the future may be considered hazardous.

Appendix A – Sample Location Plan

N

LEGEND

- SS1 Soil sample location
- Composite sample groups

Notes:

1. This plan has been prepared for soil contamination risk assessment purposes only. No liability is accepted if the plan is used for any other purposes.
2. Any measurements taken from this plan which are not dimensioned on the electronic copy are at the risk of the user.
3. Soil sample locations are approximate only.

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Sample Location Plan
27 Hamptons Rd - Horse Track Area

Scale: NTS
Date: 18 October 2018
Drawing No: 01058/1

N

LEGEND

- SS1 — Soil sample location
- SS1 — Soil sample location XRF and laboratory tested
- SS1 — Soil sample location that exceeds the recreational SGV for lead
- Sample T7 was included in the composite group with T5 and T6 on the larger sample plan.

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Sample Location Plan

27 Hamptons Rd - House and Working Area

Scale: NTS

Date: 18 October 2018

Drawing No: 01058/2

Appendix B – Table of XRF Results

Table of XRF Results - 27 Hamptons Road
Date of testing: 1st October 2018
Units: ppm

Sample ID (Lab tested samples in BOLD)	Sample Depth	XRF Reading No	Date & Time	Test Duration (secs)	Total Recoverable Arsenic		Total Recoverable Lead		Total Recoverable Mercury		Total Recoverable Zinc	
					Result	Error	Result	Error	Result	Error	Result	Error
BP1	surface	96	1/10/2018 11:14	26	48.38	12.62	37.79	13.16	<LOD	12.76	757.89	44.74
BP2	surface	97	1/10/2018 11:22	60	<LOD	9.74	71.33	8.37	<LOD	6.14	163.77	12.05
BP2	surface	98	1/10/2018 11:23	60	<LOD	10.23	66.9	8.73	<LOD	6.88	189.53	13.63
BP2	surface	99	1/10/2018 11:25	60	<LOD	10.05	73.87	8.53	<LOD	6.77	162.4	12.17
BP3	0-50mm	100	1/10/2018 11:28	30	<LOD	9.25	<LOD	11.43	12.2	7.56	17.54	9.26
H1.1	0-50mm	101	1/10/2018 11:31	60	<LOD	18.87	393.53	16.21	<LOD	6.84	272.76	15.54
H1.1	0-50mm	102	1/10/2018 11:32	60	<LOD	26.34	416.29	22.36	<LOD	9.96	154.71	16.56
H1.1	0-50mm	103	1/10/2018 11:33	60	<LOD	26.71	500.11	22.75	<LOD	9.86	148.58	15.29
H2.1	0-50mm	104	1/10/2018 11:35	60	19.87	11.96	277.72	14.95	<LOD	7.64	358.05	18.78
H2.1	0-50mm	105	1/10/2018 11:36	60	34.74	14.26	357.44	17.59	<LOD	8	364.62	20.07
H2.1	0-50mm	106	1/10/2018 11:38	60	46.5	16.41	**657.72**	20.41	<LOD	7.57	530.34	21.09
H2.2	250mm	107	1/10/2018 11:41	60	<LOD	15.86	187.83	13.69	<LOD	8.15	162.53	14.17
H2.2	250mm	108	1/10/2018 11:42	30	<LOD	25.46	225.86	21.18	<LOD	11.88	211.67	22.79
H2.2	250mm	109	1/10/2018 11:43	60	<LOD	14.56	152.74	12.16	<LOD	7.87	126.23	12.29
H3.1	50mm	110	1/10/2018 11:45	60	17.36	10.04	169.96	12.47	<LOD	7.5	256.31	16.34
H3.1	50mm	111	1/10/2018 11:46	60	<LOD	16.59	172.51	13.97	<LOD	8.8	268.82	18.62
H3.1	50mm	112	1/10/2018 11:47	60	<LOD	16.22	156	13.54	<LOD	8.88	221.33	17.22
H3.2	250mm	113	1/10/2018 11:54	60	<LOD	12.63	149.6	10.65	<LOD	6.43	218.65	13.71
H3.2	250mm	114	1/10/2018 11:55	60	<LOD	13.73	117.79	11.84	<LOD	8.42	133.3	13.47
H3.2	250mm	115	1/10/2018 11:56	60	<LOD	13.24	113.43	11.27	<LOD	8.12	170.46	14.28
H4.1	50-100mm	116	1/10/2018 11:58	60	<LOD	12.13	77.81	10.18	<LOD	8.07	217.92	16.11
H4.1	50-100mm	117	1/10/2018 12:00	60	17.8	7.73	80.45	9.41	<LOD	7.16	213.68	14.64
H4.1	50-100mm	118	1/10/2018 12:01	60	<LOD	11.33	85.36	9.47	<LOD	7.07	220.65	14.7
H5.1	50-100mm	120	1/10/2018 12:08	60	<LOD	14.62	60.07	12.65	<LOD	11.93	147.9	18.29
H5.1	50-100mm	121	1/10/2018 12:09	60	15.67	9.41	73.8	11.47	<LOD	9.68	169.86	16.53
H5.1	50-100mm	122	1/10/2018 12:10	60	<LOD	9.6	47.8	8.03	<LOD	6.94	167.36	12.89
H6.1	50-100mm	123	1/10/2018 12:12	60	35.1	15.91	**541.46**	19.86	<LOD	7.8	608.31	23.94
H6.1	50-100mm	124	1/10/2018 12:13	60	26.26	13.81	343.5	17.18	<LOD	8.06	608.76	25.35
H6.1	50-100mm	125	1/10/2018 12:14	60	<LOD	26.78	**620.13**	22.79	<LOD	8.68	496.96	23.51
S1.1	surface	126	1/10/2018 12:21	60	16.52	10.26	210.19	12.83	<LOD	7.65	1200.32	32.14
S1.1	surface	127	1/10/2018 12:22	60	22	13.47	280.11	16.79	<LOD	9.39	1008.08	34.3
S1.1	surface	128	1/10/2018 12:23	60	<LOD	20.57	331.8	17.72	<LOD	8.74	1211.55	36.9
S2.1	0-50mm	129	1/10/2018 12:25	60	<LOD	14.86	177.66	12.55	<LOD	7.71	406.61	20
S2.1	0-50mm	130	1/10/2018 12:26	60	<LOD	13.83	155.19	11.58	<LOD	7.65	397.74	19.21
S2.1	0-50mm	131	1/10/2018 12:27	60	18.11	9.72	174.04	12.06	<LOD	7.2	368.82	18.47
S3.1	0-50mm	132	1/10/2018 12:32	62	29.78	16.59	**752.19**	20.91	7.19	4.76	901.66	26.17
S3.1	0-50mm	133	1/10/2018 12:33	60	44.82	21.24	**979.22**	26.67	<LOD	7.91	918.66	29.77
S3.1	0-50mm	134	1/10/2018 12:35	60	31.8	19.37	**731.86**	24.37	<LOD	8.86	851.66	30.09
S4.1	0-50mm	135	1/10/2018 12:36	60	<LOD	11.86	92.13	10.08	<LOD	7.18	192.44	14.45
S4.1	0-50mm	136	1/10/2018 12:37	60	<LOD	12.16	102.84	10.39	<LOD	7.37	205.35	14.79
S4.1	0-50mm	137	1/10/2018 12:38	60	<LOD	10.42	94.83	8.75	<LOD	6.16	228.31	13.37
S5.1	0-50mm	138	1/10/2018 12:45	60	<LOD	13.88	154.65	11.81	<LOD	7.68	347.31	18.43
S5.1	0-50mm	139	1/10/2018 12:47	60	<LOD	13.48	163.76	11.58	<LOD	6.62	432.05	19.55
S5.1	0-50mm	140	1/10/2018 12:48	60	<LOD	9.75	80.02	8.24	<LOD	5.65	360.57	16.42
S6.1	0-50mm	141	1/10/2018 12:51	60	<LOD	10.96	85.61	9.51	<LOD	7.43	144.72	12.3
S6.1	0-50mm	142	1/10/2018 12:53	60	<LOD	12.49	93.55	10.87	<LOD	8.32	144.07	13.71
S6.1	0-50mm	143	1/10/2018 12:54	60	<LOD	11.36	85.46	9.79	<LOD	7.75	137.13	12.45
Soil Guideline Values	Recreational				80		880		1,800		30,000	
	Outdoor Worker				70		3,300		4,200		400,000	
	Reference				NES		NES		NES		NEPM	
XRF likely to be below SGV					-		*503.5*		-		-	

Result exceeds residential SGV
Result is likely to exceed residential SGV based on regression analysis

Appendix C – Table of Laboratory Results

Table of Laboratory Results - 27 Hamptons Road

Date of testing: 1st October 2018

Analyte	Sample Name:	BP3	H2.1	H2.2	H3.1	H4.1	H4.2	H6.1	S1.1	S3.1	Soil Guideline Values					
Soil results	Lab Number:	2057742.1	2057742.2	2057742.3	2057742.4	2057742.5	2057742.6	2057742.7	2057742.8	2057742.9	**Recreational**	**Commercial/ Outdoor Worker**	**Reference**	**Ecological receptors**	**Reference**	**Background$_1$**
	Depth	0-50mm	0-50mm	250mm	50mm	50-100mm	50-100mm	50-100mm	surface	0-50mm						
Heavy Metals																
Total Recoverable Arsenic	mg/kg dry wt	12	12	5	7	20	19	19	5	6	80	70	NES	17	CCME	4.90
Total Recoverable Cadmium	mg/kg dry wt	0.14	0.76	0.14	0.71	0.59	0.63	0.88	1.52	1.78	400	1,300	NES	10	CCME	0.13
Total Recoverable Chromium	mg/kg dry wt	22	21	15	23	24	24	23	15	15	2,700	6,300	NES	64	CCME	16.9
Total Recoverable Copper	mg/kg dry wt	37	22	6	21	32	32	34	125	24	>10,000	>10,000	NES	63	CCME	12.4
Total Recoverable Lead	mg/kg dry wt	9.1	*550*	199	*410*	135	240	**910**	240	**1,500**	880	3,300	NES	300	CCME	21.3
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-	-	-	-	-	1,800	4,200	NES	12	CCME	0.11
Total Recoverable Nickel	mg/kg dry wt	*55*	11	11	10	10	10	12	14	11	800	1,800	EAUK	50	CCME	13.1
Total Recoverable Zinc	mg/kg dry wt	51	*490*	136	*390*	*320*	*330*	*650*	*880*	*1,030*	30,000	400,000	NEPM	200	CCME	69.6

Analyte	Sample Name:	Composite of T1, T2, T3 & T4	Composite of T5, T6 & T7	Soil Guideline Values							
Soil results	Lab Number:	2057742.17	2057742.18	**Adjusted Recreational (3 samples)**	**Adjusted Recreational (4 samples)**	**Adjusted Commercial/ Outdoor Worker (3 samples)**	**Adjusted Commercial/ Outdoor Worker (4 samples)**	**Reference**	**Ecological receptors**	**Reference**	**Background$_1$**
	Depth	surface	surface								
Heavy Metals											
Total Recoverable Arsenic	mg/kg dry wt	5	8	26.7	20	23.3	17.5	NES	17	CCME	4.90
Total Recoverable Cadmium	mg/kg dry wt	0.14	< 0.10	100	100	433	325	NES	10	CCME	0.13
Total Recoverable Chromium	mg/kg dry wt	17	21	460	675	2,100	1,575	NES	64	CCME	16.9
Total Recoverable Copper	mg/kg dry wt	17	33	>3,333	>2,500	>3,333	>2,500	NES	63	CCME	12.4
Total Recoverable Lead	mg/kg dry wt	12	6.6	293.3	220	1,100	825	NES	300	CCME	21.3
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	600	450	1,400	1,050	NES	12	CCME	0.11
Total Recoverable Nickel	mg/kg dry wt	27	*60*	130	200	600	450	EAUK	50	CCME	13.1
Total Recoverable Zinc	mg/kg dry wt	41	28	7,400	7,500	133,333	100,000	NEPM	200	CCME	69.6

Indicates result exceeds residential guideline value
Indicates result exceeds ecological guideline value
Indicates result exceeds background value for soil type

Analyte	Sample Name:	BP3	Composite of T1, T2, T3 & T4	Composite of T5, T6 & T7	Soil Guideline Values									
Soil results	Lab Number:	2057742.1	2057742.17	2057742.18										
	Depth	0-50mm	surface	surface	**Recreational**	**Adjusted Recreational (3 samples)**	**Adjusted Recreational (4 samples)**	**Commercial/ Outdoor Worker**	**Adjusted Commercial/ Outdoor Worker (3 samples)**	**Adjusted Commercial/ Outdoor Worker (4 samples)**	**Reference**	**Ecological receptors**	**Reference**	**Background$_1$**
Polycyclic Aromatic Hydrocarbons Screening in Soil														
1-Methylnaphthalene	mg/kg dry wt	0.052	0.024	0.08	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	0.043	0.02	0.057	-	-	-	-	-	-	-	-	-	-
Perylene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.04	< 0.03	< 0.03	40	13.3	10	35	11.7	8.75	NES	-	-	0.922 $_2$
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.04	< 0.03	< 0.03	-	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Acenaphthene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[a]anthracene *	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[a]pyrene (BAP)*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Benzo[k]fluoranthene*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Chrysene*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Dibenzo[a,h]anthracene*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Fluoranthene*	mg/kg dry wt	< 0.014	0.012	< 0.012	-	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene*	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.07	< 0.06	< 0.06	-	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg dry wt	0.038	0.021	0.025	900 $_3$	300 $_3$	225 $_3$	-	-	-	GAS	-	-	-
Pyrene	mg/kg dry wt	< 0.014	< 0.011	< 0.012	-	-	-	-	-	-	-	-	-	-
Total of Reported PAHs in Soil	mg/kg	< 0.4	< 0.3	< 0.3	-	-	-	-	-	-	-	-	-	-

* Compounds included in Benzo[a]pyrene Potency Equivalency Factor calculation (NES)

Indicates result exceeds residential guideline value
Indicates result exceeds ecological guideline value
Indicates result exceeds background value for soil type

NES - National Environmental Standard for Assessing and Managing Contaminants in Soils, MfE
NEPM - National Environmental Protection Measures 2013, Formerly NEPC, Australia
EAUK - Soil guideline values for nickel - Environment Agency UK 2009
CCME - Canadian Environmental Quality Guidelines, CCME (updated 2012)
GAS - Users' Guide to the Guidelines for Assessing and Managing Contaminated Gasworks Sites in New Zealand (MfE, 1997)
$_1$ Concentrations for "Regional, Recent" soil group from Background concentrations in Canterbury soils, Tonkin and Taylor, July 2007
$_2$ Background concentrations of polycylic aromatic hydrocarbons in Christchurch urban soils, Tonkin and Taylor, 2007
$_3$ No recreational guideline is available for Phenanthrene, the values given are 'Residential 10% Produce'

Appendix D – Laboratory Reports

Hill Laboratories
TRIED, TESTED AND TRUSTED

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Certificate of Analysis

Client:	Malloch Environmental Limited	**Lab No:**	2057742 SPv1
Contact:	Nicola Peacock C/- Malloch Environmental Limited 801 East Maddisons Road Rolleston 7614	**Date Received:**	01-Oct-2018
		Date Reported:	11-Oct-2018
		Quote No:	72157
		Order No:	
		Client Reference:	Hamptons
		Submitted By:	Nicola Peacock

Sample Type: Soil

Sample Name:		BP3 01-Oct-2018 10:31 am	H2.1 01-Oct-2018 10:42 am	H2.2 01-Oct-2018 10:45 am	H3.1 01-Oct-2018 10:52 am	H4.1 01-Oct-2018 11:02 am
Lab Number:		2057742.1	2057742.2	2057742.3	2057742.4	2057742.5
Individual Tests						
Dry Matter	g/100g as rcvd	73	-	-	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	12	5	7	20
Total Recoverable Cadmium	mg/kg dry wt	-	0.76	0.14	0.71	0.59
Total Recoverable Chromium	mg/kg dry wt	-	21	15	23	24
Total Recoverable Copper	mg/kg dry wt	-	22	6	21	32
Total Recoverable Lead	mg/kg dry wt	-	550	199	410	135
Total Recoverable Nickel	mg/kg dry wt	-	11	11	10	10
Total Recoverable Zinc	mg/kg dry wt	-	490	136	390	320
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	12	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.14	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	22	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	37	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	9.1	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	55	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	51	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	0.052	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	0.043	-	-	-	-
Perylene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.04	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.014	-	-	-	-
Acenaphthene	mg/kg dry wt	< 0.014	-	-	-	-
Anthracene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.014	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.014	-	-	-	-
Chrysene	mg/kg dry wt	< 0.014	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.014	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.014	-	-	-	-

Sample Type: Soil						
Sample Name:		BP3 01-Oct-2018 10:31 am	H2.1 01-Oct-2018 10:42 am	H2.2 01-Oct-2018 10:45 am	H3.1 01-Oct-2018 10:52 am	H4.1 01-Oct-2018 11:02 am
Lab Number:		2057742.1	2057742.2	2057742.3	2057742.4	2057742.5
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Fluorene	mg/kg dry wt	< 0.014	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.014	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.07	-	-	-	-
Phenanthrene	mg/kg dry wt	0.038	-	-	-	-
Pyrene	mg/kg dry wt	< 0.014	-	-	-	-
Total of Reported PAHs in Soil*	mg/kg	< 0.4	-	-	-	-

Sample Name:		H4.2 01-Oct-2018 11:03 am	H6.1 01-Oct-2018 11:17 am	S1.1 01-Oct-2018 11:27 am	S3.1 01-Oct-2018 11:38 am	Composite of T1, T2, T3 & T4
Lab Number:		2057742.6	2057742.7	2057742.8	2057742.9	2057742.17
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	89
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	19	19	5	6	-
Total Recoverable Cadmium	mg/kg dry wt	0.63	0.88	1.52	1.78	-
Total Recoverable Chromium	mg/kg dry wt	24	23	15	15	-
Total Recoverable Copper	mg/kg dry wt	32	34	125	24	-
Total Recoverable Lead	mg/kg dry wt	240	910	240	1,500	-
Total Recoverable Nickel	mg/kg dry wt	10	12	14	11	-
Total Recoverable Zinc	mg/kg dry wt	330	650	880	1,030	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	-	5
Total Recoverable Cadmium	mg/kg dry wt	-	-	-	-	0.14
Total Recoverable Chromium	mg/kg dry wt	-	-	-	-	17
Total Recoverable Copper	mg/kg dry wt	-	-	-	-	17
Total Recoverable Lead	mg/kg dry wt	-	-	-	-	12.0
Total Recoverable Mercury	mg/kg dry wt	-	-	-	-	< 0.10
Total Recoverable Nickel	mg/kg dry wt	-	-	-	-	27
Total Recoverable Zinc	mg/kg dry wt	-	-	-	-	41
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	-	-	-	-	0.024
2-Methylnaphthalene	mg/kg dry wt	-	-	-	-	0.020
Perylene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	-	-	-	-	< 0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	-	-	-	-	< 0.03
Acenaphthylene	mg/kg dry wt	-	-	-	-	< 0.011
Acenaphthene	mg/kg dry wt	-	-	-	-	< 0.011
Anthracene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[a]anthracene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[e]pyrene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[g,h,i]perylene	mg/kg dry wt	-	-	-	-	< 0.011
Benzo[k]fluoranthene	mg/kg dry wt	-	-	-	-	< 0.011
Chrysene	mg/kg dry wt	-	-	-	-	< 0.011
Dibenzo[a,h]anthracene	mg/kg dry wt	-	-	-	-	< 0.011
Fluoranthene	mg/kg dry wt	-	-	-	-	0.012
Fluorene	mg/kg dry wt	-	-	-	-	< 0.011
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	-	-	-	-	< 0.011
Naphthalene	mg/kg dry wt	-	-	-	-	< 0.06
Phenanthrene	mg/kg dry wt	-	-	-	-	0.021
Pyrene	mg/kg dry wt	-	-	-	-	< 0.011
Total of Reported PAHs in Soil*	mg/kg	-	-	-	-	< 0.3

Sample Type: Soil						
Sample Name:		Composite of T5, T6 & T7				
Lab Number:		2057742.18				
Individual Tests						
Dry Matter	g/100g as rcvd	83	-	-	-	-
Heavy Metals with Mercury, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	8	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	21	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	33	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	6.6	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	< 0.10	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	60	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	28	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	0.080	-	-	-	-
2-Methylnaphthalene	mg/kg dry wt	0.057	-	-	-	-
Perylene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	-	-	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.012	-	-	-	-
Acenaphthene	mg/kg dry wt	< 0.012	-	-	-	-
Anthracene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[e]pyrene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	-	-	-	-
Chrysene	mg/kg dry wt	< 0.012	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	-	-	-	-
Fluoranthene	mg/kg dry wt	< 0.012	-	-	-	-
Fluorene	mg/kg dry wt	< 0.012	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.06	-	-	-	-
Phenanthrene	mg/kg dry wt	0.025	-	-	-	-
Pyrene	mg/kg dry wt	< 0.012	-	-	-	-
Total of Reported PAHs in Soil*	mg/kg	< 0.3	-	-	-	-

Analyst's Comments

Carbon particulates were observed in the matrix of sample 2057742.17 and this has absorbed most of the System Monitoring Compound Benzo[a]pyrene-d12 in the PAH analysis, whereby the recovery was 36%. Therefore the results presented for these analytes may not represent the actual concentration in the sample.

Carbon particulates were also observed in the matrix of sample 2057742.18 and this has absorbed most of the System Monitoring Compounds in the PAH analysis, whereby the recovery for Fluoranthene-d10 and Benzo[a]pyrene-d12 was 52% and 9% respectively. Therefore the results presented for these analytes may not represent the actual concentration in the sample.

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%.	-	1-9, 17-18

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
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	2-9
Heavy Metals with Mercury, 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, 17-18
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]	-	1, 17-18
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	1, 17-18
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	10-16
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benz(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 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1 + 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	1, 17-18
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k) fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.1 + 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	1, 17-18
Total of Reported PAHs in Soil*	Sonication extraction, SPE cleanup, GC-MS SIM analysis.	0.3 mg/kg	1, 17-18

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.

Ara Heron BSc (Tech)
Client Services Manager - Environmental