Before the Independent Commissioners

Under	the Resource Management Act 1991
In the matter of	a hearing on submissions on the proposed Te Tai o Poutini Plan
	Topic 20: Settlement Zone and its Precincts
	Submitter: **Russell Robinson** and **Brunner Builders Limited (S515)**

Statement of Evidence of Helen Christina Kellett

(Contaminated Land)

18 March 2024

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Qualifications and experience

1 My full name is Helen Christina Kellett.

2 I have 4.5 years' experience as a professional Environmental Scientist and 11 years' experience as a professional Engineering Geologist.

3 I am currently employed as Environmental Scientist and Senior Engineering Geologist at Wiley Geotechnical Ltd. and have held that position since 1 November 2019.

4 My previous work experience includes many Environmental Site Investigations similar to the one carried out at Lot 1 DP2820 and Pt RS3806, Arnold Valley Road, Moana (**Site**).

5 This evidence is provided in support of the submission by Russell Robinson and Brunner Builders Limited seeking to rezone the Site from notified Settlement Zone and Rural Residential Precinct to a mix of Settlement Zone and Settlement Zone with Settlement Centre Precinct, subject to an Outline Development Plan (**ODP**), through the Proposed Te Tai o Poutini Plan (**TTPP**).

6 My role has been to provide investigation and assessment of the site in relation to contaminated land.

7 I have visited the site and am familiar with the site and area.

8 In preparing this statement of evidence I have considered the following documents:

(a) Submission of Russell Robinson and Brunner Builders Limited;

(b) Ministry for the Environment 2012: Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health;

(c) Ministry for the Environment 2011: Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand

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

(e) Ministry for the Environment. (2011) Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils.

(f) Ministry for the Environment 2011: Ministry for the Environment Hazardous Activities and Industries List

9 In preparing this statement of evidence I have considered the following planning provisions:

(a) Te Tai o Poutini District Plan (notified June 2022) (**TTPP**)

(b) The Resource Management Act 1991 (**RMA**)

(c) Resource Management (National Environmental Standard for Assessing and Managing Contaminants in soil to Protect Human Health) Regulations 2011 (**NESCS**).

Code of Conduct for Expert Witnesses

10 While this is not a hearing before the Environment Court, I confirm that I have read the Code of Conduct for expert witnesses contained in the Environment Court of New Zealand Practice Note 2023 and that I have complied with it when preparing my evidence. Other than when I state I am relying on the advice of another person, this evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of evidence

11 I have prepared evidence in relation to whether the hazardous activities identified in the site's history have resulted in contamination impacts that may pose an unacceptable risk to human health during, and subsequent to, residential and commercial development of the site.

Summary of Assessment

12 I was requested by Brunner Builders Ltd to provide a Preliminary Environmental Site Investigation Report (PSI) to accompany a re-zoning plan change request made on the Grey District Plan (**Attachment 1**). Subsequently I was requested by Brunner Builders Ltd to provide a Detailed Environmental Site Investigation Report (**DSI**) (**Attachment 2**). The findings on contamination remain relevant to this process. In summary my report states the following:

(a) Activities relating to five Hazardous Activities and Industries List (**HAIL**) categories were identified on the site being:

(i) a golf course (historical), golf clubhouse and lawnmower shed located at the site (Category A10 – Persistent pesticide bulk

storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds);

(ii) a transportable fuel tank, temporarily located in the storage yard during our site visit on 10 March 2020 (Category A17 – Storage tanks or drums for fuel, chemicals or liquid waste);

(iii) an airstrip / landing pad located at the site, historically. (Category F1 – Airports including fuel storage, workshops, washdown areas, or fire practice areas);

(iv) a storage yard located at the site, housing vehicles and, temporarily, a transportable fuel tank (now removed) (Category F8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances);

(v) Moana town landfill (now closed) (Category G3 – Landfill sites).

(b) An intrusive investigation was undertaken comprising:

(i) Collection of 35 soil samples from 35 locations in the approximate location of the golf course and associated sheds, air strip, landfill, and storage yard.

(ii) Visual and olfactory inspection of soil samples in the field.

(iii) Submission of 35 soil samples to RJ Hill Laboratories (Hills) for analysis of a suite of common heavy metals, and organochlorine pesticides (OCPs).

(iv) Interpretation of laboratory results, in terms of the adopted human health criteria for medium-density residential land use, commercial land use and excavation / redevelopment earthworks.

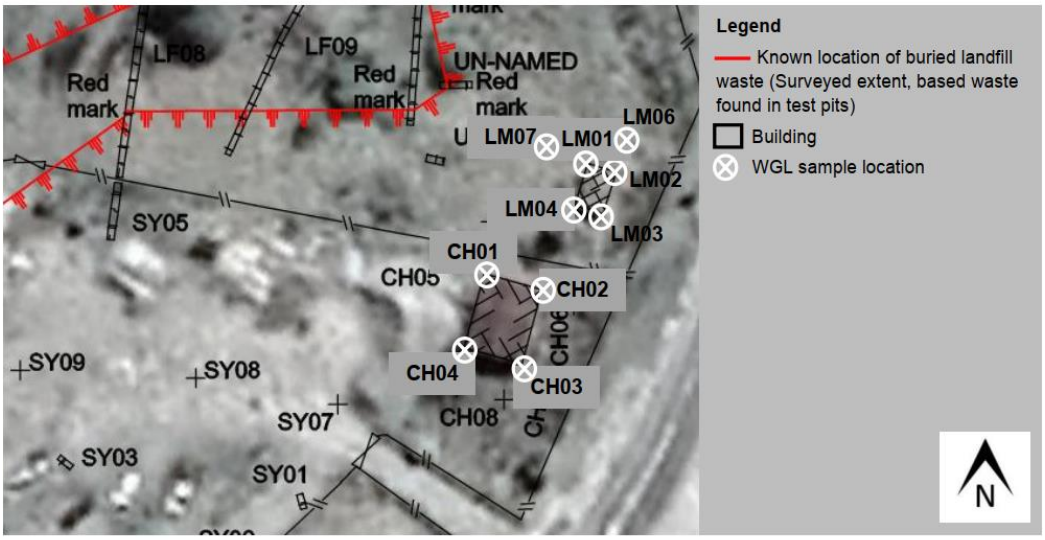
TTPP/NES-CS provisions

13 Policy CL – P1 of the TTPP (District Wide Matters, Hazards and Risks – Contaminated Land) requires that the site be assessed for potential contamination impacts as a result of current and historical land use and activities, including an investigation into the risk to human health and the environment. Our investigation found the following:

(a) Results of laboratory analyses indicate that the majority of soil samples contained contaminants at concentrations below the adopted soil contaminant standards for residential, recreational and

commercial / industrial land use. Samples LM04 and CH03, on the south eastern side of the site, next to the lawnmower shed and the golf clubhouse, contained lead at concentrations above the adopted soil contaminant standard for residential land use but below adopted soil contaminant standards for recreational and commercial / industrial land use. The location of the sample sites is identified in Appendix 3 of the DSI, with the relevant plan reproduced below for convenience.

Golf Clubhouse and Lawnmower Shed Sample Locations



Images sourced from Google and Coastwide Survey Ltd.

14 Policy CL – P2 of the TTPP requires that contaminated land is used, subdivided or developed in a way that avoids or mitigates adverse effects on the environment and manages the effects on human health, appropriate for the intended land use. With regards to this policy:

(a) Should an application for subdivision of the site be submitted, subdivision plans should be reviewed by a Suitably Qualified and Experienced Practitioner (**SQEP**) (Contaminated Land) such that the proposed land use in the location of samples LM04 and CH03 may be confirmed. At that time, remediation and/or mitigation options should be assessed in accordance with the NESCS. Should remediation of the site be undertaken, it is expected that remedial work would occur at the time of subdivision earthworks as a condition of Resource Consent.

(b) Based on the current contamination status of the site, given the potential sources identified, it is considered highly unlikely that there will be a risk to human health from chemical contamination of the new residential and commercial development, if the following activities are done to the piece of land:

(i) Developing the site for residential, commercial and recreational use.

(ii) Future use as a residential subdivision with a commercial area and recreation reserve areas.

(iii) Assessment, at subdivision stage, and remediation (if required) of the area in the location of samples LM04 and CH03, such that this area meets the requirements of the NESCS for the proposed land use.

(c) I consider that a subdivision or change in use of the land would require a Controlled Activity resource consent under the NESCS, because the requirements of Regulation 9(1) and 9(3) of the NESCS have been met. Management of contaminated soil will be controlled through this process.

(d) Owing to the exceedance of residential soil contaminant standard in samples LM04 and CH03, the soil in this area should not be classed as “cleanfill” and, as I have recommended above, the management of this area may require remediation, dependent on the proposed end use of the area, to be confirmed at subdivision stage. I have recommended a Contaminated Site Management Plan (CSMP)be implemented during subdivision earthworks stage. Several options exist to manage this area and these can be confirmed in a Remediation Action Plan (RAP) at the time of an application for resource consent for subdivision, and assessed as part of a resource consent under the NESCS.

(e) Should remediation be undertaken, the following process is generally implemented under the NESCS:

(i) A RAP is produced to establish the remedial and management methodology required to mitigate the risk posed by contaminants.

(ii) Based on the outcome of the RAP, a CSMP is produced to ensure the safety of site workers, as well as to prevent any discharges to neighboring sites and the environment as earthworks are undertaken on contaminated sites. The CSMP outlines:

(A) Site control procedures;

(B) Health and safety procedures;

(C) Environmental management procedures; and

(D) Site personnel responsible for implementing and monitoring controls and procedures at the site.

(E) Details of any monitoring requirements, disposal requirements and procedures to be implemented following the discovery of unexpected contamination.

(iii) A Site Validation Report (SVR) is completed. Remediation work and validation sampling results reported in a SVR enable compliance with any consent conditions. If the remediation strategy includes measures such as capping and ongoing controls to limit soil contact, then an Ongoing Site Management Plan (OSMP) will also be provided. This document then becomes part of the regulatory authorities records for the site and future owners and occupiers can be fully informed of any ongoing requirements

(f) Given that no background criteria exist for the West Coast region, I cannot determine whether contaminant concentrations in the soils on site are comparable to ambient concentrations of trace elements in the soil. Therefore, I recommend that at the time a resource consent application for subdivision and development is undertaken, the West Coast Regional Council and Grey District Council are consulted prior to commencement of earthworks to determine requirements for "cleanfill" soils in all other areas of the site.

Conclusion

15 Based on the PSI and DSI investigations I have undertaken on this Site for the purpose of residential subdivision and development, there is a sufficient level of knowledge associated with previous land uses and the potential for contamination. I am confident that subdivision and development as identified in the proposed Moana North ODP can be undertaken from a contaminated land perspective. Any specific land remediation for areas LM04 and CH03 and overall management of the site, including the suitability of material for reuse as fill, can be addressed appropriately at the time of subdivision and development resource consent processes through the NESCS, and TTPP Policies CL-01 and CL-02.

Helen Christina Kellett

Dated this 18th day of March 2024

Reference: C20001

Preliminary Environmental Site Investigation

Lot 1 DP2820 and Pt RS 3806
Arnold Valley Road
Moana

Submitted to:

Brunner Builders Ltd.
100 Main South Road
Karoro
Greymouth 7805

Wiley Geotechnical Ltd.
Level 1, 61 Cambridge Terrace, Christchurch
PO Box 21171, Edgeware, Christchurch 8143

Contents

1 Executive Summary

Wiley Geotechnical Limited (WGL) was requested by Brunner Builders Ltd. to provide a preliminary environmental site investigation report (PSI) for the proposed Plan Change from Rural to Residential land zoning at Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana, West Coast (herein referred to as 'the site').

The purpose of the PSI is to assess the presence of potential contamination sources that may exist as a result of current or historical activities on site or within the surrounding area, with potential to cause harm to human health and the environment.

The site is underlain by sandstone of the O'Keefe Formation and is not within the boundaries of any known aquifer systems.

The site is not currently used for commercial purposes, however; it was previously used for the Moana town landfill. This activity is recognised by the MfE as a HAIL activity (G3 – Landfill Sites).

A preliminary risk assessment based on the results of the desktop study and site inspection was undertaken, based on identified completed 'source-pathway-receptor' linkages. The principal risks identified on site are to the health of site construction workers who may be involved with excavation of potentially contaminated material within the site boundary and future residents of the proposed new "Residential" land zone.

As the PSI concluded that a HAIL activity has been confirmed on the site, the subdivision cannot be considered a Permitted Activity at this time. A detailed site environmental investigation (DSI) with soil sampling is recommended.

16 April 2020

Brunner Builders Ltd.
100 Main South Road
Karoro
Greymouth 7805

RE: Preliminary Environmental Site Investigation (PSI) for Proposed Plan Change for Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana, West Coast

2 Scope of Work

Wiley Geotechnical Limited (WGL) was requested by Brunner Builders Ltd, to provide a preliminary environmental investigation report (PSI) suitable for the proposed Plan Change from Rural to Residential land zoning at Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana.

The purpose of this investigation is to assess whether the Resource Management (*National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health*) Regulations[1] (herein referred to as the NES) applies to the site, according to criteria specified by NES Regulation 5.

If the NES applies, the investigation would assess the suitability of the site for residential land zoning, in terms of the activities being considered Permitted Activities under Rules 8(4) and 8(3), respectively.

This report was prepared in general accordance with the Ministry for the Environment (MfE) *Contaminated Land Management Guidelines* (CLMG) *No. 1: Reporting on Contaminated Sites in New Zealand* [2].

2.1 Objectives

The objectives of this investigation were to assess the site's history in terms of potentially contaminating activities, and determine whether or not those activities could have resulted in contaminants being present at concentrations that pose an unacceptable risk to human health, subsequent to re-zoning for residential land use.

2.2 Approach

The following summarises the scope of work completed to satisfy the investigation objectives.

2.3 Review of Site History and Information

Several sources were contacted for information relating to past and present uses of the site and to identify any other environmental issues which may be on record.

These consisted of:

- Undertaking a walkover inspection, to identify potential visual and olfactory indicators of contamination;
- Reviewing geological logs describing subsurface material from the site from a recent geotechnical investigation;
- Communication with the West Coast Regional Council (WCRC) and the Grey District Council (GDC) relating to former land use;
- Reviewing information recorded within the GDC Property and Rates resource, Grey District Plan, and the WCRC Local Maps online resource; and
- Reviewing publicly available historical aerial photographs of Moana in general, as well as the area within and around the site.

3 Site Identification

Site information is summarised in Table 1.

Table 1: Site Information

Location	Arnold Valley Road, Moana
Legal Description	Lot 1 DP2820 and Pt RS 3806
Site Area	Approximately 26.7 ha

A Site Location Plan is presented in Appendix 1.

3.1 Site History

Available records for the site are sparse and past site ownership details are largely unknown. Former site uses are largely based on anecdotal evidence. Site ownership information is listed in Table 2.

Table 2: Site Ownership Information

Date	Property Owner	Site Use	Potential Associated Site Use Conditions / Contaminants
2019 - Present	Brunner Builders Ltd.	Rural / Temporary storage yard Proposed use: Residential	None
Unknown - 2019	Greymouth Developments Ltd.	Disused / Rural	None
Unknown	Unknown	Landfill	• Change in ambient water temperature • Change in water pH • Conductivity of water • Ammonia (NH_3) • Chloride • Dissolved Oxygen (DO) in water • Chemical Oxygen Demand in water (COD) • Biological Oxygen Demand in water (BOD) • Nitrate nitrogen • Water hardeners • Semi-volatile Organic Compounds (SVOCs) • Volatile Organic Compounds (VOCs) • Boron • Chromium • Iron • Copper • Zinc • Arsenic • Lead • Sulphate • Aluminium • Cadmium • Landfill Gas (LFG)

We understand that the closed landfill area is proposed to be used as a green space or residential reserve.

3.2 Zoning and Permits

Current zoning category and known permits are listed in table 3.

Table 3: Zoning and Permits

Territorial Authority	Grey District Council (GDC)
Current Zoning	Rural
Proposed Zoning	Residential
Current Permits	Resource Consents RC95042/1 and RC95042/3
Expired Permits	Resource Consent RC95042/2

Consent number RC95042/1 Moana Landfill Discharge Permit, for the discharge of contaminants to water, is a consent with “current” status attached to land parcel Pt RS 3806. The consent was issued on 8 March 2000 with a 35 year term from the date of issue.

Consent number RC95042/3 Moana Landfill Discharge Permit, for the discharge of contaminants to air, is a consent with “current” status attached to land parcel Pt RS 3806. The consent was issued on 8 March 2000 with a 35 year term from the date of issue.

Expired consent number RC95042/2 Moana Landfill Discharge Permit, for the discharge of contaminants to land from the Moana Landfill, is a consent attached to land parcel Pt RS 3806. The consent was issued on 8 March 2000 with a two year term from the date of issue.

A copy of the Resource Consent documentation is presented in Appendix 2.

3.3 Grey District Council Property File

WGL requested a copy of the property file from the GDC. No property file was available at the time of our request.

3.4 West Coast Regional Council Local Maps

The following maps[5] were reviewed to assess whether any known sites of interest are located at, or near, the site:

- West Coast Property
- West Coast Consents
- West Coast Management Plans
- West Coast Water Bores
- DOC Stewardship Land

Consent numbers RC95042/1 and RC95042/3, described in section 3.2, are attached to land parcel Pt RS 3806.

No other areas of interest were located on the site, but an area of DOC Public Conservation Land is located at the corner of the south west boundary of Lot 1 DP2820, described as Conservation Area – Taku Street - Moana.

3.5 Anecdotal Evidence

The current owners purchased the property in October 2019 and have provided information regarding current and former site uses.

Known former site uses include:

- Air strip / helicopter landing pad (in approximately the 1980's)
- Golf Course
- Agriculture (at least 20 years ago)
- Landfill
- Storage Yard (current use)

There is no current requirement for water usage on site. Approximately six streams / natural drainage channels are present on the site, those nearest the former landfill are tested by the Grey District Council on a regular basis for landfill contaminants.

The only fuel stored on site is in small amounts in a in a transportable fuel tank. There are no chemicals stored on site.

There are no livestock grazing on the site. The owner states there are no historical livestock dips located on the site.

The current owner is aware that the site has previously been used for landfill activities and indicated that the area immediately to the west of the storage yard on Pt RS 3806 is the location of the former landfill. He was unsure of the operational timeframe of the landfill, or the extent and the depth of fill material. However, he stated that the landfill area was once a natural gully and that household and farm waste was put into the landfill. The landfill has since been closed and remediated.

The owner says, with the exception of the remediated landfill, there are no environmental issues pertaining to the site. On neighbouring properties, there is a petrol station opposite the south side of Pt RS 3806 and a recycling centre opposite the central eastern section of Pt RS 3806.

The current owner states that the previous owner, Greymouth Developments Ltd. did not use the site. We were unable to contact Greymouth Developments Ltd. for comment.

A copy of the interview is presented in Appendix 3.

3.6 Greymouth District Council

We contacted the GDC for more information pertaining to the closed landfill. The following information was provided:

- A copy of the current Resource Consent documentation, dated 22 March 2000.

- A copy of the Landfill Closure and Remediation Plan report, dated May 2002.
- Site Map 1, undated.
- Site Map 2, undated.
- Landfill Designation Map, dated 2019.
- Water Sampling data.

Staff at the GDC stated that the landfill was operational from pre-1982 until 2002, when it was closed and remediated.

Refuse is reported to comprise mixed waste with a mass of approximately 25,000 m^3, covered with clean hard fill gravel sourced from the surrounding land.

Each of the documents listed above are presented as Appendices 2 and 4 - 8 of this report.

3.7 Review of Historical Aerial Photographs

Photographs on the retrolens.nz website[6] and Google Earth[7] have been reviewed to obtain information on the past uses of the site. Aerial photographs taken between 1943 and 2019 have been reviewed.

Table 4 summarises the features visible in each image. Images are presented as an attachment to this report.

Table 4: Historical Photographs

1943[6]	The site and surrounding area were largely undeveloped, with the western edges and south western portion of Lot 1 DP2820 being heavily vegetated with forest. Development related to Moana township begins approximately 250 m south of the site.
1953[6]	The site and surrounding area were largely undeveloped. A north trending, linear section of land has been cleared to the north of the north eastern corner of lot Pt RS 3806.
1962[6]	Arnold Valley Road was being straightened at the north eastern boundary of the site and an access road had been driven east to west across the site to the edge to the forest, on the north west side of Lot 1 DP2820, where material removed for road construction appears to be stockpiled. A line of trees had been planted adjacent to a northeast to south west trending terrace, across Pt RS 3806, approximately 350 m from the south boundary of the site, with land cleared of vegetation to the south of the trees. An east to west access track had been driven across the south side of Pt RS 3806.
1968[6]	Developments relating to Moana township appear to begin adjacent to the site. An excavation is located to the north of the north eastern boundary of Pt RS 3806. This may be a small quarry.
1973[6]	Earthworks and / or clearing of vegetation had been undertaken on the south eastern side of Pt RS 3806 between the south boundary and a south east to north west trending gully, approximately 180 m from the south boundary, adjacent to a bend in Arnold Valley Road. There may have been a building constructed at the site, on the south eastern side of Pt RS 3806. The remainder of the site appears undeveloped. The excavation is located to the north of the north eastern boundary of Pt RS 3806, thought to be a small quarry, has expanded, but remains relatively small.
1982[6]	Several ancillary buildings were present on the south side of Pt RS 3806 and a cattle stop or similar appears to have been installed. Further vegetation clearance had taken place, back to the eastern edge of a south east to north west trending gully, approximately 180 m from the south boundary, on the south side of Pt RS 3806. An unknown material had been stockpiled on the south eastern side of the site adjacent to the gully; this may be landfill material. Earthworks and/or clearing of vegetation had also taken place north of the gully, however; the extent of this clearance is unknown as imagery of the north eastern side of Pt RS 3806 was unavailable. Lot 1 DP2820 appears undeveloped. The site immediately to the east has been developed with a shed and yard.
2013 to 2019[7]	Two buildings remain on the site, on the south side of Pt RS 3806, with a roughly square cleared yard area to the west of the buildings. To the south and west of the yard area there appears to be a water body. The south east to north west trending gully, approximately 180 m from the south boundary, on the south side of Pt RS 3806, and now to the west of the existing yard, appears to have been partially filled; we consider this to be the approximate location of a closed landfill. The extent of former land clearance on Pt RS 3806 is visible, with an area of low vegetation growth present on the south side of the lot extending past the landfill area, in a linear strip, approximately 350 m from the south boundary, to the tree lined terrace edge. This may be the location of a former airstrip and helicopter landing pad, reported to have been operational in approximately the 1980's.

Aerial photographs are presented in Appendix 9.

4 Site Condition and Surrounding Environment

The site setting is summarised in Table 5.

Table 5: Site Setting

Topography	The site is located on a broad terraced gully generally trending towards the south west and is largely unused, with grass and moss providing the majority of ground cover.
Local Setting	The site is located on the northern edge of the Moana township and is in a rural setting with a forested area to the north and west and Arnold Valley Road to the east.
Nearest Surface Water & Use	There are approximately six small streams or drainages that run through the site with two apparent (based on aerial imagery) areas of ponding water. The majority of these are vegetated with little access available. Where access was found, the base and banks of the streams and drainages were vegetated with grasses and mosses. On-site surface water is unused and allowed to drain naturally from the site, towards the Arnold River. The site is located approximately 480 m north of Lake Brunner and approximately 500 m east of the Arnold River. The Arnold River is the outflow of Lake Brunner. The Moana Sewerage Pond is located approximately 530 m to the east of the site.

4.1 Site Walkover Inspection

A site walkover inspection was undertaken on 10 March 2020 by Helen Kellett of WGL. Photographs taken during the inspection are presented in Appendix 10.

4.2 Visual Evidence

The site is currently unused, except for a storage yard, on the south side of Pt RS 3806, that is temporarily being used by contractors installing fibre optic cables in Moana township.

A small swale is present at the western edge of the storage yard, approximately 100 m from Arnold Valley Road. This is thought to be the boundary of the closed landfill.

Two disused sheds are located adjacent to the storage yard, on the east side of Pt RS 3806.

The site is terraced, cut by several small streams or drainage channels with the majority of ground covered with grasses and mosses. Waterways are generally surrounded by denser vegetation including areas of gorse, blackberries and native plants. Ponding water is located north of the sheds on the eastern side of Pt RS 3806. Based on aerial imagery, ponding water is thought to be present on the south side of Pt RS 3806, to the south of the closed landfill, but was inaccessible, owing to vegetation.

The western edges of Lot 1 DP2820, particularly the south western side, are heavily vegetated with native forest.

A small amount of fuel is stored on site, temporarily, in the storage yard, on fine gravel fill, in a transportable fuel tank.

No potential visual or olfactory indicators of contamination were observed during the inspection.

5 Geology and Hydrology

Site geology and hydrogeology is summarised in Table 6.

Table 6: Geology and Hydrology

Geology	The GNS map (Nathan et al. 2002) for the site indicates that it is underlain by dominantly gravel and sand glacial till deposits overlying the O'Keefe Formation, which is part of the Blue Bottom Group. We consider porosity of the gravel and sand glacial till deposits to be approximately 20%.
Hydrogeology	The groundwater depth at the site is variable owing to the terraced nature of the site. Four out of 18 test pits, excavated to between 1.5 m and 2.5 m depth, encountered standing water. The highest standing water level encountered at the site was 1.3 m depth below ground level in two locations on the south eastern side of the site, to the east of the closed landfill, close to a body of ponded surface water. Standing water was encountered at 1.6 m depth in two further locations, one near an apparent area of ponded water, south of the closed landfill, on the south side of the site, and one near a stream on the north western side of the site. There are no known aquifers beneath the site. Given the location of the site and its elevation above lake Brunner and the Arnold Valley, we consider that the standing water encountered may be perched water and that true groundwater level is likely to be somewhat deeper.
Hydrology	There are approximately six small streams or drainages that run through the site. At the time of our visit, there was little access available to the majority of the stream banks owing to vegetation, however where access was available, we estimate approximately 5 mm to 20 mm of water present in the base of the streams and drainages. The streams and drainage channels appear to flow to the west, into the Arnold River. The site is located approximately 500 m east of the Arnold River. There is an area of ponding water to the east of the closed landfill, and a second apparent (based on aerial imagery) area of ponding water, to the south of the closed landfill.

5.1 Geological Logs

WGL investigated the underlying geology at the site during a recent geotechnical investigation[4]. The subsurface material encountered in the on-site test pit investigations consisted typically of a topsoil layer underlain by silty or sandy gravel. The maximum depth of investigation was 2.5 m below ground level and groundwater was not encountered in that particular test pit. Landfill waste was encountered in one location (TP03), 1.5 m below the surface, beneath silty and sandy gravel fill capping layers. The location of TP03 is presented in Appendix 1.

6 Site Water Sampling

Water sampling of the streams and drainages in the immediate vicinity of the closed landfill has been undertaken since May 2000. The water samples are tested for indicators of leaching from the closed landfill on a six monthly basis, in line with consent conditions. We understand that Verum Group (formerly CRL Energy Ltd.) are currently contracted to undertake water sampling, on behalf of the GDC.

There are four sample locations around the closed landfill. One upstream point, ML1, one downstream point, ML2, and two points in the mixing zone, ML3 and ML4. Maps indicating the locations of the sample points are presented in Appendices 5 and 6.

A visual assessment is undertaken in each sample location and water samples are collected. In accordance with consent conditions, the visual assessment records the following:

- Recent weather conditions
- Substrate condition
- Presence of aquatic life
- Undesirable biological / vegetation growth
- Visible staining
- Water clarity / colour
- Oil / grease films
- Scums / foams
- Floatable / suspended solids
- Odour

In accordance with consent conditions, each sample is screened for the following conditions / contaminants:

- pH
- Conductivity
- Temperature
- Dissolved Oxygen
- Chloride
- Total Ammoniacal Nitrogen

At the time of writing WGL did not have access to quality assurance and quality control procedures undertaken by Verum Group or the screening Laboratory.

7 Basis for Guideline Values

The current Resource Consent conditions outline the required concentration limits for each condition or contaminant. These limits appear to have been based on the national standards and guidelines in the ANZECC 1992: “Australia and New Zealand Water Quality Guidelines for Fresh and Marine Waters – Protection of Aquatic Plant, Animal and Microbial Communities”

Adopted guideline values are presented in Appendix 8.

8 Sample Results

WGL requested a copy of the water sampling results from the GDC. In general, the sample results show reasonably similar conditions and contaminant levels between ambient upstream samples and downstream samples. There have been a few non-compliant sample results recorded, but these appear, for the most part, to be one-off or short-lived exceedances.

Water sampling results are presented in Appendix 8.

9 Site Characterisation

9.1 Summary of Identified Hazardous Activities and Industries

The following activities or industries noted on the Hazardous Activities and Industries List[8] (HAIL) have been identified during review of the site history:

- Category A10 – Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.
- Category A17 – Storage tanks or drums for fuel, chemicals or liquid waste.
- Category F1 – Airports including fuel storage, workshops, washdown areas, or fire practice areas.
- Category F8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances.
- Category G3 – Landfill Sites

9.2 Conceptual Site Model

A contamination conceptual site model, presented in Table 7, consists of three primary components to allow the potential for risk to be determined. These are:

- Source of contamination;
- Pathway to allow the contamination to mobilise; and
- Sensitive receptors which may be impacted by the contamination.

Table 7: Conceptual Site Model

Source	Pathway	Receptor
Heavy metals	Dermal absorption (direct contact); Ingestion and / or inhalation of soil / LFG; Leaching of contaminants to groundwater; Inhalation of dust.	Maintenance / Excavation workers; Site workers; Future residents.
Semi-volatile organic compounds (SVOCs)		
Volatile organic compounds (VOCs)		
Landfill gas (LFG)		
PAHs		
Risk to human health?	Contamination residue and gasses (if any) from within the former landfill area and leaching from the landfill site (if any) may pose a potential risk to human health. Laboratory analysis of water samples is ongoing; however, laboratory analysis of soil and gas samples will be required to quantify the risk.	

10 Conclusions and Recommendations

Information obtained as part of this investigation indicates that part of the site has formerly been used for landfill. Soil contaminants may be buried in the landfill at the site, and potential contaminants in the soils or migration of LFG may pose a risk to human health. The site is also thought to have housed a small airstrip / landing pad and to have been part of a golf course. Soil contaminants related to these activities may be present in the soils. Based on our investigation, we consider that NES regulations apply to the site, according to criteria specified in NES Regulation 5.

Based on the evidence gathered in this investigation, the proposed subdivision cannot be considered a Permitted Activity at this time until soil and gas samples have been assessed. We recommend a detailed site environmental investigation (DSI). The scope of testing undertaken during the DSI should be determined during the investigation.

Water sampling has been undertaken for the past 20 years at the site. The sample results indicate leaching of contaminants is low.

11 References

1. Ministry for the Environment 2012: Users' Guide National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health.
2. Ministry for the Environment 2011: Contaminated Land Management Guidelines No.1: Reporting on Contaminated Sites in New Zealand.
3. GNS Webmap Institute of Geological and Nuclear Sciences 2013: 1:250,000 Geology. Viewed at: http://data.gns.cri.nz/geology/
4. Wiley Geotechnical Limited 2019: Geotechnical Investigation Report Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana. Reference: C20001.000.001
5. West Coast Regional Council: WestMaps online resource. Viewed at: https://gis.westcoast.govt.nz/WestMaps/
6. Local Government Geospatial Alliance 2017: Retrolens – Historical Image Resource Project. Viewed at: http://retrolens.nz
7. Google Earth Pro V.7.3.2.5487. Moana, West Coast, New Zealand. -42.569470° lat, 171.481505° lon, Eye alt 3.03 km. Digital Globe 2019. [March 2020]
8. Ministry for the Environment 2011: Ministry for the Environment Hazardous Activities and Industries List.
9. Grey District Council (2005). Grey District Plan. Retrieved March 2020, from https://www.greydc.govt.nz/SiteCollectionDocuments/OurServices/Planning/DistrictPlan/Complete%20version/Complete%20District%20Plan.pdf
10. Grey District Council. Rates Information. Retrieved February 2020, from https://maps.greydc.govt.nz/intramaps90/default.htm?configId=2f6f83a4-782b-45eb-9b60-d5819e718428

LIMITATIONS

(i) This report has been prepared for the use of our client, Brunner Builders Ltd. and their professional advisers, and the relevant Regional Authorities in relation to the specified project brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

(ii) Assessments made in this report are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this report based on accepted normal methods of site investigations. Variations in ground conditions may exist between test locations and therefore have not been taken into account in the report.

(iii) This Limitation should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on 021 127 1291 or helen@wileygeotechnical.co.nz if you require any further information.

Report prepared by

Helen Kellett

Senior Engineering Geologist

Reviewed by

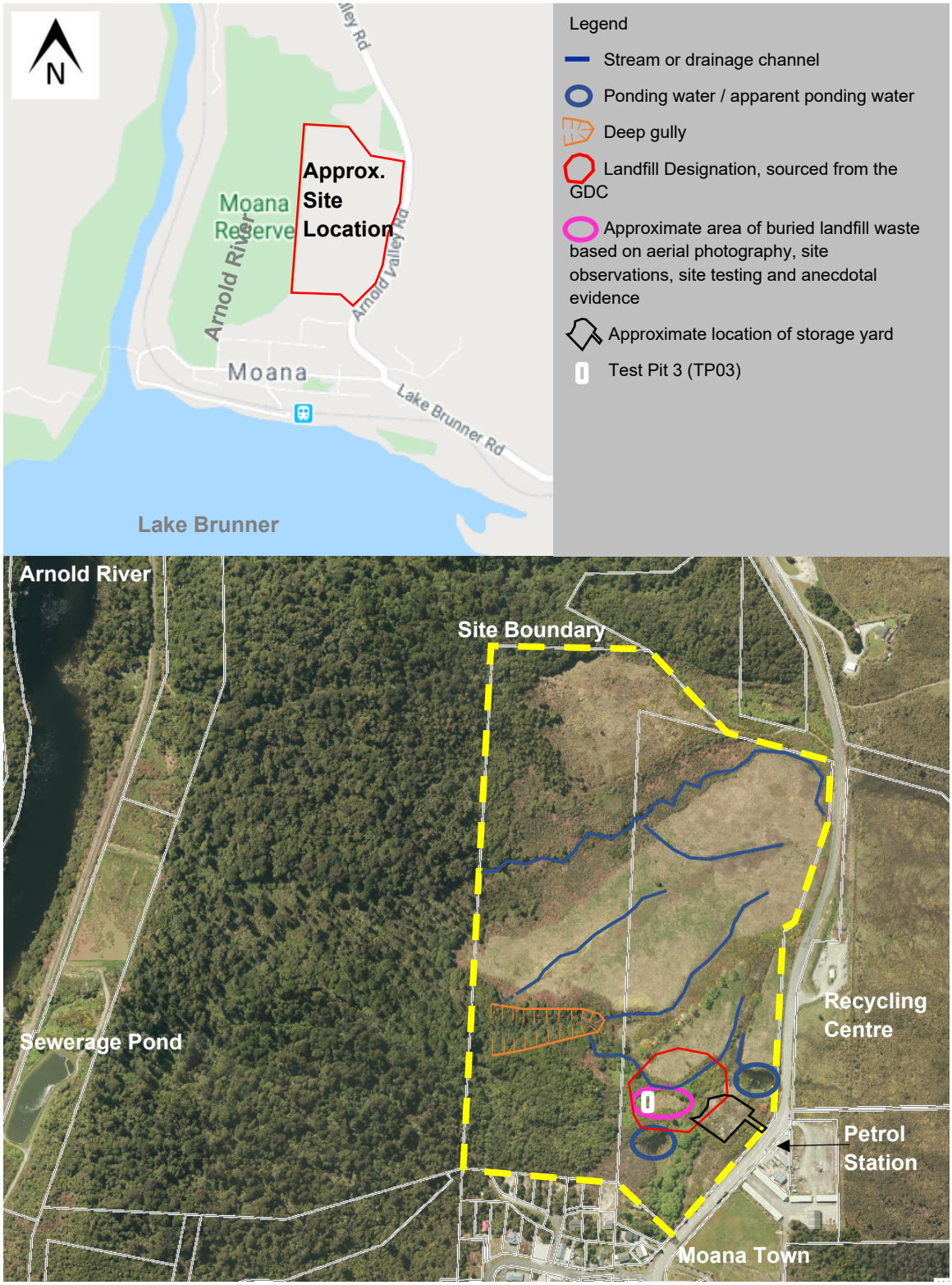
Claude Midgley, CEnvP

Associate Environmental Scientist

Matt Wiley, CPEng

Principal Engineer

Appendix 1: Site Location Plan



Appendix 2: Resource Consent

THE WEST COAST
REGIONAL COUNCIL

153 Tainui Street,
P.O. Box 66, Greymouth.
The West Coast, New Zealand.
Telephone (03) 768 0466
Toll Free 0508 800 118
Facsimile (03) 768 7133

RESOURCE CONSENT

Pursuant to Part VI of the Resource Management Act 1991 The West Coast Regional Council hereby grants to:

GREY DISTRICT COUNCIL
P.O. BOX 382
GREYMOUTH.

A Resource Consent for the term and upon the conditions hereinafter set forth.

File No:	RC95042
Resource Consent No:	RC95042/1 RC95042/2 RC95042/3
Date of Issue:	8 March 2000
Term:	RC95042/1 & RC95042/3 - 35 Years from date of issue RC95042/2 – 2 Years from date of issue
Type of Resource Consent:	Discharge Permits
Purpose of Resource Consent:	Discharge contaminants associated with the disposal of solid waste and the products of solid waste decomposition to air and waterbodies from the Moana Landfill.
Location:	Moana
Legal Description:	

Consents Sought:

Resource Consent No.	Type of Resource Consent	Purpose
RC95042/1	Discharge Permit to Water	To discharge contaminants associated with the disposal of solid waste and the products of solid waste decomposition to a small unnamed creek from the Moana landfill.
RC95042/2	Discharge Permit to Land	To discharge solid waste to the Moana Landfill.

RC95042/3	Discharge Permit to Air	To discharge contaminants (including landfill gas, dust and odorous substances) associated with the disposal of solid waste and the products of solid waste decomposition to air from the Moana Landfill.

Conditions:

RC95042/1

Compliance conditions

1. The landfill site shall be operated in accordance with the site management plan dated October 1998 and any subsequent update to that plan. The plan may be amended as the consent holder considers appropriate during the time of these consents to ensure compliance with the conditions of this consent. At any time during the period of this consent, a copy of the latest version of the site management plan shall be forwarded to the consent authority upon request.

2. Three months prior to the closure of the site the Consent Holder shall prepare a 'site closure and remediation plan'. The site closure and remediation plan shall comply with the conditions of this consent. The plan may be amended as the Consent Holder considers appropriate during the time of these consents. At any time during the period of this consent, a copy of the latest version of the management and operations plan shall be forwarded to the Consent Authority upon request. The site closure and remediation plan shall at least address the following matters:

   2.1 Description of site closure and remediation works, including landscaping and revegetation

   2.2 Remediation programme including timetable, sequence of events and duration

   2.3 Remediation methods and equipment to be used

   2.4 Location, design, operation and maintenance of stormwater runoff control and leachate control facilities

2.5 Qualifications of the designer of the stormwater runoff control and leachate control facilities

2.6 Measures to discourage unauthorised dumping at the site post-closure; including signage and alternative facilities (eg. transfer station, new landfill etc.)

2.7 Methods for vermin and weed control

2.8 Future use for the site in the context of remediation

Receiving Surface Water Quality

3. The ambient pH in the creek identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 1 shall not be varied by more than 0.5 pH units as recorded at sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

4. The ambient concentration of ammonia (NH_3) in the creek identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 1 shall not be increased by more than $0.03g/m^3$ as recorded at sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

5. The ambient chloride concentration in the creek identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 1 shall not be increased by more than $0.1g/m^3$ as recorded at sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

6. The ambient dissolved oxygen concentration in the creek identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 1 shall not be increased by more than $6.0g/m^3$ as recorded at sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

7. The ambient temperature in the creek identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 1 shall not be increased by more than 5.0 degrees Celsius as recorded at sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

8. The level of conductivity in the drains identified on site plan 69771/C08 as recorded at a point identified on site plan 69771/C08 as sample point 2 shall not be more than double that of the ambient level as recorded at sample point 1 as identified on site plan 69771/C08 as a result of leachate discharge.

9. The ambient concentration of all parameters stated in condition 17 at a point identified on site plan 69771/C08 as sample point 1 shall not be varied so as to exceed the national standards and guidelines in the ANZECC 1992: *"Australia and New Zealand Water Quality Guidelines for marine and fresh water – Protection of Aquatic Plant, Animal and Microbial Communities"* for each parameter at the sample point 2 as identified on site plan 69771/C08 as a result of leachate discharge.

10. There shall be no discharge to the creeks identified on site plan 69771/C08 that may cause or result in any:

    10.1 Conspicuous oil or grease films, scums or foams, or floatable or suspended materials;

    10.2 Conspicuous change in the colour or visual clarity;

    10.3 Emission of objectionable odour;

    10.4 Rendering of the fresh water unsuitable for consumption by farm animals or;

    10.5 Significant adverse effect on aquatic life;

    10.6 Undesirable biological growth

11. If there is a breach of Condition 10 the consent holder shall notify the consent authority within 24 hours of recording such matters.

12. If at any time one or more of the standards set out in Condition 3 to 9 are breached the consent holder shall notify the consent authority within 48 hours of the breach being identified.

Monitoring Method

13. The analysis and preservation of all water samples collected in accordance with this consent shall be carried out in accordance with the most recent standard method of analysis of water and wastewater or any equivalent method. All trace element analysis shall be reported as acid soluble concentration. The collection and analysis of samples shall be carried out by a suitably qualified person. Copies of their qualifications shall be forwarded to the consent authority upon request.

Tier 1 Monitoring Conditions

14. Unless otherwise advised in writing by the consent authority the consent holder shall monitor the effects of leachate discharge from the landfill site in general accordance with the monitoring programme submitted to the consent authority with the application dated October 1999 and the monitoring shall be carried out in accordance with condition 15 below. The consent authority may increase the frequency of monitoring from time to time; depending on the results of monitoring supplied to the consent authority, in accordance with condition 16. If the consent authority requires increased monitoring, the monitoring programme shall be updated and a copy supplied to the Consent Authority.

15. The standard sampling frequency shall be six months. The consent holder shall collect surface water samples for laboratory analysis and/or conduct field analysis of the following parameters:

- pH
- Ammonia (NH_3
- Temperature
- Chloride
- Dissolved oxygen
- Conductivity

The presence of the following shall be recorded – conspicuous oil or grease films, scums or foams, or floatable or suspended materials; conspicuous change in colour or visual clarity, objectionable odour; significant adverse effect on aquatic life, including fish kill and undesirable biological growths.

16. Within 30 days of notifying the Consent Authority of a breach of conditions 2 to 9, the consent holder shall supply the following information in the form of a tier 1 monitoring report to the consent authority. The report shall detail:.

16.1 Nature of the discharge and sensitivity of the receiving environment to the effects of the discharge;

16.2 An assessment of actual and potential effects of the discharge;

16.3 Any possible alternative methods of discharge for the future;

16.4 Details of any correction/mitigation measures undertaken or to be undertaken to avoid remedy or mitigate the actual or potential effect of the discharge on the environment.

The tier 1 monitoring report shall be prepared by a suitably qualified person. This information is required in addition to the tier 1 monitoring requirements.

Tier 2 Monitoring

17. Upon receipt of the information required in condition 16 the consent holder shall at the request of the consent authority carry out sampling in general accordance with the monitoring programme submitted to the consent authority with the application dated October 1999 and in accordance with condition 13 for any one or more of the following parameters.

- pH
- Conductivity
- Ammonia (NH_3)
- Chloride
- Dissolved oxygen
- Temperature
- COD (chemical oxygen demand)
- BOD_5 (which is five day biological oxygen demand)
- Nitrate nitrogen
- Hardeners
- SVOCs (semi volatile organic compounds) – screen test

- VOC (volatile organic compounds) – screen test
- Boron (acid soluble)
- Chromium (acid soluble)
- Iron (acid soluble)
- Copper (acid soluble)
- Zinc (acid soluble)
- Arsenic (acid soluble)
- Lead (acid soluble)
- Sulphate (acid soluble)
- Aluminium (acid soluble)
- Cadmium (acid soluble)

18. If the results from the tier 2 monitoring show that a particular parameter listed in condition 17 exceeds the standards and guidelines in ANZECC, 1992: *"Australia and New Zealand Water Quality Guidelines for Marine and Freshwater – Protection of Aquatic Plant, Animal and Microbial Communities";* for that parameter then the parameter shall be added to the tier 1 monitoring in accordance with condition 15 below. If after subsequent monitoring, the results of that parameter fall within the aforementioned national standards and guidelines for that parameter then that parameter may be removed from the list of parameters requiring routine monitoring under Condition 15.

19. Within 30 days of conducting tier 2 monitoring in accordance with condition 17 the consent holder shall supply to the consent authority with a tier 2 monitoring report containing the information prescribed in condition 16.1 to 16.4. This report shall also be prepared by a suitably qualified person.

Monitoring of closure of site

20. Upon closure of the site the consent holder shall complete a benthic macroinvertebrate survey at each monitoring site identified on site plan 69771/C08 to evaluate general stream health and cumulative effects of any leachate. If the benthic macroinvertebrate survey indicates that leachate may be having an effect on stream health then the information required in condition 16.1 to 16.4 shall be provided to the consent authority and the consent authority may then require further monitoring in accordance with condition 17.

Annual Reporting

21. The consent holder shall compile a monitoring report for this site and forward that report to the consent authority before each anniversary of the granting of this resource consent. As a minimum the report shall include the following:

    21.1 The summary of all monitoring results supported by an interpretor's analysis to the effectiveness of any treatment method in meeting the compliance limits in Condition 3 to 10.

    21.2 Any environmentally significant trends in water quality.

    21.3 Any incidents or problems experienced with achieving consent compliance.

    21.4 The summary of any complaints received and any mitigation measures that were adopted.

    21.5 Any maintenance works needed, proposed or that have been undertaken to ensure compliance with the consent conditions.

    21.6 Any modifications to more effectively control the quality of the discharge.

    21.7 Adverse effects from the discharge, and steps taken or proposed to be taken in order to correct or mitigate these.

22. Notwithstanding the monitoring and reporting requirements set out in these conditions upon any confirmation of any adverse effect on the environment caused by the discharge of contaminant from the landfill site, the consent holder shall take all reasonably necessary steps to avoid, remedy or mitigate such effects on the environment.

Review Conditions

23. Pursuant to section 127(1) of the Resource Management Act 1991, the consent holder may apply to the consent authority for the change or cancellation of any conditions of this consent within three months after the first anniversary of the date of commencement of this consent and within three months after every subsequent anniversary.

24. Within three months following completion of the final solid waste strategy report and after the first anniversary of the date of commencement of any activities authorised by this consent and within three months after every subsequent anniversary, the consent authority may serve notice on the consent holder of its intention to review the conditions of the consent pursuant to the provisions of section 128(1) of the Resource Management Act 1991 for the following purposes:

24.1 To change the standards imposed by conditions of this consent or to impose additional conditions in relation to standards or monitoring in order to avoid, remedy or mitigate any adverse effects on the environment which may arise from the exercise of this consent.

24.2 To change the standards imposed by conditions of this consent to standards that are consistent with any relevant regional plan or act of Parliament.

24.3 To require the consent holder to adopt the best practicable option to remove or reduce any adverse effects on the discharge of contaminants to water.

24.4 To assess the appropriateness of the imposed water quality monitoring regimes, including locations, sampling parameters, monitoring frequencies, the monitoring programme and any further information requested by the Consent Authority pursuant to condition 21 and to alter these accordingly.

24.5 To ensure that the information requested pursuant to conditions 15, 16 and 17 is appropriate and sufficient to remove or reduce any adverse effect on the environment.

25. The consent holder shall remain liable under the Resource Management Act, amendment or replacement legislation for any breach of conditions of the consent which occur before the expiry of the consent and for any adverse effect on the environment caused by the exercise of this consent which become apparent during or after the expiry of the consent.

Fees

26. The consent holder shall pay to the consent authority such administrative and monitoring fees as fixed from time to time by the consent authority in accordance with section 36 of

the Resource Management Act 1991 or any charge prescribed in accordance with the regulations made under section 360 of the Resource Management Act 1991.

RC95042/2

My decision is that pursuant to section 105 of the Resource Management Act 1991 the resource consent to discharge contaminants to land from Moana Landfill is granted for a term of two years subject to the following conditions:

1. The landfill site shall be operated in accordance with the site management plan dated October 1998 or any subsequent update to that plan. The plan may be amended as the consent holder considers appropriate during the time of these consents to ensure compliance with the conditions of this consent. At any time during the period of this consent, a copy of the latest version of the management plan shall be forwarded to the consent authority upon request.

2. Three months prior to the closure of the site the Consent Holder shall prepare a 'site closure and remediation plan'. The site closure and remediation plan shall comply with the conditions of this consent. The plan may be amended as the Consent Holder considers appropriate during the time of these consents. At any time during the period of this consent, a copy of the latest version of the management and operations plan shall be forwarded to the Consent Authority upon request. The site closure and remediation plan shall at least address the following matters:

   2.1 Description of site closure and remediation works, including landscaping and revegetation

   2.2 Remediation programme including timetable, sequence of events and duration

   2.3 Remediation methods and equipment to be used

   2.4 Measures to discourage unauthorised dumping at the site post-closure; including signage and alternative facilities (eg. transfer station, new landfill etc.)

2.5 Methods for vermin and weed control

2.8 Future use for the site in the context of remediation

3. There shall be no wind blown litter beyond the subject boundary.

4. No hazardous substances shall be accepted for disposal on this site. Hazardous substances include the following:

- Coatings and solvents: including paint, varnish and associated thinners
- Adhesives
- Oil, grease and other petroleum products: including transformer oil
- Resin
- Batteries
- Bitumen products
- Explosive materials
- Medical waste
- Pathological waste
- Acids/alkalis (e.g. caustic soda and lime)
- Any scheduled poisons as defined in the Toxic Substances Regulations
- Any chemical in liquid or powder form whether of agricultural or industrial use including fertiliser
- Inorganic chemicals including heavy metals and asbestos
- Sludge from chemical/industrial processes
- Any substances defined as hazardous in the Regulations to the Hazardous Substances and New Organisms Act 1996 or amendment or replacement legislation

Review Conditions

5. Pursuant to section 127(1) of the Resource Management Act 1991, the consent holder may apply to the consent authority for the change or cancellation of any condition of this consent within three months after the first anniversary of the date of commencement of this consent and within three months after every subsequent anniversary.

6. Within three months following completion of the final Solid Waste Strategy Report and after the first anniversary of the date of commencement of any activities authorised by this

consent and within three months after every subsequent anniversary, the consent authority may serve notice on the consent holder of its intention to review the conditions of the consent pursuant to section 128(1) of the Resource Management Act 1991 for the following purposes:

6.1 To impose additional conditions in relation to standards or monitoring in order to avoid, remedy or mitigate any adverse effects on the environment which may arise from the exercise of this consent.

6.2 To change the standards imposed by conditions of this consent to standards that are consistent with any relevant regional plan.

Ongoing Liability

7. The consent holder shall remain liable under the Resource Management Act, any amendment or replacement legislation for any breach of conditions of the consent which occur before the expiry of the consent and for any adverse effects on the environment caused by the exercise of this consent which become apparent during the expiry of the consent.

Fees

8. The consent holder shall pay to the consent authority such administrative and monitoring fees as fixed from time to time by the consent authority in accordance with section 36 of the Resource Management Act 1991 or any charge prescribed in accordance with Regulations made under section 360 of the Resource Management Act 1991.

RC95042/3

My decision is that pursuant to Section 105 of the Resource Management Act 1991 the resource consent to discharge contaminants to air from Moana Landfill is granted for a term of 35 years subject to the following conditions:

1. The landfill site shall be operated in accordance with the site management plan dated October 1998 and any subsequent update to that plan. The plan may be amended as the consent holder considers appropriate during the time of these consents to ensure compliance with the conditions of this consent. At any time during the period of this consent, a copy of the latest version of the site management plan shall be forwarded to the consent authority upon request.

2. No material shall be burnt at the landfill site unless permitted by another consent or a regional air quality plan.

3. There shall be no discharge of contaminants into air from the landfill operation resulting in any of the following adverse effects at or beyond the boundary of the site.

    3.1 Offensive or objectionable odours;

    3.2 Offensive or objectionable dust; and / or

    3.3 Dangerous or noxious ambient concentrations of any airborne contaminants

Review Conditions

4. Pursuant to section 127(1) of the Resource Management Act 1991, the consent holder may apply to the consent authority for the change or cancellation of any condition of this consent within three months after the first anniversary of the date of commencement of this consent and within three months after every subsequent anniversary.

5. Within three months following the completion of the Final Solid Waste Strategy report and after the first anniversary of the date of commencement of any activities authorised by this consent and within three months after every subsequent anniversary, the consent authority may serve notice on the consent holder of its intention to review the condition of the consent pursuant to the provisions of section 128(1) of the Resource Management Act 1991 for the following purposes:

5.1 To change the standards imposed by conditions of this consent to standards that are consistent with any relevant regional plan or act of Parliament.

5.2 To change the standards imposed by conditions of this consent or to impose additional conditions in relation to standards or monitoring in order to avoid, remedy or mitigate any adverse effect on the environment which may arise from the exercise of this consent.

5.3 To require the consent holder to adopt the best practicable option to remove or reduce any adverse effects on the discharge of contaminants to air.

Ongoing Liability

6. The consent holder shall remain liable under the Resource Management Act, any amendment or replacement legislation for any breach of conditions of this consent which occur before the expiry of this consent and for any adverse effects on the environment caused by the exercise of this consent which become apparent during or after the expiry of the consent.

Fees

7. The consent holder shall pay to the consent authority such administrative and monitoring fees as fixed from time to time by the consent authority in accordance with section 36 of the Resource Management Act 1991, or any charge prescribed in accordance with the regulations made under section 360 of the Resource Management Act 1991.

T. DAY
CHIEF EXECUTIVE OFFICER

Appendix 3: Anecdotal Evidence

Anecdotal Evidence – Russell Robinson, Brunner Builders Ltd.

What are the known previous land uses of the site?

no stock on site for 20+ years, golf course, air strip in 1980s, landfill, short term current usage as store for road metals while installing fibre optic cables in the town.

What kind of pesticides are you aware of that are currently in use/have been used historically on the site?

None

Has produce been grown there over the years?

No

Are there any fire pits on site?

No

How is agricultural waste managed (if applicable)?

None

What agrichemicals and fertilisers are currently or have been in use?

None

Are there any known historical livestock dips on site?

No

Are there any other environmental issues pertaining to the site or neighbouring properties that you are aware of?

Petrol Station across the road, recycling station across the road

Is any fuel stored on site, how much and where?

Temporary in storage yard

What chemicals are currently stored on site?

None

Are you aware of any landfill activities on site?

Yes

If so, where on the property was the landfill located and what is its depth?

old landfill behind storage yard, depth unknown.

How long was the landfill operational (dates)?

Unkown.

Landfill has been remediated.

What type of landfill material is buried on the site?

General household waste, farm rubbish.

What is their source of water and has it ever been tested for contaminants? What sort of contaminants?

No water currently used on site. Streams are tested by CRL Energy Ltd, on behalf of the Grey District Council, for landfill contaminants on a quarterly basis.

When did you purchase the property?

October 2019

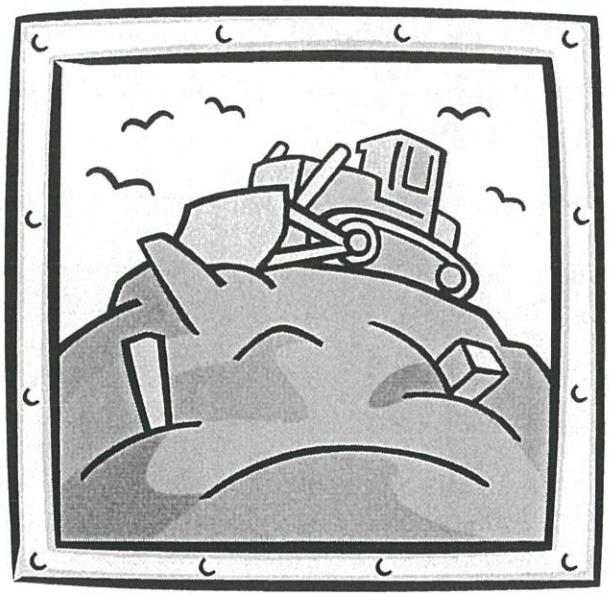
Do you know who owned the land before you and where those people are now?

Greymouth Developments Ltd.

Is either in Whangarei, or possibly in Australia.

He did not use the land while he owned it.

Appendix 4: Landfill Closure and Remediation Plan Report



Grey District Council

Moana Landfill – Site Closure & Remediation Plan

May 2002

Grey District Council

Table of Contents – As per RC95042

Please refer to the conditions attached to RC95042/1 – Discharge Permit to Water and RC95042/2 – Discharge Permit to Land, RC 950423/3 – Discharge Permit to Air

The following either has been done or is proposed under the above Resource Consent conditions.

1.1 Description of Site Closure & Remediation Works, including Landscaping & Revegetation

When closed the Moana landfill consisted of a 'U' shaped refuse mass of approximately 25,000m³, this was located in a deep gully extending from the Arnold Valley Road boundary near the existing entrance to the present dump face 100m to the west.

The site has generally accepted mixed waste and this has been covered with gravels from the surrounding site.

Remediation works since closure on 16 April have revolved around the continued acceptance of clean hard fill for site cover and contouring and drainage works (see attached plan). The site will continue to be used as a cleanfill/greenwaste, skip, recycle centre until the present landowner develops the site in approximately 3 years time.

1.2 Remediation Programme including Timetable, Sequence of Events & Duration

- Clean hardfill will be accepted and used to cover the refuse face and contouring, greenwaste will be accepted and mulched to provide topsoil on the closed face. When final contour has been achieved the areas will be grassed.

- A macro-invertebrate testing programme upstream and downstream at the site has been instigated and results will be forwarded to the West Coast Regional Council when available.

1.3 Remediation Methods & Equipment to be Used

Spreading of hard fill will be by bulldozer and hydraulic excavator.

1.4 Location, Design, Operation & Maintenance of Stormwater Runoff Control & Leachate Control Facilities

Stormwater run-off control is not a problem as the area of hard fill over the refuse face is quite small and surrounded by rough pasture which traps silt. A cut off drain has diverted surface water from upstream of the refuse mass. Contouring the site will divert surface water to downstream of the refuse face.

At present there are no plants to install a settling pond at the toe of the refuse mass, due to the steepness of the bush clad gully surrounding it and potential environmental damage heavy machines could cause.

1.5 Qualifications of the Designer of the Stormwater Runoff Control & Leachate Control Facilities

Due to the relatively small refuse mass and small stormwater catchment, no specialist design is required. If ongoing environmental testing reveals adverse effects, then specialists will be sought.

1.6 Measures to Discourage Unauthorised Dumping at the Site Post-Closure; including Signage & Alternative Facilities (eg transfer station, new landfill etc)

The site has been reopened as a hardfill/greenwaste – skip transfer, recycling site. Hours are restricted and an operator is on site to supervise dumping and keep the site clean and tidy.

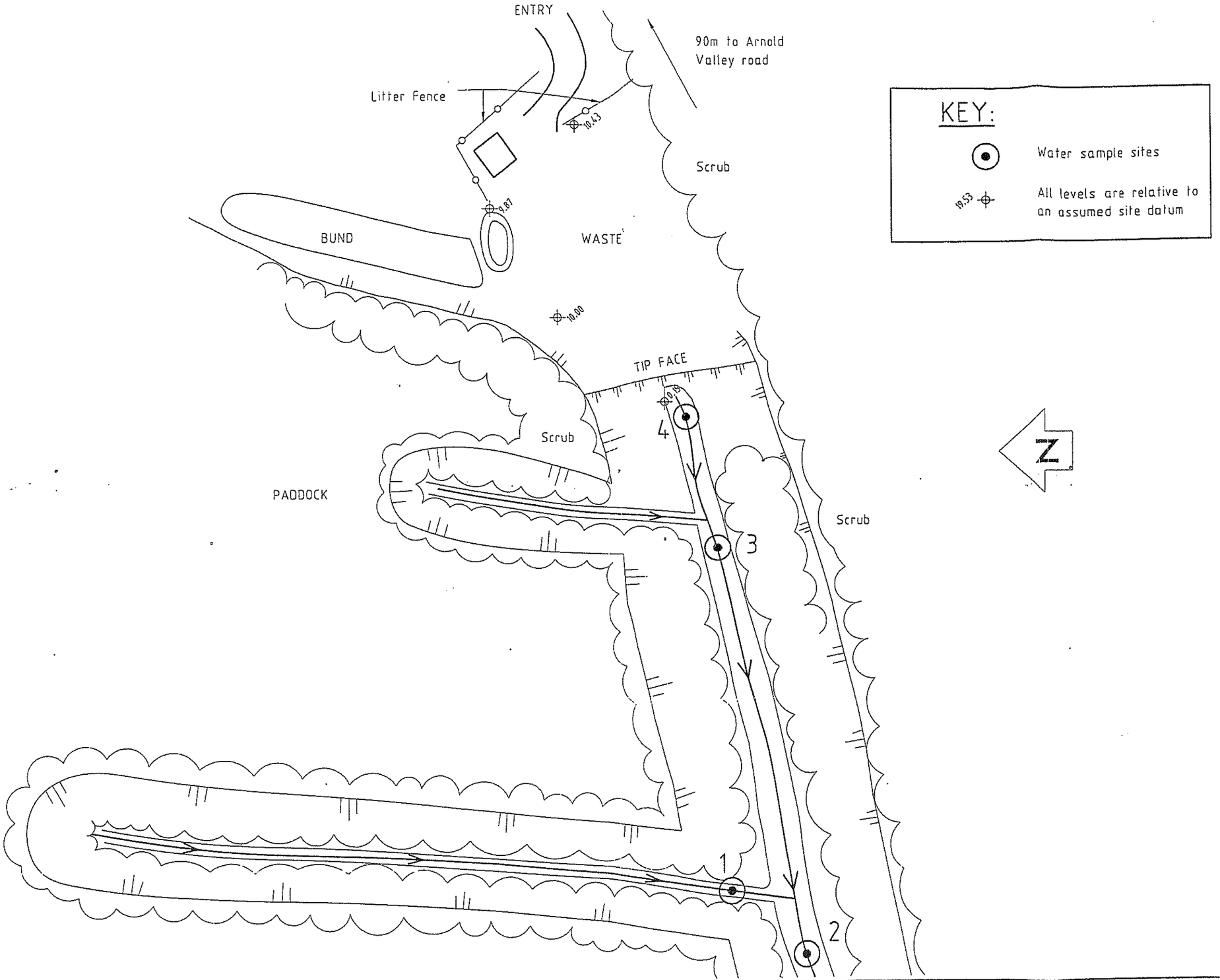
1.7 Methods for Vermin & Weed Control

A control programme commenced post closure and vermin numbers are low.

1.8 Future Use for the Site in the Context of Remediation

As mentioned in 1.1 and 1.2 above, the future use of this site will entail hard fill dumping and greenwaste processing for rehabilitation of refuse face. The landowner has indicated agreement with management of the site as per this document.

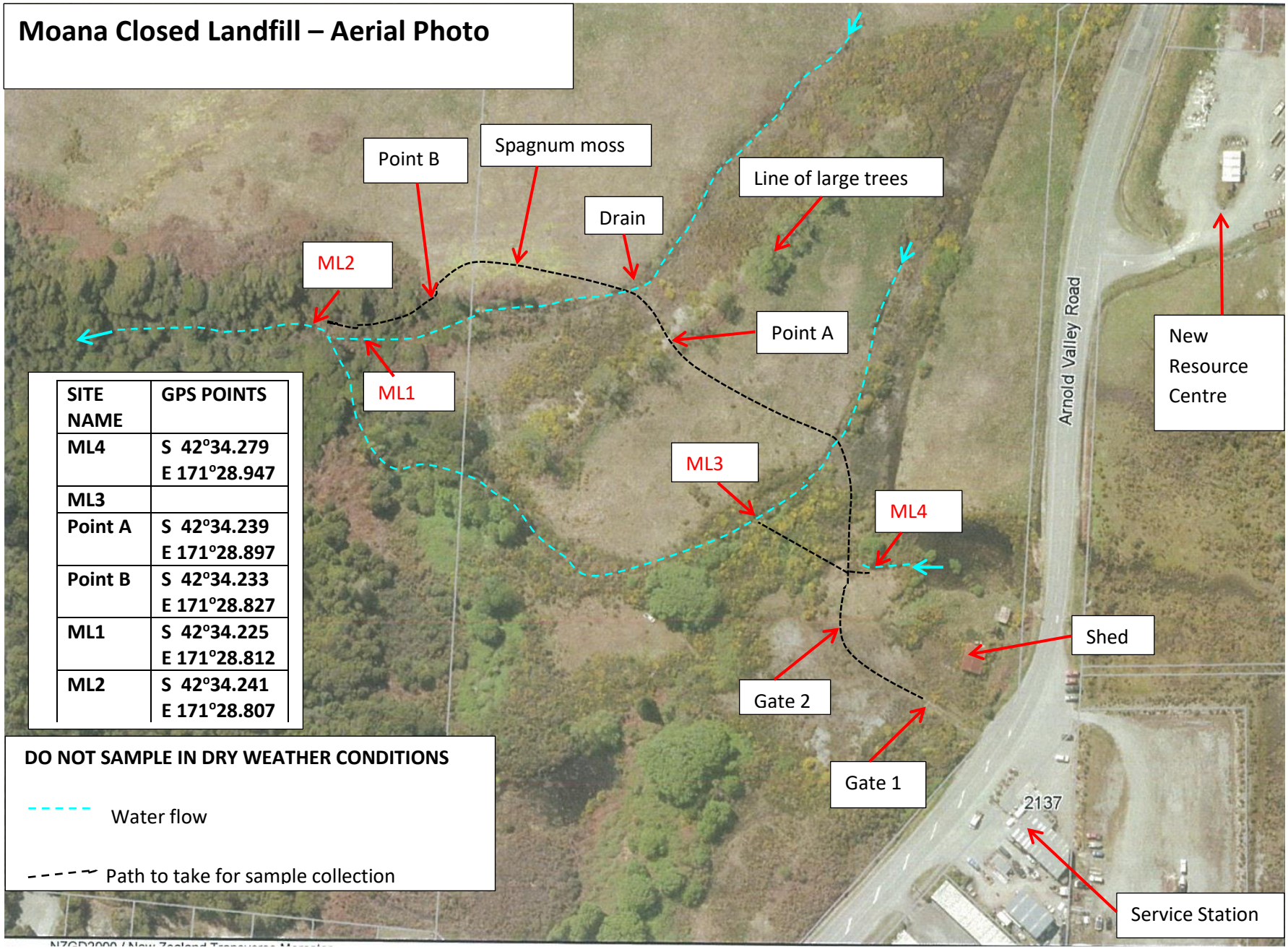
Appendix 5: Site Map 1



CAD Ref . P:\697\69771\CAD\77100C08 XRefs · IMAGE MONT4 @ 0,0	COPYRIGHT © MONTGOMERY WATSON NEW ZEALAND LTD	SCALES 1:1000 FIELDBOOK			MONTGOMERY WATSON	MÜANA REFUSE DISPOSAL SITE	Status Stamp Date Stamp
			BY	DATE			
		SURVEYED					
		DESIGNED					
		DRAWN					
REV AMENDMENTS	DATE INIT	APPROVED				SITE PLAN	Job No. 69771.00 · Sheet No. C8 · Rev. A

Appendix 6: Site Map 2

Moana Closed Landfill – Aerial Photo



SITE NAME	GPS POINTS
ML4	S 42°34.279 E 171°28.947
ML3	
Point A	S 42°34.239 E 171°28.897
Point B	S 42°34.233 E 171°28.827
ML1	S 42°34.225 E 171°28.812
ML2	S 42°34.241 E 171°28.807

DO NOT SAMPLE IN DRY WEATHER CONDITIONS

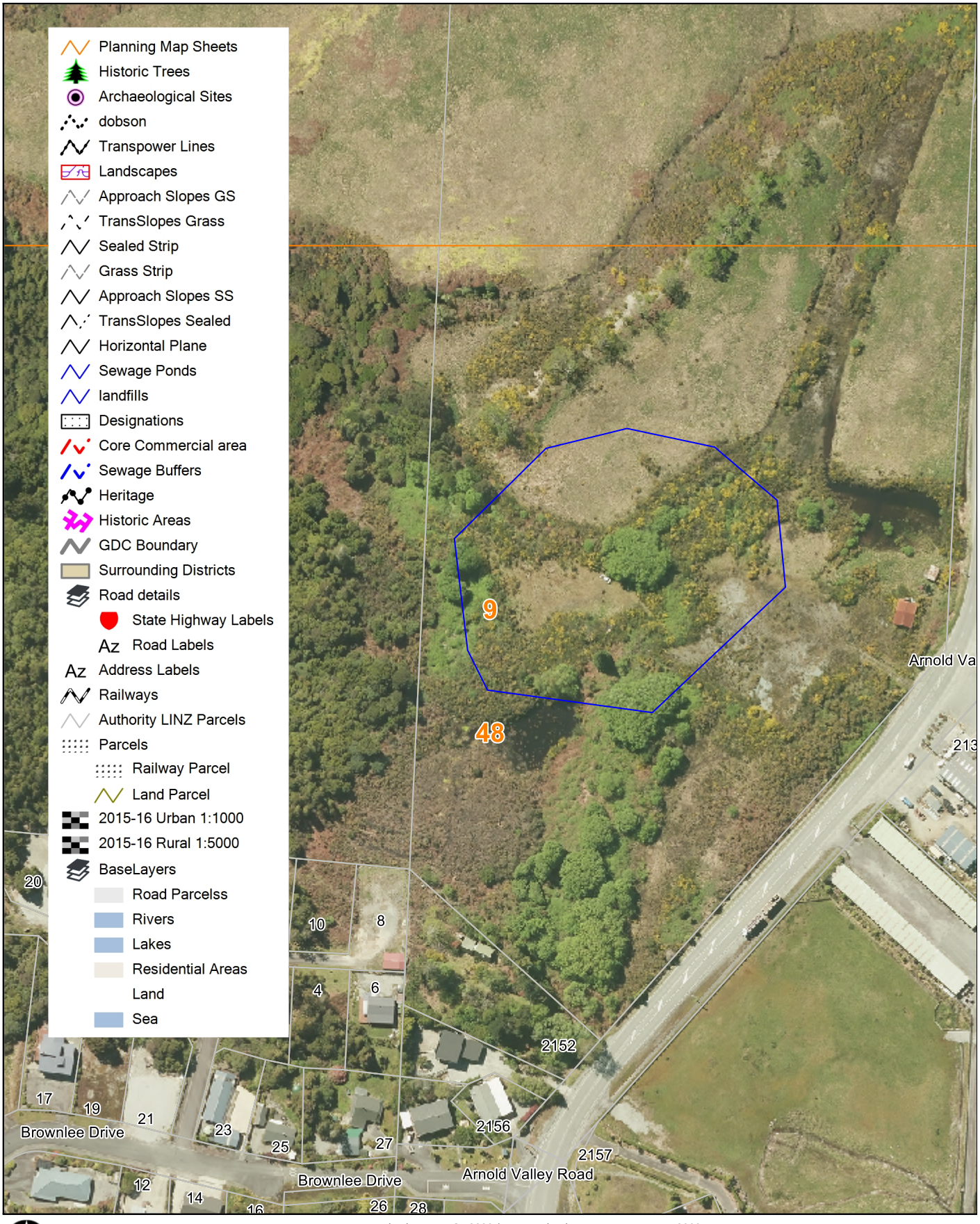
Water flow

Path to take for sample collection

Appendix 7: Landfill Designation Map

Created By: Kurtis Perrin-Smith
Print Date: 11/06/2019
Print Time: 2:16 PM

MĀWHERA GREY DISTRICT COUNCIL



Scale: 1:2000
Original Sheet Size A4

Projection: NZGD2000 / New Zealand Transverse Mercator 2000
Bounds: 1475158.11087135,5285424.38055311
1475483.22238505,5285828.56067529

Appendix 8: Water Sampling Data

MOANA CLOSED LANDFILL - Test Results

Resource Consent File No. RC95042

Colour code:

ML1 Upstream sample point
ML2 Downstream sample point
Consent Limit Value
ML3 Discharge Point in the 'mixing' zone
ML4 Discharge point
Non-compliances of Consent Conditions 3 - 8

To maintain format - Insert new columns at I. Copy G to I. Enter new monitoring results into I. Check and adjust formulas in YEARLY figures.

MOANA LANDFILL	Sample Point	Compliance Limit	OVERALL MEDIAN	OVERALL AVERAGE	OVERALL MIN.	OVERALL MAX.			2-Apr-19	15-Oct-18	16-Mar-18	19-Sep-17	28-Mar-17	12-Sep-16	9-May-16
pH	ML1 Upstream		6.8	6.7	5.1	7.8			6.8	6.1	6.3	5.9	7.2	6.7	7.3
	ML2 Downstream	<0.5pH units variance to ML1	6.6	6.6	5.3	7.6			6.7	6.2	5.9	6.0	6.4	6.6	7.0
	Upper Consent Limit		*7.3*	*7.2*	*5.6*	*8.3*	*0.5*		*7.3*	*6.6*	*6.8*	*6.4*	*7.7*	*7.2*	*7.8*
	Lower Consent Limit		*6.3*	*6.2*	*4.6*	*7.3*	*-0.5*		*6.3*	*5.6*	*5.8*	*5.4*	*6.7*	*6.2*	*6.8*
	ML3 Mix zone		7.0	6.8	4.8	7.7			6.1	4.8	5.7	6.8		7.0	7.4
	ML4 Discharge		6.7	6.6	4.9	8.0			5.0	4.9	6.4	6.1		6.6	7.0
Conductivity (uS/cm)	ML1 Upstream		26	27	17	49			19	17	24	19	26	31	26
	ML2 Downstream	<2uS/cm times ML1	30	32	21	56			56	45	26	55	29	36	30
	Consent Limit		*52*	*54*	*33*	*98*	*0*		*38*	*33*	*48*	*38*	*52*	*62*	*52*
	ML3 Mix zone		41	47	16	98			16	21	26	26		86	76
	ML4 Discharge		249	251	15	648			15	19	23	23		239	248
Temperature °C	ML1 Upstream		9.9	9.9	1.0	16.2			12	8	15	10	14	6.8	12.3
	ML2 Downstream	<5.0°C greater then ML1	10.1	10.1	0.5	17.8			12	8	15	10	14	6.7	12.3
	Consent Limit		*14.9*	*14.9*	*6.0*	*21.2*	*5.0*		*17.0*	*13.2*	*20.0*	*15*	*19*	*11.8*	*17.3*
	ML3 Mix zone		9.0	9.4	2.0	17.0			12	9	17	10		6.4	12.1
	ML4 Discharge		12.0	11.2	5.1	19.0			13	15	19	13		8.1	12.0
Dissolved Oxygen (g/m3)	ML1 Upstream		10.3	10.3	5.7	13.4			9.3	10.6	7.6	9.9	7.6	11.9	10.2
	ML2 Downstream	<6.0g/m³ less then ML1	9.9	10.0	4.8	12.9			10.2	12.2	7.4	9.6	7.8	11.6	9.8
	Consent Limit		*4.3*	*4.3*	*-0.3*	*7.4*	*-6.0*		*3.3*	*4.6*	*1.6*	*3.9*	*1.6*	*5.9*	*4.2*
	ML3 Mix zone		9.6	9.0	2.6	12.5			9.9	9.8	8.2	8.2		11.2	8.7
	ML4 Discharge		6.0	5.7	0.7	13.2			10.0	13.2	7.7	9.1		8.2	6.8
Chloride (g/m³)	ML1 Upstream		4.2	4.6	2.0	11.0			2.7	2.4	3.4	2.8	3.1	5.5	3.7
	ML2 Downstream	<0.5g/m³ greater then ML1	4.3	4.7	2.0	10.5			3.1	2.7	3.4	2.9	3.1	5.2	3.5
	Consent Limit		*4.7*	*5.1*	*2.0*	*11.5*	*0.5*		*3.2*	*2.9*	*3.9*	*3.3*	*3.6*	*6.0*	*4.2*
	ML3 Mix zone		4.2	4.9	2.2	10.0			2.8	3.0	3.9	3.2		4.8	3.2
	ML4 Discharge		6.4	10.6	2.6	37.0			2.6	3.0	4.0	2.8		4.9	3.4
Total Ammoniacal Nitrogen (g/m³)	ML1 Upstream		0.00	0.01	0.00	0.14			0.00	0.00	0.00	0.00	0.00	0.00	0.00
	ML2 Downstream	<0.03g/m³ greater then ML1	0.00	0.01	0.00	0.06			0.03	0.017	0.00	0.024	0.02	0.00	0.00
	Consent Limit		*0.03*	*0.04*	*0.03*	*0.17*	*0.03*		*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*
	ML3 Mix zone		0.00	0.01	0.00	0.19			0.00	0.00	0.00	0.00		0.02	0.00
	ML4 Discharge		0.42	0.90	0.00	3.29			0.00	0.00	0.00	0.00		0.18	0.14
Comment										Limited flow at ML3 and ML4.	Limited flow at ML1 and ML2. ML3 vitually stagnant.				

22-Sep-15	30-Mar-15	27-Aug-14	31-Mar-14	28-Aug-13	3-Apr-13	23-Aug-12	29-Feb-12	3-Aug-11	21-Feb-11	26-Aug-10	23-Dec-09	29-Jun-09	30-Dec-08	4-Jul-08	~~1-Dec-07~~	27-Jun-07
6.9	6.5	6.3	6.4	6.9	6.7	7.1	6.3	7.0	5.6	6.6	7.1	7.3	7.3	7.3		6.6
6.5	6.5	5.9	5.9	6.6	6.6	6.6	5.8	7.2	5.3	6.6	7.1	7.4	7.0	7.2		6.7
7.4	*7.0*	*6.8*	*6.9*	*7.4*	*7.2*	*7.6*	*6.8*	*7.5*	*6.1*	*7.1*	*7.6*	*7.8*	*7.8*	*7.8*		*7.1*
6.4	*6.0*	*5.8*	*5.9*	*6.4*	*6.2*	*6.6*	*5.8*	*6.5*	*5.1*	*6.1*	*6.6*	*6.8*	*6.8*	*6.8*		*6.1*
7.0	6.7	5.9	5.8	6.8	7.1	6.4	6.1	7.4		6.8	6.9	7.5		7.3		7.2
6.6	6.7	6.5		6.4	6.8		7.1	6.9		7.7				8.0		6.6
23	30	32	34	28	31	33	37	49	32	19	25	24	29	25		30
26	30	46	35	27	33	31	36	50	35	23	27	23	30	27		38
46	*60*	*64*	*68*	*56*	*62*	*66*	*74*	*98*	*64*	*38*	*50*	*48*	*58*	*50*		*60*
52	37	56	41	53	38	32	43	90		22	55	25		40		85
208	261	380		357	175		310	286		200			289	249		400
7.4	14.5	5.1	12.2	9.1	14.4	7.7	14.0	5.8	15.3	8.3	15.7	5.3	16.2	7.0		2.3
7.3	14.1	5.3	12.3	8.9	15.1	7.6	14.6	5.6	16.2	8.0	15.7	5.1	17.8	6.7		2.1
12.4	*19.5*	*10.1*	*17.2*	*14.1*	*19.4*	*12.7*	*19.0*	*10.8*	*20.3*	*13.3*	*20.7*	*10.3*	*21.2*	*12.0*		*7.3*
7.0	14.1	5.1	12.0	8.5	13.6	6.8	14.2	4.3		8.4	15.8	4.8		6.6		2.1
7.6	13.1	7.7		9.3	12.8		13.3	7.4		8.2			14.2	8.7		7.3
11.7	10.1	11.8	9.5	8.4	10.3	10.3	9.1	12.1	11.7		11.0	11.0	10.2			12.9
9.9	9.9	9.5	6.8	8.4	10.2	9.8	7.2	11.6	4.8		11.5	9.3	7.2			12.9
5.7	*4.1*	*5.8*	*3.5*	*2.4*	*4.3*	*4.3*	*3.1*	*6.1*	*5.7*		*5.0*	*5.0*	*4.2*			*6.9*
8.8	8.7	5.3	3.0	7.3	10.2	7.3	2.6	10.9			9.7	9.8				11.2
4.8	6.2	1.3		0.7	6.6		4.3	5.9					2.7			8.1
4.3	4.3	4.6	3.9	3.7	6.5	3.5	5.9	11.0	4.2	2.0	3.5	4.2	4.2	4.6		7.7
4.0	4.0	4.4	3.6	3.6	6.6	3.7	5.3	10.5	4.2	2.1	4.0	4.3	4.0	4.9		7.8
4.8	*4.8*	*5.1*	*4.4*	*4.2*	*7.0*	*4.0*	*6.4*	*11.5*	*4.7*	*2.03*	*3.53*	*4.7*	*4.7*	*5.1*		*8.2*
3.9	3.9	4.0	3.1	3.7	6.8	4.2	4.1	9.5		2.2	4.2	5.1		5.8		8.7
5.2	5.2	5.3		6.2	5.9		6.4	10.7		4.7			14.0	10.0		15.8
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.02	0.0	0.01	0.0		0.0
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.01	0.0	0.01	0.0		0.0
0.03	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.03*	*0.05*	*0.03*	*0.04*	*0.03*		*0.03*
0.00	0.00	0.00	0.00	0.00	0.016	0.00	0.00	0.03		0.0	0.02	0.0		0.02		0.19
0.13	0.13	1.20		0.860	0.102		0.42	0.25		0.134			1.80	0.87		3.29
			ML4 dry.	ML4 - Limited flow.	ML4 - Limited flow.											

31-Jan-07	26-Jun-06	29-Dec-05	31-May-05	1-Jul-04	29-Jan-04	13-Jun-03	21-Nov-02	25-Jul-02	13-Dec-01	12-Jul-01	6-Dec-00	10-May-00
7.4	7.8	7.1	7.3	6.7	7.2	6.8	5.8	5.1	5.8	5.6	6.9	6.7
7.4	7.6	7.1	7.3	7.0	7.4	6.9	6.2	5.8	6.7	6.5	6.3	6.3
7.9	*8.3*	*7.6*	*7.8*	*7.2*	*7.7*	*7.3*	*6.3*	*5.6*	*6.3*	*6.1*	*7.4*	*7.2*
6.9	*7.3*	*6.6*	*6.8*	*6.2*	*6.7*	*6.3*	*5.3*	*4.6*	*5.3*	*5.1*	*6.4*	*6.2*
7.4	7.7	6.8	7.3	7.2		7.1		5.9	7.0			7.3
6.8	7.2	6.5	6.9	6.8		6.6			6.8			
26	20	23	26	21	17	23	26	27	27	32	40	21
25	21	25	27	35	27	23	29	25	36	30	35	25
52	*40*	*46*	*52*	*42*	*34*	*46*	*52*	*54*	*54*	*64*	*80*	*42*
30	28	58	48	67		28	35	31	98			70
300	229	255	241	181		275			457			648
13.0	2.3	15.5	6.7	5.9	14.2	5.9	11.1	3.7	14.1	1.0	13.5	9.7
13.1	1.9	15.9	6.8	5.7	16.2	5.7	13.5	4.5	14.1	0.5	13.7	10.1
18.0	*7.3*	*20.5*	*11.7*	*10.9*	*19.2*	*10.9*	*16.1*	*8.7*	*19.1*	*6.0*	*18.5*	*14.7*
13.5	2.0	15.8	6.4	6.1		5.9	12.5	4.6	15.9			10.3
13.2	5.1	15.0	8.6	9.5		8.9			16.2			15.0
9.9	13.1	11.6	9.6	13.2	13.4	12.3	8.6	9.5	5.7	6.5	11.6	7.6
9.8	12.7	11.6	9.9	12.5	6.5	12.3	11.2	11.7	12.3	12.8	10.8	7.4
3.9	*7.1*	*5.6*	*3.6*	*7.2*	*7.4*	*6.3*	*2.6*	*3.5*	*-0.3*	*0.5*	*5.6*	*1.6*
9.3	12.1	8.7	9.4	12.5		10.9	10.1	11.5	10.5			6.6
3.8	2.9	2.3	6.0	6.9		2.0			9.0			2.3
2.8	4.1	3.1	8.8	7.9	6.9	6.0	5.1	4.2	2.9	4.5	4.6	2.6
5.0	4.7	4.5	8.8	7.8	6.1	5.9	5.4	3.8	2.0	5.5	6.1	2.4
3.3	*4.6*	*3.6*	*9.3*	*8.4*	*7.4*	*6.5*	*5.6*	*4.7*	*3.4*	*5.0*	*5.1*	*3.1*
3.2	4.9	4.2	10.0	9.6		5.9	4.6	3.7	4.5			5.6
10.3	15.4	15.5	21.3	17.4		27.0			11.6			37.0
0.03	0.0	0.02	0.0	0.05	0.0	0.14	0.0	0.01	0.01	0.04	0.05	0.0
0.04	0.0	0.01	0.01	0.02	0.0	0.0	0.0	0.0	0.0	0.04	0.06	0.01
0.06	*0.03*	*0.05*	*0.03*	*0.08*	*0.03*	*0.17*	*0.03*	*0.04*	*0.04*	*0.07*	*0.08*	*0.03*
0.04	0.00	0.02	0.00	0.04		0.00	0.00	0.00	0.03			0.00
1.23	2.00	2.10	1.20	0.19		3.20			1.65			1.53
ML4 - Ponded.												

MOANA CLOSED LANDFILL - Observations

Colour code:

ML1 Upstream sample point
ML2 Downstream sample point
ML3 Discharge Point in the 'mixing' zone
ML4 Discharge point

Insert new columns at D. Enter now observations into D.

MOANA LANDFILL			2-Apr-19	15-Oct-18	16-Mar-18	19-Sep-17	28-Mar-17	12-Sep-16	9-May-16
Weather			Fine today and yesterday.	Fine today and previous day. Air temperature 14oC.	Fine today and previous day.	Overcast with light breeze, some rain today. Fine yesterday, heavy rain throughout the week prior.	Fine today and previous day.	Fine today and previous 2 days.	Rain today (Monday) and preceding 24 hours.
Substrate	ML1 Upstream		Gravelly sand.	Gravelly sand and cobbles.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
	ML2 Downstream		Gravelly sand.	Gravelly sand and cobbles.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
	ML3 Mix zone		Gravelly sand.	Gravelly sand.	Gravelly sand, brown mud.	Gravelly sand.	Mud/gravelly sand.	Gravelly sand.	Gravelly sand.
	ML4 Discharge		Cobbles.	Cobbles, mud, vegetable matter and orage ppt.	Gravelly sand, brown mud.	Cobbles and mud.	Mud/grvelly sand	Cobbles, mud, vegetable matter and orage ppt.	Cobbles, mud, vegetable matter and orage ppt.
Aquatic Life	ML1 Upstream		No	No	No	No	No	No	No
	ML2 Downstream		No	No	No	No	No	No	No
	ML3 Mix zone		No	Yes	Filamentous algae	Macro-invertebrates and some cress.	No	No	Some cres.
	ML4 Discharge		No	Filamentous algae.	Filamentous algae.	Filamentous algae and macro-invertebrates.	No	No	Filamentous algae.
Undesirable Growth	ML1 Upstream		No	No	No	No	No	No	No
	ML2 Downstream		No	No	No	No	No	No	No
	ML3 Mix zone		No	Algae.	No	Grasses	Orange growth.	No	No
	ML4 Discharge		No	Orange growth.	Slime and algae.	Slime and algae.	Orange growth.	Orange growth.	Orange growth.
Visible Staining	ML1 Upstream		No	No	No	No	No	No	No
	ML2 Downstream		No	No	No	No	No	No	No
	ML3 Mix zone		No	Brown staining.	Brown ppt.	No	Orange/brown ppt.	No	No
	ML4 Discharge		No	Orange/brown ppt.	Orange/brown ppt.	Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.
Visible Clarity/colour	ML1 Upstream		100%	90%	70%	90%	80-90%	90%	90%
	ML2 Downstream		100%	90%	70%	90%	80-90%	90%	90%
	ML3 Mix zone		100%	90%	70%	80%	70%	90%	90%
	ML4 Discharge		100%	60%	70%	90%	70%	60%	60%
Oil/grease films	ML1 Upstream		No.	No.	No.	No.	No.	No.	No.
	ML2 Downstream		No.	No.	No.	No.	No.	No.	No.
	ML3 Mix zone		No.	No.	No.	No.	No.	No.	No.
	ML4 Discharge		No.	No.	No.	surface oil sheen.	Oil film.	Oil & grease film.	Oil & grease film.
Scums/foams	ML1 Upstream		No.	No.	No.	No.	No.	No.	No.
	ML2 Downstream		No.	No.	No.	No.	No.	No.	No.
	ML3 Mix zone		No.	No.	No.	No.	No.	No.	No.
	ML4 Discharge		No.	No.	No.	Scum present.	No.	No	Foam and scum.
Floatable/suspended solids	ML1 Upstream		No.	No.	No.	No.	No.	No.	No.
	ML2 Downstream		No.	No.	No.	No.	No.	No.	No.
	ML3 Mix zone		No.	No.	No.	No.	Orange ppt.	No.	No.
	ML4 Discharge		No	No	No	Scum.	Orange ppt.	Orange ppt.	Orange ppt.
Odour	ML1 Upstream		No	No	No	No	No	No	No
	ML2 Downstream		No	No	No	No	No	No	No
	ML3 Mix zone		No	No	Rotten vegetation.	No	No	No	No
	ML4 Discharge		No	Rotten veg.	odour.	No	Rotten veg.	Rotten vegetation.	Rotten veg.
Comment			Lots of blackberry at ML2, some at ML3.	Limited flow at ML3 and ML4.	Limited flow at ML1 and ML2. ML3 vitually stagnant.				

22-Sep-15	30-Mar-15	27-Aug-14	31-Mar-14	28-Aug-13	3-Apr-13	23-Aug-12	28-Feb-12	3-Aug-11	21-Feb-11	26-Aug-10
Rain today and preceding 24 hrs.	Rain today (Monday) and previous 24 h.	Fine today, Fine previous 48 hours.	Overcast today, and previous day, Fine 2 days before.	Fine at time of sampling, Rain preceding 48 hrs.	Heavy rain today. Fine previous day. Light rain day before that.	Fine today. Light rain previous 24 hrs.	Fine today. Fine previous 24 hrs.	Fine today. Fine previous 24 hours.	Fine today. Fine previous 24 hours.	Showers/Rain today. Fine previous 24 hours.
Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Dry.	Gravelly sand.
Cobbles, mud, vegetable matter and orage ppt.	Cobbles, mud, vegetable matter and orage ppt.	Cobbles, mud, vegetable matter and orage ppt.	Cobbles, mud, vegetable matter.	Cobbles, mud, vegetable matter.	Cobbles, mud, vegetable matter.	Cobbles, mud, vegetable matter.	Cobbles, mud, vegetable matter.	Cobbles, mud, vegetable matter.	Dry.	Fine sand, vegetable matter.
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	No	No	No	No	No	No	No.	No
Some cres.	Some cres.	No	No	No	No	No	No	No	Dry.	No
Filamentous algae.	Filamentous algae.	Filamentous algae.	No	No	No	No	No	No	Dry.	No
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	Blackberries.	No	No	No	No	No	Dry.	No
Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.		Orange ppt.
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	No	No	No	No	No	No	Dry.	No
Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Orange / Brown ppt.	Dry.	Orange ppt.
90%	90%	90%	90%	90%	80-90%	80-90%	80-90%	80-90%	100%.	80-90%
90%	90%	90%	90%	90%	80-90%	80-90%	80-90%	80-90%	80%.	80-90%
90%	90%	90%	80-90%	80-90%	80-90%	80-90%	80-90%	80-90%	Dry.	80-90%
60%	Low.	Low.	n/a	<10%	<50%.	Dry.	40%.	60%.	Dry.	100%.
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	Dry.	No
Oil & grease film.	Oil film.	Oil film.	Oil film.	Oil film.	Oil film.	Dry.	Surface oil sheen.	Surface oil sheen.	Dry.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	Dry.	No
Foam.	Foam and scum.	Foam and scum.	n/a	No.	No.	Dry.	No.	Foam.	Dry.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No
No.	No.	Orange matter.	No.	No.	No.	No.	No.	No.	Dry.	No
Yes	Scum	Scum	n/a	Orange ppt.	Orange ppt.	Dry.	Orange ppt.	Orange ppt.	Dry.	No
No	No	No	No	No	No	No	No	No	No.	No
No	No	No	No	No	No	No	No	No	No.	No
Rotten vegetation.	No	No	No	No	No	No	No	No	Dry.	No
Rotten vegetation.	Rotten vegetation.	Rotten vegetation.	Rotten vegetation.	Yes anerobic.	No	Dry.	No	No	Dry.	No
			ML4 dry.	ML4 - Limited flow.	ML4 - Limited flow.					

23-Dec-09	26-Jun-09	30-Dec-08	4-Jul-08	~~1-Dec-07~~	27-Jun-07	31-Jan-07	26-Jun-06	29-Dec-05	31-May-05	1-Jul-04
Fine today. Fine previous 24 hours.	Fine today Monday, Light rain Saturday.	Fine today. Fine last week	Rain today. Rain last week.		Fine today. Light rain last week.	Fine today. Fine previous week	Fine. Fine previous week	Fine. Fine previous week	Rain. Rain previous week	Fine weather. Light rain previous week.
Gravelly sand.	Gravelly sand.	Cobbles/Gravelly sand	Cobbles, Gravelly sand.		Cobbles, Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Gravelly sand.	Gravelly sand.	Gravelly sand	Gravelly sand.		Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Gravelly sand.	Gravelly sand.	Dry	Gravelly sand.		Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Dry.	Dry.	Cobbles, a lot of vegetable matter, fine sand, orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.		Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Small cobbles, a lot of vegetable matter, fine sand, orange ppt
No.	No.	Yes	No		No	No	No	No	No	No
No.	No.	Yes	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	No	No		No	No	No	Minor filamentous algae.	Minor filamentous algae.	Minor filamentous algae.
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
N/A.	N/A.	Orange growth.	Orange growth.		Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange growth.	Orange ppt
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	Orange brown substrate	Orange / Brown substrate		Orange / Brown substrate	Orange / Brown substrate	Orange / Brown substrate	Orange / Brown substrate	Orange / Brown substrate	Orange / Brown substrate
80-90%	80-90%	80-90%	80-90%		80-90%	80-90%	80-90%	80-90%	80-90%	80-90%
80-90%	80-90%	80-90%	80-90%		80-90%	80-90%	80-90%	80-90%	80-90%	80-90%
80-90%	80-90%	Dry	80-90%		80-90%	80-90%	80-90%	80-90%	80-90%	80-90%
Dry.	Dry.	0.1	80-90%		80-90%	60%	50%	90%	90%	80-90%
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	Oil sheen	No		Oil sheen.	Oil sheen.	Oil sheen.	Oil sheen.	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	No	No		No	No	No	No	No	No
No.	No.	Dry	No		No	No	No	No	No	No
Dry.	Dry.	No	No		No	No	No	No	No	No

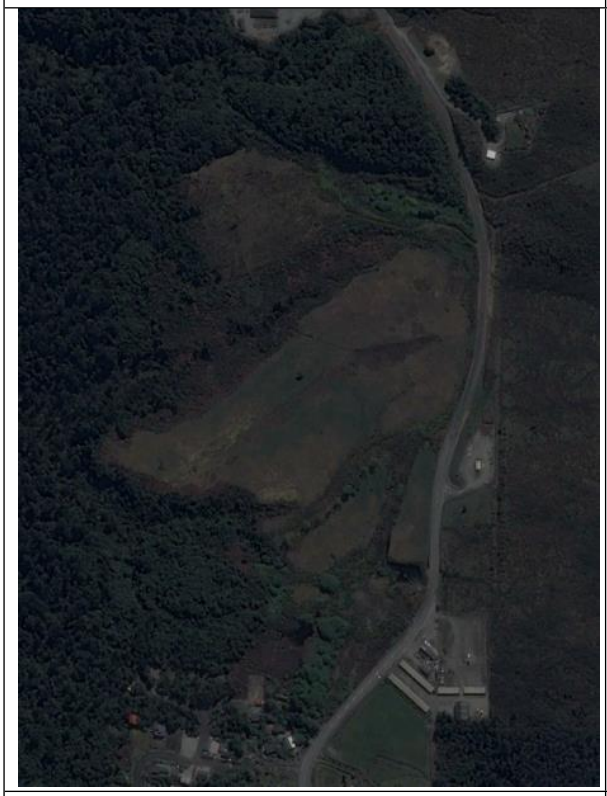
ML4 - Ponded.

29-Jan-04	13-Jun-03	21-Nov-02	25-Jul-02	13-Dec-01	12-Jul-01	6-Dec-00	10-May-00
Fine weather. Light rain previous week.	Light rain preceding week, fine weather today	Fine weather.	Fine weather. Light rain previous week.	Showers today. Wet previous week.	Fine previous week. Frosts.	Fine previous week. Frosts.	Fine today. Light rain Tuesday, heavy rain Sunday.
Gravelly sand.	Cobbles, Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Gravelly sand.	Cobbles, Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Dry.	Cobbles, Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.	Gravelly sand.
Dry.	Cobbles, fine sand, orange ppt.	Dry.	Dry.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.	Cobbles, a lot of vegetable matter, fine sand. Orange ppt.
No	No	No	No	No	No	Minor filamentous algae. No	No
No	No	No	No	No	No	Minor filamentous algae. No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	No	Dry.	Dry.	Minor filamentous algae.	Dry.	Dry.	Minor filamentous growth.
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	Orange growth.	Dry.	Dry.	Orange growth.	Dry.	Dry.	Orange growth.
No	No	No	No	No	No	No	No
Dry.	Orange growth.	Dry.	Dry.	Orange growth.	Dry.	Dry.	Orange growth.
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	Orange ppt.	Orange ppt.	Orange ppt.	Dry.	Dry.	No
Dry.	Orange ppt.	Dry.	Dry.	Orange brown substrate.	Dry.	Dry.	Orange growth substrate.
80-90%	80-90%	80-90%	80-90%	80-90%	80-90%	80-90%	80-90%
80-90%	80-90%	80-90%	80-90%	80-90%	80-90%	80-90%	80-90%
Dry.	80-90%	80-90%	80-90%	80-90%	Dry.	Dry.	80-90%
Dry.	80%	Dry.	Dry.	0.3	Dry.	Dry.	0.6
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	Surface oil sheen	Dry.	Dry.	Surface oil schene.	Dry.	Dry.	Surface oil scheen.
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	No	Dry.	Dry.	Surface oil scheen.	Dry.	Dry.	Surface oil scheen.
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	No	Dry.	Dry.	No	Dry.	Dry.	No
No	No	No	No	No	No	No	No
No	No	No	No	No	No	No	No
Dry.	No	No	No	No	Dry.	Dry.	No
Dry.	No	Dry.	Dry.	No	Dry.	Dry.	No

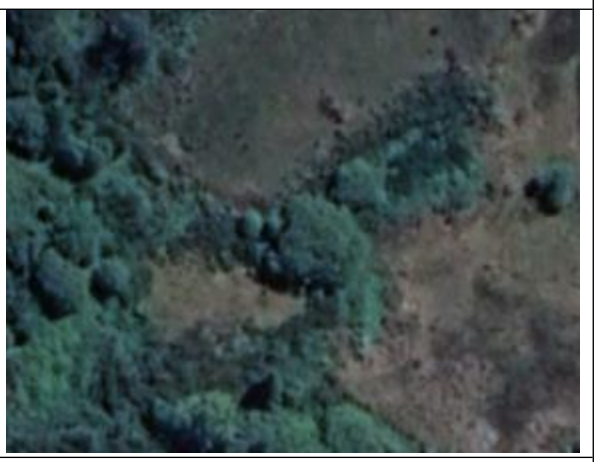
Appendix 9: Historical Aerial Photographs

<table>
<tr><td>  </td><td>  </td></tr>
<tr><td>Date: 1943</td><td>Date: 1953</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td>Date: 1962</td><td>Date: 1968</td></tr>
</table>

	
Date: 1973 (top: whole site, bottom: south east side of site)	Date: 1982 (top: west side of site, bottom: south east side of site)

	
Date: 2013	Date: 2014
	
Date: 2015	Date: 2019

Landfill Area Comparison

	
Date: 1982 (Early landfill activity)	Date: 2019 (Closed, remediated landfill)

Appendix 10: Site Photographs

Photo 1: North east side of site, looking south east

Photo 2: West site of site, looking south

Photo 3: Unnamed stream, approximately 350 m from the south boundary of the site, beneath a line of trees at the terrace edge, looking south west

Photo 4: Remediated landfill area, west edge of storage yard, looking west

Photo 5: South east side of site looking south from the storage yard

Photo 6: Storage yard, south east side of site, looking west

Detailed Environmental Site Investigation

Lot 1 DP2820 and Pt RS 3806

Arnold Valley Road
Moana

Submitted to:

Brunner Builders Ltd.

Wiley Geotechnical Ltd.
Level 1, 61 Cambridge Terrace, Christchurch
PO Box 21171, Edgeware, Christchurch 8143

Contents

1 Executive Summary

Wiley Geotechnical Limited (WGL) was requested by Brunner Builders Ltd. to provide a Detailed environmental Site Investigation report (DSI) for the proposed Plan Change from Rural to Residential and Commercial land zoning at Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana, West Coast (herein referred to as 'the site').

This DSI follows on from a preliminary environmental site investigation report (PSI), produced by WGL, dated 16 April 2020, and should be read in conjunction with the PSI report. The PSI concluded that a DSI is necessary, as a HAIL activity has been confirmed on the site. Parts of the site have historically been used for landfill, an airstrip / landing pad and a golf course. A storage yard area is located on the site housing vehicles and, formerly, a transportable fuel tank. These activities are recognised by the Ministry for the Environment (MfE) as Hazardous Activities and Industries List (HAIL) activities (Category A10 – Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds; Category A17 – Storage tanks or drums for fuel, chemicals or liquid waste; Category F1 – Airports including fuel storage, workshops, washdown areas, or fire practice areas; Category F8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances; Category G3 – Landfill sites). Potential contaminants in the soils on the site, resulting from these activities, may pose a risk to human health.

As part of this DSI, soil sampling was undertaken on the site obtain representative samples of the various layers encountered at the site. The soil samples were transported by WGL to RJ Hill Laboratories (Hills) to analyse the concentrations of contaminants (if any) present and to determine whether or not they pose an acceptable risk to human health. The laboratory results were used to quantify the risks (if any) to human health. We compared the laboratory results to assessment criteria, selected in accordance with the MfE (2011) Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations (herein referred to as the NES) and the MfE (2011) Contaminated Land Management Guidelines No. 2, to assess risk to human health.

Laboratory results indicated that contaminants are not present at concentrations that could pose an unacceptable risk to human health, as a result of the proposed development of the site for residential and commercial use. It is therefore recommended that the proposed development of the site be approved as a Controlled Activity under NES Regulation 9(1) and 9(3).

2 Introduction

Wiley Geotechnical Limited (WGL) was requested by Brunner Builders Ltd. to provide a detailed environmental site investigation report (DSI) to quantify the potential risks to health at Lot 1 DP2820 and Pt RS 3806, Arnold Valley Road, Moana, West Coast. A Site Location Plan is presented in Appendix 1.

This DSI Report follows the results of our preliminary environmental site investigation (PSI), dated 16 April 2020.

This report was prepared in general accordance with the MfE (2012) Contaminated Land Management Guidelines (CLMG) No. 1: Reporting on Contaminated Sites in New Zealand and CLMG No. 5: Site Investigation and Analysis of Soils.

3 Objectives

The objective of this investigation was to assess whether the hazardous activities identified in the site's history have resulted in contamination impacts that may pose an unacceptable risk to human health during, and subsequent to, residential and commercial development.

4 Site History Summary

This DSI report should be read in conjunction with the PSI report, dated 16 April 2020. Not all information provided in the PSI report has been reproduced in this DSI report.

4.1. Wiley Geotechnical Ltd. PSI Report (2020)

WGL undertook a PSI to assess information relating to the site's past and present uses, as well as to identify any other environmental issues which may be on record. We summarise the findings of the PSI investigation below.

The following activities or industries noted on the MfE Hazardous Activities and Industries List (HAIL; 2011) were identified during the review of the site history:

- Category A10 – Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds.
    - This activity is represented by a golf course (historical), golf clubhouse and lawnmower shed located at the site.
- Category A17 – Storage tanks or drums for fuel, chemicals or liquid waste.
    - This activity is represented by a transportable fuel tank, temporarily located in the storage yard during our site visit on 10 March 2020.
- Category F1 – Airports including fuel storage, workshops, washdown areas, or fire practice areas.
    - This activity is represented an airstrip / landing pad located at the site, historically.

- Category F8 – Transport depots or yards including areas used for refuelling or the bulk storage of hazardous substances.
    - This activity is represented a storage yard located at the site, housing vehicles and, temporarily, a transportable fuel tank (now removed).
- Category G3 – Landfill sites
    - This activity is represented by the Moana town landfill (now closed).

Contaminants related to these activities may be present in the soils. Based on our investigation, we consider that NES regulations apply to the site, according to criteria specified in NES Regulation 5.

4.2. Additional Anecdotal Evidence

Since our PSI report was completed, further local knowledge has been supplied:

- Maintenance of the golf course was limited with the turf mown to form a rough course and greens.
- Use of the airstrip was limited with planes flying in to deliver supplies to the town and taking off again straight after. No fuel or aircraft were stored on site and no maintenance took place on site.

4.3. Proposed Development and Regulatory Context

The majority of the site is currently undeveloped. Historically, there has been a town landfill located on the south side of the site, an airstrip / landing pad, located on the south side of the site and a golf course, located through the mid-section of the site. Two small sheds relating to the golf course remain on the south eastern side of the site, the southern-most shed being a former golf clubhouse and the northern shed being a former lawnmower shed. A storage yard area is located on the south side of the site housing vehicles and, formerly a transportable fuel tank. A new, large shed with steel cladding and a concrete foundation pad has been constructed at the south side of the storage yard area.

The site is intended to be developed to create a new residential community, with residential lots to be developed over the majority of the site. A commercial area and a mixed-use area are proposed for the south eastern side of the site, to serve the Moana community. Public use areas are included in the proposed development in the form of reserve areas, with a large reserve intended in the location of the former landfill and smaller reserve areas in the locations of natural waterways. The site owner intends to work with the Department of Conservation (DoC) to develop an outdoor education centre on the north side of the site, and access to walking trials located on the neighbouring DoC land to the west of the site.

Based on the evidence gathered during the PSI, the proposed development cannot be considered a Permitted Activity under NES Regulation 8(3)(c) and 8(4) owing to HAIL activities having previously occurred at the site. Therefore, a DSI is required to assess whether the proposed development can be undertaken as a Controlled Activity under NES Regulation 9.

5 Intrusive investigation

The following scope of work was undertaken to assess whether contamination impacts, resulting from the identified HAIL activities, are present at concentrations that may pose an unacceptable risk to human health:

- Collection of 35 soil samples from 35 locations in the approximate location of the golf course and associated sheds, air strip, landfill, and storage yard.
- Visual and olfactory inspection of soil samples in the field;
- Submission of 35 soil samples to RJ Hill Laboratories (Hills) for analysis of a suite of common heavy metals, and organochlorine pesticides (OCPs);
- Interpretation of laboratory results, in terms of the adopted human health criteria for residential and commercial land use and excavation / redevelopment earthworks;
- Present the findings of the investigation, including the suitability of the site for development for residential and commercial use, and recommendations to manage impacted areas (if any).

6 Sampling and Analysis Plan

Based on a draft site development plan provided to us by Brunner Builders Ltd., produced by James Lunday Urban Design Ltd and Outerspace Landscape Architects Ltd., dated 25 January 2021, our site observations from our site visit for our PSI report, anecdotal evidence from the site owner and historical aerial photographs available on retrolens.nz website and Google Earth, we developed a soil sampling plan for the site.

Limited information was available regarding the location of the landfill and its extent. Test pits were dug on site, prior to our visit to collect soil samples, to evaluate the nature of the waste, the depth of the capping layer and the extent of the landfill. This information informed our sampling plan and will be used, in conjunction with our soil sample results in the final design of the site development plan. The test pits and the majority of sample points were located by Coastwide Surveys Ltd. and a plan indicating the extent of landfill waste was developed; the Landfill Plan is presented in Appendix 2.

To assess whether the proposed development of the site qualifies as a Controlled Activity under NES Regulation 9, 35 soil samples were taken from 35 locations within and around the approximate location of the golf course and associated sheds, air strip, landfill, and storage yard. The locations of our sampling points are considered to be representative of the soils across the site.

6.1. Soil Sampling

WGL visited the site on 16 March 2021 to collect soil samples. 35 samples were collected from 35 locations (refer to the Sample Location Plans presented in Appendix 3). Sample information is summarised in Table 1.

The cleanfill cap on the landfill was between 0.5 m and 1.1 m thick and comprised a gravelly silt layer between the surface and 0.2 - 0.3 m bgl, underlain by a sandy gravel layer between 0.3 – 0.4 m thick, further underlain by a gravelly silt capping layer between 0.2 -0.4 m thick, immediately overlying the landfill waste. The landfill waste observed comprised general refuse (e.g. wood, plastics, metal) and domestic waste (e.g. cans, bottles, jars).

Table 1: List of Samples

Sample Location	Sample Name	Sample Depth (m)	Soil Type	Laboratory Analytes
GC01	GC01	0 – 0.2	Silt.	Heavy Metals, Organochlorine Pesticide Residue.
GC03	GC03	0 – 0.2	Silt.	Heavy Metals, Organochlorine Pesticide Residue.
GC04	GC04	0 – 0.2	Silt.	Heavy Metals, Organochlorine Pesticide Residue.
GC05	GC05	0 – 0.2	Silt.	Heavy Metals, Organochlorine Pesticide Residue.
AS01	AS01	0 – 0.2	Silty gravel.	Heavy Metals.
AS02	AS02	0 – 0.2	Silty gravel.	Heavy Metals.
LF01	LF01	0 – 0.2	Gravelly silt.	Heavy Metals.
LF03	LF03	0 – 0.2	Gravelly silt.	Heavy Metals.
LF04	LF04	0 – 0.2	Gravelly silt	Heavy Metals.
LF06	LF06	0 – 0.2	Gravelly silt	Heavy Metals.
LF07	LF07	0 – 0.2	Gravelly silt	Heavy Metals.
LF08	LF08	0 – 0.2	Gravelly silt	Heavy Metals.
LM01	LM01	0 – 0.2	Gravelly silt	Heavy Metals.
LM02	LM02	0 – 0.2	Gravelly silt	Heavy Metals.
LM03	LM03	0 – 0.2	Gravelly silt	Heavy Metals.
LM04	LM04	0 – 0.2	Gravelly silt	Heavy Metals.
LM06	LM06	0 – 0.2	Gravelly silt	Heavy Metals.
LM07	LM07	0 – 0.2	Gravelly silt	Heavy Metals.
CH01	CH01	0 – 0.2	Gravelly silt	Heavy Metals.
CH02	CH02	0 – 0.2	Gravelly silt	Heavy Metals.
CH03	CH03	0 – 0.2	Gravelly silt	Heavy Metals.
CH04	CH04	0 – 0.2	Silty gravel	Heavy Metals.
SY01	SY01	0 – 0.2	Sandy gravel	Heavy Metals.
SY02	SY02	0 – 0.2	Sandy gravel	Heavy Metals.
SY03	SY03	0 – 0.2	Sandy gravel	Heavy Metals.
SY04	SY04	0 – 0.2	Sandy gravel	Heavy Metals.
SY05	SY05	0 – 0.2	Sandy gravel	Heavy Metals.
SY08	SY08	0 – 0.2	Sandy gravel	Heavy Metals.
SY09	SY09	0 – 0.2	Sandy gravel	Heavy Metals.
SY010	SY010	0 – 0.2	Sandy gravel	Heavy Metals.
SY011	SY011	0 – 0.2	Sandy gravel	Heavy Metals.

6.2. Sampling Methodology

The following was undertaken during the soil sampling works:

- Samples were collected from various depths at 35 locations. The locations, sample names, depths, description of the material represented by each sample and the laboratory analytes are described in Table 1.
- Samples were compressed directly into laboratory supplied containers using a new pair of nitrile gloves for each sample. Prior to sampling, the equipment (hand auger or trowel) was decontaminated using a triple wash procedure with potable water, Decon 90 solution and deionised water. Test pits were dug in the locations of storage yard and landfill areas and samples were taken directly from the test pit walls;
- Visual and olfactory inspections of each sample were performed for indicators of contamination;
- Placement of samples into a chilly bin and transported, under standard WGL chain of custody procedures, to Hills for analysis; and
- WGL requested that Hills test samples for the analytes described in Table 1.

7 Quality Assurance / Quality Control

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

- Standard sample registers and chain of custody records have been kept for all samples;
- The use of Hills, accredited by International Accreditation New Zealand (IANZ), to conduct laboratory analyses; and
- During the site investigation every attempt was made to ensure that cross contamination did not occur through the use of the procedures outlined within this document.

8 Investigation Criteria

The criteria were selected to evaluate the risks to human health during redevelopment earthworks or maintenance of underground services, and for future site use as a residential area with commercial and recreational facilities.

8.1. NES

The NES, which has been in effect since 1 January 2012, introduced soil contaminant standards (SCSs) for 12 priority contaminants for the protection of human health under a variety of land use scenarios.

The investigation criteria referenced in this report has been selected from the NES to assess risks to human health. Given the proposed use of the site with a number of residential properties, ranging in size from approximately 260 m^2 up to 2,000 m^2, a soil contaminant standard (SCS), with an anticipated ingestion of 10% produce grown on the site, has been selected. However, parts of the site are proposed to be used for reserve areas and commercial areas and, as such, soil contaminant standards (SCSs) for recreational land use and commercial / industrial land use, based on an outdoor worker scenario, have also been selected.

Human health criteria for commercial / industrial land use also used as surrogate values to assess the short-term risk to earthworks contractors on site during future soil disturbance associated with development activities.

8.2. Soil Criteria

The assessment criteria referenced in this report have been selected in line with the NES and the MfE (2011), *Contaminated Land Management Guidelines No. 2* to assess risks to human health during the commercial / industrial land use exposure scenarios, which also act as a surrogate for maintenance of underground services or excavation activities.

Where a soil contaminant standard (SCS) was not available, other appropriate criteria for residential land use were sourced from the United States Environmental Protection Agency (2019) *Regional Screening Levels*, Australian National Environmental Protection Council (1999) and *Guideline on the Investigation Levels for Soil and Water*.

Criteria for background concentrations of heavy metals for the West Coast region The West Coast Regional Council have confirmed that no background criteria exist for concentrations of trace elements in the soil on the West Coast.

9 Results

Table 2 compares heavy metal soil contaminant concentrations in the samples with the adopted assessment criteria described above. No organochlorine pesticide residue was detected within laboratory detection limits. The full laboratory certificates are presented in Appendix 4.

Table 2: Sample Laboratory Results for Heavy Metals Compared with Investigation Criteria

Analyte	Units	GC01	GC03	CG04	GC05	AS01	AS03	Assessment Criteria		
								Residential 10% produce	Recreation	Commercial / Industrial
Lab Sample ID		2534828.1	2534828.2	2534828.3	2534828.4	2534828.9	2534828.10			
Soil Depth		surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m			
Sample Date		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021			
Heavy Metals								Heavy Metals		
Arsenic	mg/kg	<2	<2	3	<2	4	<2	20 (A)	80 (A)	70 (A)
Cadmium	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	3 (A)	400 (A)	1,300 (A)
Chromium (total)	mg/kg	8	14	20	7	15	17	460 (A)	2,700 (A)	6,300 (A)
Copper	mg/kg	4	3	<2	<2	12	3	10,000 (A)	10,000 (A)	10,000 (A)
Lead	mg/kg	13.9	15.2	14.1	7.8	11.7	10.8	210 (A)	880 (A)	3,300 (A)
Nickel	mg/kg	<2	3	7	<2	15	10	400 (B)	-	6,000 (B)
Zinc	mg/kg	6	7	18	5	33	20	7,400 (B)	-	400,000 (B)

Analyte	Units	LF01	LF03	LF04	LF06	LF07	LF08	Assessment Criteria		
								Residential 10% produce	Recreation	Commercial / Industrial
Lab Sample ID		2534828.11	2534828.12	2534828.13	2534828.14	2534828.15	2534828.16			
Soil Depth		surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m			
Sample Date		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021			
Heavy Metals								Heavy Metals		
Arsenic	mg/kg	5	4	18	5	3	4	20 (A)	80 (A)	70 (A)
Cadmium	mg/kg	<0.10	<0.10	0.29	<0.10	0.13	<0.10	3 (A)	400 (A)	1,300 (A)
Chromium (total)	mg/kg	15	14	24	15	17	14	460 (A)	2,700 (A)	6,300 (A)
Copper	mg/kg	19	9	36	18	18	13	10,000 (A)	10,000 (A)	10,000 (A)
Lead	mg/kg	34	16.9	88	27	18.3	13	210 (A)	880 (A)	3,300 (A)
Nickel	mg/kg	16	10	15	14	14	14	400 (B)	-	6,000 (B)
Zinc	mg/kg	77	51	161	144	41	35	7,400 (B)	-	400,000 (B)

Analyte	Units	LM01	LM02	LM03	LM04	LM06	LM07	Assessment Criteria		
								Residential 10% produce	Recreation	Commercial / Industrial
Lab Sample ID		2534828.21	2534828.22	2534828.23	2534828.24	2534828.25	2534828.26			
Soil Depth		surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m			
Sample Date		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021			
Heavy Metals								Heavy Metals		
Arsenic	mg/kg	5	4	3	5	4	5	20 (A)	80 (A)	70 (A)
Cadmium	mg/kg	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	3 (A)	400 (A)	1,300 (A)
Chromium (total)	mg/kg	13	11	16	15	16	17	460 (A)	2,700 (A)	6,300 (A)
Copper	mg/kg	8	8	3	11	10	12	10,000 (A)	10,000 (A)	10,000 (A)
Lead	mg/kg	83	61	24	260	24	14.1	210 (A)	880 (A)	3,300 (A)
Nickel	mg/kg	10	6	9	12	12	12	400 (B)	-	6,000 (B)
Zinc	mg/kg	220	124	63	97	55	35	7,400 (B)	-	400,000 (B)

Analyte	Units	CH01	CH02	CH03	CH04	SY01	SY02	Assessment Criteria		
								Residential 10% produce	Recreation	Commercial / Industrial
Lab Sample ID		2534828.17	2534828.18	2534828.19	2534828.2	2534828.27	2534828.28			
Soil Depth		surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m			
Sample Date		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021			
Heavy Metals								Heavy Metals		
Arsenic	mg/kg	4	3	5	4	5	3	20 (A)	80 (A)	70 (A)
Cadmium	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	3 (A)	400 (A)	1,300 (A)
Chromium (total)	mg/kg	11	146	15	16	16	15	460 (A)	2,700 (A)	6,300 (A)
Copper	mg/kg	8	3	11	10	12	10	10,000 (A)	10,000 (A)	10,000 (A)
Lead	mg/kg	61	24	260	24	14.5	12.4	210 (A)	880 (A)	3,300 (A)
Nickel	mg/kg	6	9	12	12	12	14	400 (B)	-	6,000 (B)
Zinc	mg/kg	124	63	97	55	35	35	7,400 (B)	-	400,000 (B)

Analyte	Units	SY03	SY04	SY05	SY08	SY09	SY10	SY11	Assessment Criteria		
									Residential 10% produce	Recreation	Commercial / Industrial
Lab Sample ID		2534828.29	2534828.3	2534828.31	2534828.32	2534828.33	2534828.34	2534828.35			
Soil Depth		surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m	surface - 0.2m			
Sample Date		17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021	17/02/2021			
Heavy Metals									Heavy Metals		
Arsenic	mg/kg	3	4	3	4	3	2	3	20 (A)	80 (A)	70 (A)
Cadmium	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	3 (A)	400 (A)	1,300 (A)
Chromium (total)	mg/kg	15	15	17	14	13	11	17	460 (A)	2,700 (A)	6,300 (A)
Copper	mg/kg	7	14	9	12	9	6	7	10,000 (A)	10,000 (A)	10,000 (A)
Lead	mg/kg	11.6	13.5	11.9	16.4	11.4	7.4	12.4	210 (A)	880 (A)	3,300 (A)
Nickel	mg/kg	11	15	14	14	13	9	11	400 (B)	-	6,000 (B)
Zinc	mg/kg	32	41	34	45	31	27	27	7,400 (B)	-	400,000 (B)

General Notes:
This table does not represent the full analytical results, please refer to the laboratory results for full details.
Values highlighted in orange exceed the adopted residential craiteria.
No background criteria was available.
Lead was detected above the adopted assessment criteria in two samples. No contaminants of concern were identified above the adopted assessment criteria for risks to human health for recreational or commercial land use.

Guideline Notes:
A - Methodology for Deriving Soil Guideline Values Protective of Human Health,
B - National Environment Protection (assessment of Site Contamination) Measure

9.1. Discussion

Information obtained as part of this investigation indicates that, historically, there has been a town landfill and an airstrip / landing pad, located on the south side of the site, and a golf course, located through the mid-section of the site. Two small sheds relating to the golf course remain on the south eastern side of the site, the southern-most shed being a former golf clubhouse and the northern shed being a former lawnmower shed. A storage yard area is located on the south side of the site housing vehicles and, formerly a transportable fuel tank. These activities are recognised by the Ministry for the Environment (MfE) as Hazardous Activities and Industries List (HAIL) activities.

Results of laboratory analyses indicate that the majority of soil samples contained contaminants at concentrations below the adopted criteria for residential, recreational and commercial / industrial land use. Samples LM04 and CH03, on the south eastern side of the site, next to the lawnmower shed and the golf clubhouse, contained lead at concentrations above the adopted criteria for residential land use. However, we understand that this area will not be used for residential purposes, and instead will be either a recreational use area or a commercial use area. The results for these two samples fall below the adopted criteria for both Recreational and Commercial / Industrial land use.

Based on the results of the soil analysis, we consider that the HAIL activities identified on site are highly unlikely to result in a risk to human health should the activity of residential and commercial development proceed.

10 Conceptual Site Model

A contamination conceptual site model, presented in Table 4, consists of three primary components to allow the potential for risk to be determined. These are:

- Source of contamination;
- Pathway to allow the contamination to mobilise; and
- Sensitive receptors which may be impacted by the contamination.

Table 4: Conceptual Site Model

Source	Pathway	Receptor
Landfill (Heavy metals) Air strip (Heavy metals) Golf Course (Heavy metals, pesticides) Storage yard (Heavy metals)	Dermal absorption (direct contact); Ingestion and / or inhalation of soil; Leaching of contaminants to groundwater; Inhalation of dust;	Maintenance / Excavation workers; Future residents; Future site workers (commercial)
Acceptable risk to human health?	Yes: All soil contaminants in the areas that are proposed to be used for residential purposes are below assessment criteria for residential land use and all soil contaminants are below assessment criteria for recreational and commercial land use, and for future development workers (commercial / industrial criteria).	

11 Conclusions

Based on our investigation, HAIL activities have previously been identified at the site. Soil analysis results indicate that soil in the location of lawnmower shed and the golf clubhouse, contained lead at concentrations exceeding the adopted criteria for residential land use, but below criteria for recreational and commercial land use. We understand that this area will not be used for residential purposes.

Based on the current contamination status of the site, given the potential sources identified, it is considered highly unlikely that there will be a risk to human health from chemical contamination of the new residential and commercial development, if the following activities are done to the piece of land:

- Developing the site for residential, commercial and recreational use,
- Future use as a residential subdivision with a commercial area and recreation reserve areas.

12 Recommendations

It is recommended that proposed development of the land be allowed as a Controlled Activity under the NES, because the requirements of Regulation 9(1) and 9(3) have been met. Future applications for subdivision / development / disturbance of the site should be assessed in terms of activities identified in this investigation and any potential new HAIL activities that could occur at the site at any time after this report was written.

If any non-naturally occurring material is unearthed within the residential or commercial areas of the site during future soil disturbance events, work should stop immediately and a suitably qualified

environmental practitioner should be engaged to assess the risk to human health prior to recommencing earthworks.

Owing to the exceedance of residential assessment criteria in LM04 and CH03, the soil in this area should not be classed as “cleanfill” and, as such, we recommend a Contaminated Site Management Plan be required when completing earthworks. Given that no background criteria exist for the West Coast region, we cannot determine whether contaminant concentrations in the soils on site are comparable to ambient concentrations of trace elements in the soil. Therefore, we recommend the West Coast Regional Council are consulted prior to commencement of earthworks to determine requirements for “cleanfill” soils in all other areas of the site.

13 References

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LIMITATIONS

(i) This report has been prepared for the use of our client, Brunner Builders Ltd., and their professional advisers, and the relevant Regional Authorities in relation to the specified project

brief described in this report. No liability is accepted for the use of any part of the report for any other purpose or by any other person or entity.

(ii) Assessments made in this report are based on the ground conditions indicated from published sources, site inspections and subsurface investigations described in this report based on accepted normal methods of site investigations. Variations in ground conditions may exist between test locations and therefore have not been taken into account in the report.

(iii) This Limitation should be read in conjunction with the IPENZ/ACENZ Standard Terms of Engagement.

We trust that this information meets your current requirements. Please do not hesitate to contact the undersigned on 021 127 1291 or helen@wileygeotechnical.co.nz if you require any further information.

Report prepared by

Helen Kellett

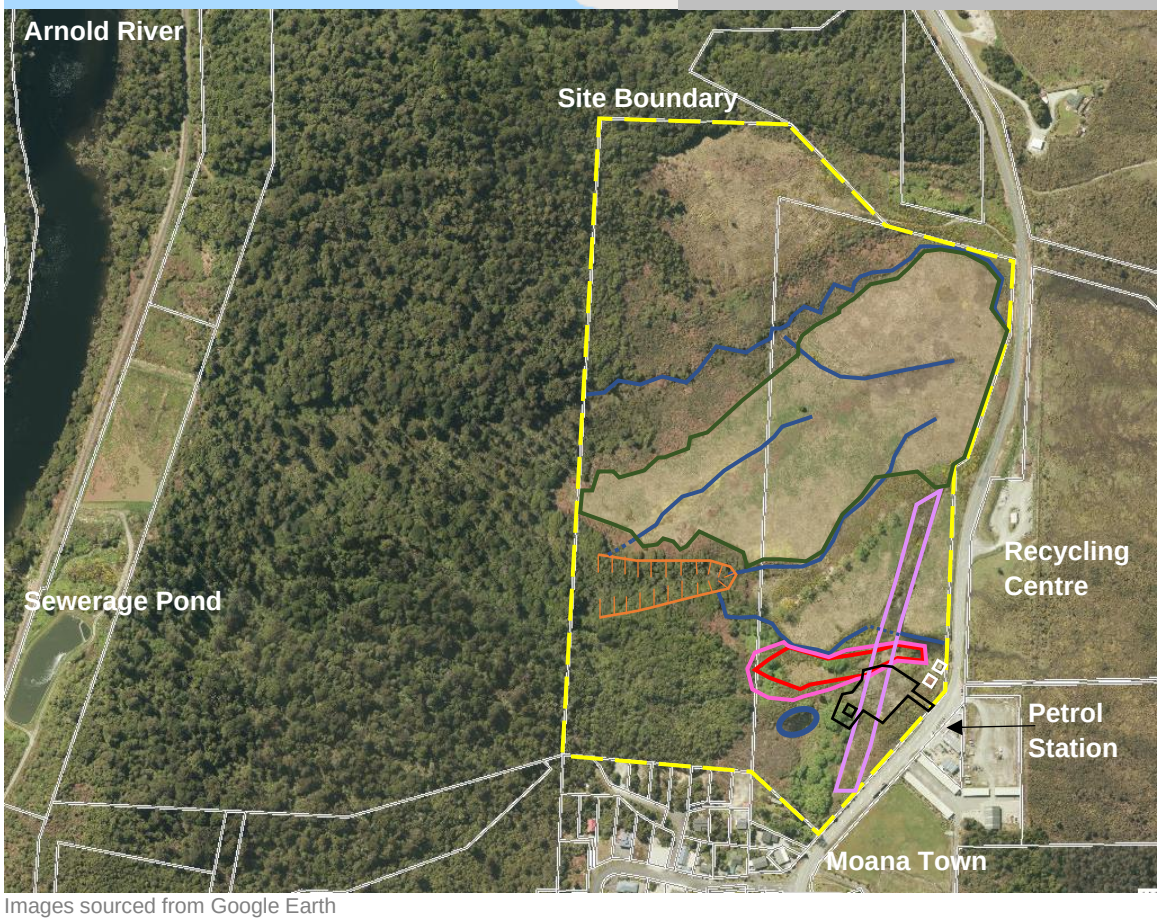
Senior Engineering Geologist

Reviewed by

Claude Midgley, CEnvP

Associate Environmental Scientist

Appendix 1: Site Location Plan



Images sourced from Google Earth

Appendix 2: Survey of Landfill Waste Area

Testpit Plan - Surveyed and prepared by Coastwide Surveys Limited

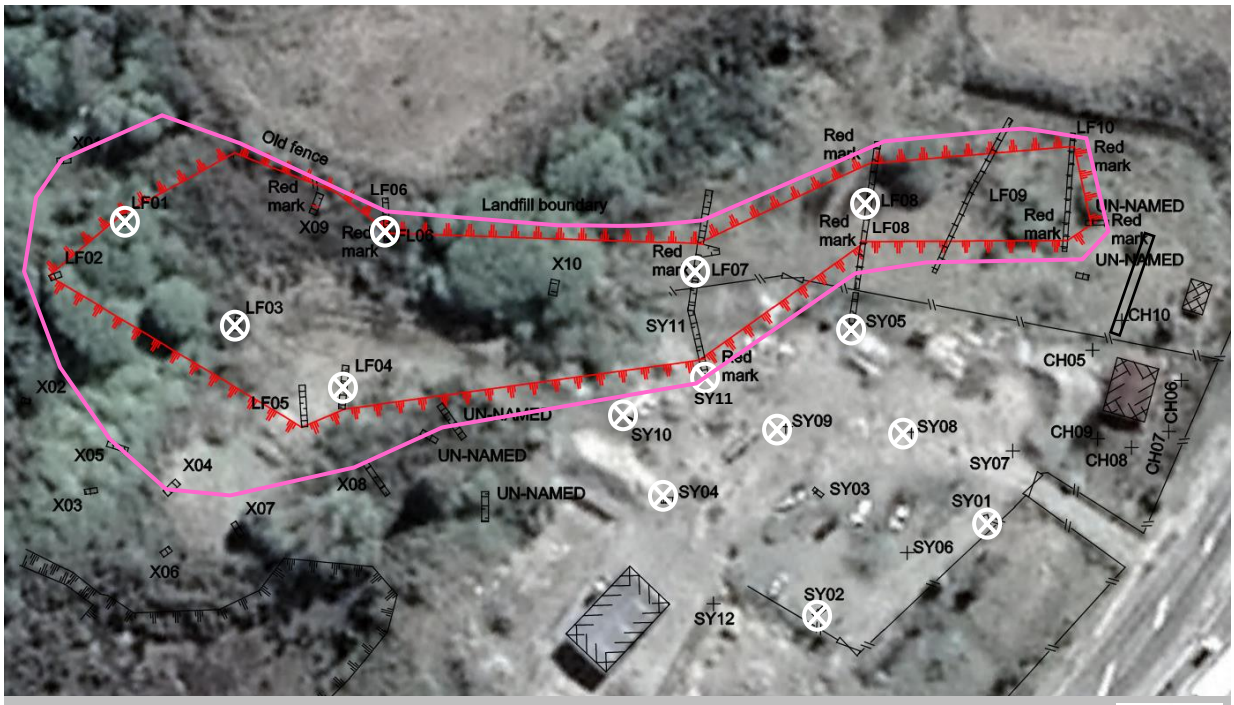
12d Model

Scale 1:750

Fri Feb 19 12:29:14 2021

Appendix 3: Sample Location Plans

Landfill and Storage Yard Sample Locations



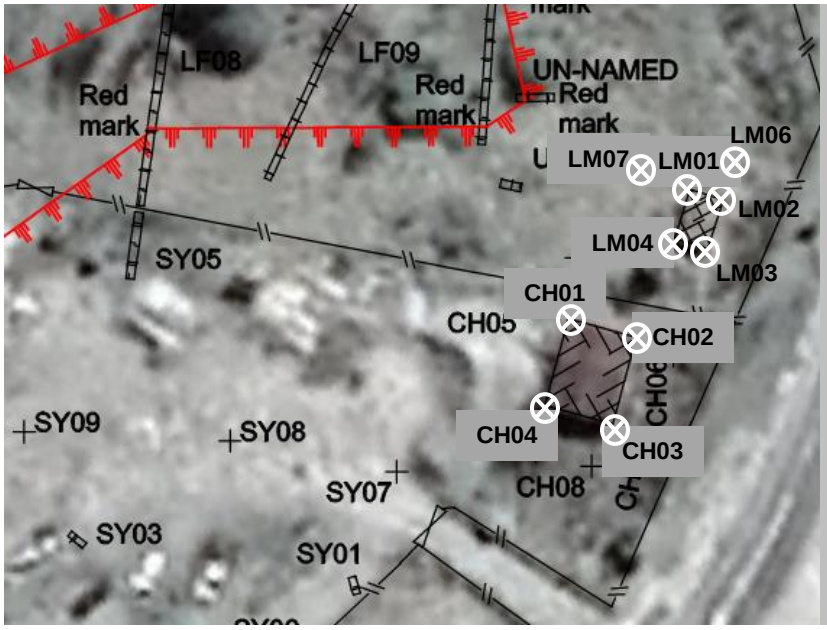
Legend

- Known location of buried landfill waste (Surveyed extent, based waste found in test pits)
- Landfill extent (surveyed extent, based on native soil found in test pits)
- WGL sample location

N

Images sourced from Google and Coastwide Survey Ltd.

Golf Clubhouse and Lawnmower Shed Sample Locations



Legend

- Known location of buried landfill waste (Surveyed extent, based waste found in test pits)
- Building
- WGL sample location

N

Images sourced from Google and Coastwide Survey Ltd.

Air Strip / Landing Pad Sample Locations

Image sourced from Google.

Golf Course Sample Locations

Image sourced from Google.

Appendix 4: Laboratory Results

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

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W www.hill-laboratories.com

Certificate of Analysis

Client:	Wiley Geotechnical Limited	**Lab No:**	2534828 SPv1
Contact:	Helen Kellett	**Date Received:**	22-Feb-2021
	C/- Wiley Geotechnical Limited	**Date Reported:**	25-Feb-2021
	PO Box 21171	**Quote No:**	109799
	Edgeware	**Order No:**	C20001
	Christchurch 8143	**Client Reference:**	C20001
		Submitted By:	Helen Kellett

Sample Type: Soil

Sample Name:		GC01 17-Feb-2021	GC03 17-Feb-2021	GC04 17-Feb-2021	GC05 17-Feb-2021	GC01A 17-Feb-2021
Lab Number:		2534828.1	2534828.2	2534828.3	2534828.4	2534828.5
Individual Tests						
Dry Matter	g/100g as rcvd	-	-	-	-	31
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	< 2	< 2	3	< 2	-
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	-
Total Recoverable Chromium	mg/kg dry wt	8	14	20	7	-
Total Recoverable Copper	mg/kg dry wt	4	3	< 2	< 2	-
Total Recoverable Lead	mg/kg dry wt	13.9	15.2	14.1	7.8	-
Total Recoverable Nickel	mg/kg dry wt	< 2	3	7	< 2	-
Total Recoverable Zinc	mg/kg dry wt	6	7	18	5	-
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	-	-	-	-	< 0.04
alpha-BHC	mg/kg dry wt	-	-	-	-	< 0.04
beta-BHC	mg/kg dry wt	-	-	-	-	< 0.04
delta-BHC	mg/kg dry wt	-	-	-	-	< 0.04
gamma-BHC (Lindane)	mg/kg dry wt	-	-	-	-	< 0.04
cis-Chlordane	mg/kg dry wt	-	-	-	-	< 0.04
trans-Chlordane	mg/kg dry wt	-	-	-	-	< 0.04
2,4'-DDD	mg/kg dry wt	-	-	-	-	< 0.04
4,4'-DDD	mg/kg dry wt	-	-	-	-	< 0.04
2,4'-DDE	mg/kg dry wt	-	-	-	-	< 0.04
4,4'-DDE	mg/kg dry wt	-	-	-	-	< 0.04
2,4'-DDT	mg/kg dry wt	-	-	-	-	< 0.04
4,4'-DDT	mg/kg dry wt	-	-	-	-	< 0.04
Total DDT Isomers	mg/kg dry wt	-	-	-	-	< 0.19
Dieldrin	mg/kg dry wt	-	-	-	-	< 0.04
Endosulfan I	mg/kg dry wt	-	-	-	-	< 0.04
Endosulfan II	mg/kg dry wt	-	-	-	-	< 0.04
Endosulfan sulphate	mg/kg dry wt	-	-	-	-	< 0.04
Endrin	mg/kg dry wt	-	-	-	-	< 0.04
Endrin aldehyde	mg/kg dry wt	-	-	-	-	< 0.04
Endrin ketone	mg/kg dry wt	-	-	-	-	< 0.04
Heptachlor	mg/kg dry wt	-	-	-	-	< 0.04
Heptachlor epoxide	mg/kg dry wt	-	-	-	-	< 0.04
Hexachlorobenzene	mg/kg dry wt	-	-	-	-	< 0.04
Methoxychlor	mg/kg dry wt	-	-	-	-	< 0.04

Sample Type: Soil						
Sample Name:		GC03A 17-Feb-2021	GC04A 17-Feb-2021	GC05A 17-Feb-2021	AS01 17-Feb-2021	AS03 17-Feb-2021
Lab Number:		2534828.6	2534828.7	2534828.8	2534828.9	2534828.10
Individual Tests						
Dry Matter	g/100g as rcvd	48	67	51	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	-	-	-	4	< 2
Total Recoverable Cadmium	mg/kg dry wt	-	-	-	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	-	-	-	15	17
Total Recoverable Copper	mg/kg dry wt	-	-	-	12	3
Total Recoverable Lead	mg/kg dry wt	-	-	-	11.7	10.8
Total Recoverable Nickel	mg/kg dry wt	-	-	-	15	10
Total Recoverable Zinc	mg/kg dry wt	-	-	-	33	20
Organochlorine Pesticides Screening in Soil						
Aldrin	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
alpha-BHC	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
beta-BHC	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
delta-BHC	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
gamma-BHC (Lindane)	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
cis-Chlordane	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
trans-Chlordane	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
2,4'-DDD	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
4,4'-DDD	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
2,4'-DDE	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
4,4'-DDE	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
2,4'-DDT	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
4,4'-DDT	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Total DDT Isomers	mg/kg dry wt	< 0.12	< 0.09	< 0.12	-	-
Dieldrin	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endosulfan I	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endosulfan II	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endosulfan sulphate	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endrin	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endrin aldehyde	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Endrin ketone	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Heptachlor	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Heptachlor epoxide	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Hexachlorobenzene	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-
Methoxychlor	mg/kg dry wt	< 0.02	< 0.015	< 0.02	-	-

Sample Name:		LF01 16-Feb-2021	LF03 16-Feb-2021	LF04 16-Feb-2021	LF06 16-Feb-2021	LF07 16-Feb-2021
Lab Number:		2534828.11	2534828.12	2534828.13	2534828.14	2534828.15
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	4	18	5	3
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	0.29	< 0.10	0.13
Total Recoverable Chromium	mg/kg dry wt	15	14	24	15	17
Total Recoverable Copper	mg/kg dry wt	19	9	36	18	18
Total Recoverable Lead	mg/kg dry wt	34	16.9	88	27	18.3
Total Recoverable Nickel	mg/kg dry wt	16	10	15	14	14
Total Recoverable Zinc	mg/kg dry wt	77	51	161	144	41

Sample Name:		LF08 16-Feb-2021	CH01 17-Feb-2021	CH02 17-Feb-2021	CH03 17-Feb-2021	CH04 17-Feb-2021
Lab Number:		2534828.16	2534828.17	2534828.18	2534828.19	2534828.20
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	5	4	4	< 2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	14	25	21	14	6
Total Recoverable Copper	mg/kg dry wt	13	13	13	10	3
Total Recoverable Lead	mg/kg dry wt	13.0	67	19.3	22	10.7

Sample Type: Soil						
Sample Name:		LF08 16-Feb-2021	CH01 17-Feb-2021	CH02 17-Feb-2021	CH03 17-Feb-2021	CH04 17-Feb-2021
Lab Number:		2534828.16	2534828.17	2534828.18	2534828.19	2534828.20
Heavy Metals, Screen Level						
Total Recoverable Nickel	mg/kg dry wt	14	15	20	13	4
Total Recoverable Zinc	mg/kg dry wt	35	400	500	198	126

Sample Name:		LM01 17-Feb-2021	LM02 17-Feb-2021	LM03 17-Feb-2021	LM04 17-Feb-2021	LM06 17-Feb-2021
Lab Number:		2534828.21	2534828.22	2534828.23	2534828.24	2534828.25
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	4	3	5	4
Total Recoverable Cadmium	mg/kg dry wt	0.12	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	13	11	16	15	16
Total Recoverable Copper	mg/kg dry wt	8	8	3	11	10
Total Recoverable Lead	mg/kg dry wt	83	61	24	260	24
Total Recoverable Nickel	mg/kg dry wt	10	6	9	12	12
Total Recoverable Zinc	mg/kg dry wt	220	124	63	97	55

Sample Name:		LM07 17-Feb-2021	SY01 16-Feb-2021	SY02 16-Feb-2021	SY03 16-Feb-2021	SY04 16-Feb-2021
Lab Number:		2534828.26	2534828.27	2534828.28	2534828.29	2534828.30
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	5	5	3	3	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	17	16	15	15	15
Total Recoverable Copper	mg/kg dry wt	12	12	10	7	14
Total Recoverable Lead	mg/kg dry wt	14.1	14.5	12.4	11.6	13.5
Total Recoverable Nickel	mg/kg dry wt	12	14	13	11	15
Total Recoverable Zinc	mg/kg dry wt	35	35	31	32	41

Sample Name:		SY05 16-Feb-2021	SY08 17-Feb-2021	SY09 17-Feb-2021	SY10 17-Feb-2021	SY11 17-Feb-2021
Lab Number:		2534828.31	2534828.32	2534828.33	2534828.34	2534828.35
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	3	4	3	2	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	17	14	13	11	17
Total Recoverable Copper	mg/kg dry wt	9	12	9	6	7
Total Recoverable Lead	mg/kg dry wt	11.9	16.4	11.4	7.4	12.4
Total Recoverable Nickel	mg/kg dry wt	14	14	13	9	11
Total Recoverable Zinc	mg/kg dry wt	34	45	31	27	27

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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. 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%.	-	1-4, 9-35
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	1-4, 9-35
Organochlorine Pesticides Screening in Soil	Sonication extraction, GC-ECD analysis. Tested on as received sample. In-house based on US EPA 8081.	0.010 - 0.06 mg/kg dry wt	5-8
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	5-8

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

Testing was completed between 24-Feb-2021 and 25-Feb-2021. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

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Martin Cowell - BSc
Client Services Manager - Environmental