Cleanfill Site Investigations, Marlborough 2010

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Executive Summary

Sustainable Environmental Engineering Limited (SEE Ltd) was commissioned by Marlborough District Council to undertake Preliminary Site Assessments on six different cleanfill sites in

the Marlborough region to ensure that they are operated within specific conditions with regard to the types of materials that are being imported onto site as outlined in the Councils Resource Management Plans and the Ministry for the Environments document titled 'A Guide to the Management of Cleanfills'

A desk study, walkover and site investigation including the excavation and logging of test pits and sampling and chemical analysis of fill materials was undertaken at each of the sites. The results of chemical analysis were compared against contaminant concentrations contained within the document produced by Marlborough District Council entitled 'Recommended limits for selected trace elements in cleanfills in Marlborough' and residential guideline values. Elevated concentrations of metals greater than the relevant guidelines were found in a number of the cleanfills.

A conceptual model was developed for each cleanfill site taking into consideration the concentrations of contaminants found and the potential receptors identified including human health and the wider environment. Complete Source-Pathway-Receptor linkages were identified and the risk posed to both human health and the wider environment was assessed. In some cases the risk to human health and the local environment from elevated concentrations of metals in the cleanfills was considered to be high.

Some of the cleanfill sites require remediating to ensure that the contaminants present will not continue to have a detrimental effect on human health and the wider environment.

Most of the Resource Consents for the cleanfill sites do not contain a definition for 'cleanfill' and if so, one that does not meet the definition contained within the MfE's document titled 'The Guide to the Management of Cleanfills' dated 2002. The Resource Consents for the investigated sites and any other cleanfill sites in the area should be amended to reflect the MfE document titled 'The Guide to the Management of Cleanfills'. Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' are acceptable.

To ensure that the practice of importing unacceptable materials onto cleanfill sites does not continue the sites need to be more strictly regulated. The primary environmental control on the successful development of a cleanfill site which poses no adverse effects on human health and the wider environment is the waste acceptance criteria documented in the resource consent. If these criteria are adhered to and other appropriate management practices implemented the potential for adverse effects will be minimal.

A detailed Site Specific Management Plan as laid out in Appendix B of the 'Guide to the Management of Cleanfills, MfE, 2002' covering all operational and management aspects of the cleanfill site should be prepared for all new cleanfill sites in the future and ones with significant ongoing life.

Contents

1. Introduction

SEE Ltd was commissioned by MDC to undertake an assessment of the nature of the waste materials contained in six cleanfill sites across Marlborough. The assessments include a site walkover, an intrusive investigation and chemical analysis of soil samples taken from each of the sites. The assessments were undertaken in order to satisfy Marlborough District Council that the cleanfill sites only contain 'cleanfill materials' as defined in Section 1.1 below.

These works are part of a monitoring program being undertaken by Marlborough District Council (MDC) to ensure that cleanfill sites under their jurisdiction are operated within specific conditions as outlined in the Marlborough District Councils Resource Management Plans, the Resource Consent for the site and the guidelines in the Ministry for the Environments document entitled 'Guide to the Management of Cleanfills' dated 2002.

The Ministry for the Environment's 'Guide to the Management of Cleanfills' document dated 2002 provides an overview of the requirements for cleanfill sites in New Zealand; the objectives of this guide are to:

- Clarify and define the term 'cleanfill';
- Outline general waste acceptance criteria for cleanfills, and explain why certain other wastes should be excluded;
- Provide guidelines for locating and determining the feasibility of a new cleanfill site;
- Define methods for effectively managing cleanfill sites to minimise adverse environmental effects; and to
- Raise awareness of the risk associated with poorly managed cleanfills.

1.1. Cleanfill Definitions

For completeness the definition of cleanfill as detailed in the MfE 'Guide to the Management of Cleanfills (2002)', the Wairau Awatere Resource Management Plan and the Marlborough Sounds Resource Management Plan have been included below. The 'Guide to the Management of Cleanfills (2002)' defines cleanfill material as:

> Material that when buried will have no adverse effect on people or the environment. Cleanfill material includes virgin natural materials such as clay, soil and rock, and other inert materials such as concrete or brick that are free of:
>
> - Combustible, putrescible, degradable or leachable components
> - Hazardous substances
> - Products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices
> - Materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances
> - Liquid waste

Tables 4.1 and 4.2 of the 'Guide to the Management of Cleanfills' document (Appendix 1) details the acceptable and unacceptable waste types a cleanfill site should and should not contain. In some cases additional evidence such as chemical analysis is required to prove that particular materials comply with the definition of cleanfill and are acceptable. Such conditionally acceptable materials are detailed in Section 4.2.2 of the guidelines.

A small quantity of building plastics such as pipes and plastic sheeting amongst a matrix of cleanfill material is considered acceptable however generally all other domestic or industrial plastics are unacceptable.

Section 4.4.2 of the 'Guide to the Management of Cleanfills' indicates that 'organic compounds should not be present on the cleanfill site', so it should not be necessary to test for these. Testing should focus on heavy metals and would typically be expected to include: arsenic, boron, cadmium, chromium, copper, cobalt, lead, mercury, nickel, tin and zinc.

The Marlborough District Councils Wairau Awatere Resource Management Plan defines cleanfill material as:

'*material that has no potential to produce harmful effects on the environment. This material is generally a natural material such as clay, soil and rock, and such other materials as concrete, brick or demolition products that are free of combustible or organic materials and are therefore not subject to biological or chemical breakdown. This will involve bulk filling operations where material is required to be carted to the filling site or specifically placed there rather than cut to fill operations such as normally occurs with construction of tracks, roads and landings.*'

The Marlborough District Councils Marlborough Sounds Resource Management Plan defines cleanfill material as:

'*material that has no potential to produce harmful effects on the environment. This material is generally a natural material such as clay, soil and rock, and such other materials as concrete, brick or demolition products that are free of combustible or organic materials and are therefore not subject to biological or chemical breakdown.*'

Due to the wide ranging and unknown nature of the potential materials deposited in cleanfill sites, the analysis recommended above and the limitations on expenditure, only the metals arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc were analysed for. If other visual or olfactory signs of contamination were detected i.e. hydrocarbons etc. additional analysis was undertaken.

1.2. Scope and Objectives

The objective of the site investigations was to ensure that each cleanfill contains only acceptable material as detailed in:

- The Councils Resource Management Plans;
- The resource consent for each individual site; and
- Table 4.2 of the 'Guide to the Management of Cleanfills' document.

To achieve the objective, the following scope of work was performed:

1. Review of general and historical information relevant to the site including the sites resource consent;
2. A site walkover to identify potential areas of concern on the site;
3. Excavation of test pits in order to log the materials on site and to take soil samples. Soil sampling was conducted in accordance with Contaminated Land Guideline No.5 'Site Investigation and Analysis of Soils' prepared by the Ministry for the Environment;
4. Laboratory analysis of four or more of the soil samples taken from each site for potential contaminants of concern including arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc and any other contaminants that may be detected by visual or olfactory means whilst on site e.g. hydrocarbons etc;

5. Comparison of contaminant concentrations against the guideline values within the document entitled 'Recommended limits for selected trace elements in cleanfills in Marlborough' produced by Marlborough District Council attached in Appendix 2. The guidelines are equidistant between the 95th percentile value for concentrations of metals/metaloids found in Marlborough's surface soils and Landcare Researcher's 2006 guideline for the protection of ecological receptors, the reference to which is within the attached document. The aforementioned document contains the trigger levels for the following metals:

Arsenic ……	13 mg/kg
Cadmium ……	1mg/kg
Chromium ……	47mg/kg
Copper ……	77 mg/kg
Lead ……	57 mg/kg
Nickel ……	34 mg/kg
Zinc ……	139mg/kg

   For completeness the contaminant concentrations present were also compared against residential guideline values which are protective of human health;

6. Development of a conceptual model for each of the sites. The conceptual model represents the characteristics of each site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with each site and determines if they are significant to human health and the wider environment.

   Definitions

   A contaminant - is a substance that is in, on or under the land and has the potential to cause harm or cause damage to an identified receptor.

   A receptor - in general terms is something that could be adversely affected by a contaminant such as people, ecological systems, property or a water body.

   A pathway - is a route or means by which a receptor can be exposed to, or affected by a contaminant.

   Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained;

7. Communication with relevant central, regional and local government officials; and

8. Preparation of a combined Preliminary Site Investigation Report taking into consideration guidelines for the reporting on contaminated sites in New Zealand as outlined in the Contaminated Land Management Guidelines No.1 Reporting on Contaminated Sites in New Zealand, Ministry for the Environment (MFE) (2001) and the Guide to the Management of Cleanfills, MFE, dated January 2002.

Due to the highly heterogeneous nature of the types of fill being dumped on site the soil sampling and chemical analysis undertaken provides an understanding of the conditions present in the test pits only and conditions may vary considerably over relatively small areas.

The report does not set out to comment on the engineering specifications or geotechnical stability of the cleanfill site.

2. Site 1 - Picton Earthworks, Picton

2.1. Site Description

The site, a cleanfill site, which has had a Resource Consent (RC No: U010076) since the 2nd August 2001, is located on Lot – Sec 133 Picton Suburban DIST, south west of Picton Refuse Tip to the west of Gravesend Place, Picton, Marlborough. The site has Resource Consent for up to 30,000m^3 of uncompacted material. Figure 1 below shows the regional location of the site.

Figure 1: Shows the regional location of the cleanfill site in Picton, Marlborough.

The cleanfill site is contained within a large south west/north east trending valley above Picton Sewerage Works.

The site is generally used by earthworks and building contractors to dump excavated materials from building sites/road cuttings etc. The site is open to the general public who must report to the site office at the refuse tip prior to the dumping of their waste. A gate is present at the northern end of the dump, which is closed on a nightly basis.

The cleanfill site is approximately 200m from northeast to southwest and 80m wide and is tiered in three distinct steps. The upper platform (approximately 66m above sea level (asl)) in the south westernmost part of the site is where the deepest area of fill and active tip face is (Photos 1 to 3 in

Appendix 5). The fill is estimated to be approximately 20m deep in this area. Trucks loaded with cleanfill drive up the access road and dump their load onto the platform close to the active tip face. The tipped material is then bulldozed over the tip face and compacted on the platform below. At the time of the site visit the middle platform (50m asl) contained a substantial quantity of old milled timber and plasterboard (Photo 3, Appendix 5), which the owner said was being sorted and would not be buried. The platform below the one with timber on it is at approximately 44m asl and has substantial quantities of concrete which was being used to fill in a large gully on the eastern boundary of the site. A capping layer of silty clayey soil has been placed over much of these areas and tarmac chip placed over that for roadways.

Within the last year, the owner indicates that approximately 2,500m^3 of dredged sea floor sediments from Picton marina have been placed on the upper platform and dewatered.

South west of the main cleanfill site is a smaller tip which has large quantities of green waste, wood, white goods etc. The tip does not have Resource Consent for tipping of this waste.

2.1.1. Resource Consent Conditions

The Resource Consent (No: U 010076) for the site has the following conditions that are relevant to this investigation.

Condition 02

That material brought to the site be restricted to "cleanfill" as defined in the Wairau Awatere Resource Management Plan.

Condition 2A

That the total volume of fill shall be no more than 5% timber, steel, road bitumen, iron, gib-board or other structural materials other than the above.

Condition 2B

That road slip debris shall not contain more than 5% vegetation matter per truck load'.

Condition 2D

That the land fill shall be supervised during the hours of operation and managed in such a way as to ensure that only cleanfill is deposited on site.

2.2. Site History

The site's current owner indicates that the site has been used as a cleanfill site since early 2000. No other historical evidence was found.

2.2.1. Possible Contaminants Associated with Historical Use

The owner indicates that as far as he is aware the material on site consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region, some demolition material (bricks, concrete) and sediment dredged from Picton Marina.

Due to the wide ranging and unknown nature of the potential materials deposited in cleanfill sites, the analysis recommended above and the limitations on expenditure, only the metals arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc were analysed for. If other visual or olfactory signs of contamination were detected i.e. hydrocarbons etc additional analysis was undertaken.

2.3. Environmental Setting

2.3.1. General Environmental Setting

The site is located in a rural area with regenerating native bush surrounding it. A residential sub-division is located approximately 300m east of the site. A small ephemeral stream flows close to the northern boundary of the site.

Figure 2: Aerial view of the cleanfill site, Picton Earthworks, dated 2007.

2.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by the Marlborough Schist which comprises of a well to poorly bedded grey to green grey sandstone to siltstone.

2.3.3. Hydrogeology

The Marlborough Schist is not considered to be a valuable groundwater source in this area.

2.4. Site Investigation

2.4.1. Soil Sampling Methodology

A sampling plan was worked out allowing for the areas that could not be investigated. The sampling plan was compromised by:

- a large area on the upper platform that was laid as hardstanding and the owner requested that no excavation was undertaken in this area;

- Large areas of wood on the middle platform; and
- Large areas of concrete on the lower platform and adjacent gully

Ten test pits were excavated on site, five on the upper platform, two at the base of the tip face, one on the middle platform and two on the lower platform. An engineer logged the test pits and 25 soil samples were taken from various depths. The test pit locations and logs are presented in Appendices 3 and 4. Six of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

2.4.2. Underlying Fill/Geology

Upper platform

Test pitting was undertaken in two main areas on the upper platform. Three test pits (TP1 to TP3) were excavated in an area where approximately 2500m^3 of dredged sediment (Photo 4) from Picton Marina had been placed to be dewatered and two close to the tip face (TP4 and TP5).

The soils in tests pits TP1 to TP3 consisted of a 600mm to 1m thick, heterogeneous, brown/tan, dry, slightly clayey FILL layer with sub angular to angular clasts of bedrock varying in size from 20mm to 400mm. Underlying the cover layer were the dredged marina sediments, which comprised of a dark grey, slightly moist, slightly clayey, sandy SILT with seashells scattered throughout. Photo 4 (Appendix 5) shows the nature of the dredged sediment.

The soil in the two test pits (TP4 and TP 5) excavated close to the tip face comprised of a heterogeneous mix of brown, dry, compact, slightly clayey, silty, sandy FILL with 20 to 100mm sub angular to angular clasts of weathered bedrock and minor amounts of natural timber (<1%), concrete and tarmac. Underlying the brown fill was a highly heterogeneous brown, moist, soft to firm, silty clayey FILL with minor amounts of sub angular to angular weathered rock clasts.

Recently dumped material on the upper platform (Photo 2), close to the tip face ready for filling and compaction comprised of a heterogeneous mix of colluvium, weathered bedrock, river gravels, concrete and used timber.

Middle Platform

The soil in the test pit (TP 6) comprised of a 600mm thick heterogeneous mix of brown, dry, silty sandy FILL with loose clasts of weathered bedrock, gravel, loose tarmac, concrete and lumps of mottled brown/grey/tan, moist, soft, silty clay. Underlying the fill was a heterogeneous brown/grey, moist, slightly clayey, silty sandy FILL with clasts of sub angular to angular weathered bedrock ranging from 50 to 100mm.

Large quantities of used wood were present on the middle platform (Photo 3). The site owner stated that it was being sorted and would not be buried.

Middle Platform - Lower Tip Face

The soil in the two test pits (TP 9 and TP10) excavated in the base of the tip face ranged from a heterogeneous brown, dry to slightly moist, silty sandy gravel FILL to a silty sandy clayey FILL (Photo 5). The gravel was sub angular to angular in nature and ranged in size from 20mm to 60mm. Minor amounts of wood (roots) were present in the fill (<1%). One sheet of corrugated iron was present in the shallow fill.

Lower Platform

The soil in the two test pits (TP7 and TP8) ranged from a heterogeneous brown, dry to slightly moist, silty, sandy gravel FILL to a silty sandy clayey FILL. The gravel was sub angular to angular in nature and ranged in size from 20mm to 60mm. Minor amounts of wood (roots) were present in the fill (<1%).

Large quantities of concrete were present on the platform itself and in the gully to the east of the site.

Logging of the test pits across the site indicated a highly heterogeneous mix of fill/soils beneath the site, as one would expect from a cleanfill site. Due to the highly heterogeneous nature of the fill deposits on site, reference to the test pit logs (Appendix 4) and photographs (Appendix 5) is considered the most appropriate way of understanding their variability and nature. Some smearing of the sides of the test pits occurred during the excavation, which can lead to misrepresentation of the material. No signs of groundwater were noted in any of the test pits. Natural ground was not detected in any of the test pits. However cuttings around the site indicated the geology to comprise of a brown/tan, stiff to very stiff, silty clay with, angular to sub angular clasts of bedrock in places representing colluvium. Underlying the colluvium was the Marlborough Schist.

Upper Tip

A smaller tip approximately 200m to the south west of the main tip contained large quantities of 'unacceptable cleanfill materials' such as wood, metal, fridges and general refuse (Photo 6, Appendix 5).

2.5. Soil Analysis - Results

The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6. Only values, which were greater than the acceptance criteria, are presented in Table 1 below. The Marlborough District Council trigger values (Appendix 2) and Residential Guidelines values which are protective of human health are also included in Table 1 for the purpose of comparison.

Table 1: Summary of analytical results from the soil sampling greater than the guideline values

Parameter	Sample ID				Guideline Values	
	TP1 (mg/kg)	TP2 (mg/kg)	TP7 (mg/kg)	TP8 (mg/kg)	MDC "trigger levels" (mg/kg)	Residential Guideline values (mg/kg)
Copper	103	114			77	130
Lead		92	84	162	57	300
Zinc				260	139	

* These are total recoverable figures.

The figures highlighted in Table 1 above indicates the soil samples, TP1 and TP2 taken from the marina dredged sediments contained elevated concentrations of copper and lead greater than the MDC 'trigger values'. Copper and lead are often found in antifouling paints/products used on boats. In addition soil samples from TP7 and TP8 contained concentrations of lead and zinc greater than the MDC 'trigger values'.

2.6. Preliminary Conceptual Model

The conceptual model (Table 2) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determines if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (6) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 2: Conceptual Model for Cleanfill site at Picton Earthworks, Picton.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
Copper, lead, zinc,	Human health	Dermal contact	Very Low	Concentrations lower than residential guideline values. Site in a rural area and contact with contaminants is unlikely.
		Ingestion	Very Low	Concentrations lower than residential guideline values. Site in a rural area and ingestion of contaminated soil is unlikely.
		Inhalation of dust/vapours	Low	Concentrations lower than residential guideline values. Inhalation of dust unlikely
	Groundwater	Vertical migration	Very low	Contaminant concentrations low. Groundwater not used.
	Surface water ecology	Vertical and lateral migration	Low to moderate	Concentrations greater than MDC trigger values. Small steam close to site. Possible contamination of stream

2.7. Conclusions

Some unacceptable cleanfill materials as detailed in the consent conditions and Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Large quantities of dewatered sludge/sediments from Picton Marina some of which contain copper and lead in concentrations greater than MDC Cleanfill guideline values;
- Soils containing elevated concentrations of lead and zinc in concentrations greater than MDC cleanfill guideline values for cleanfill sites;
- Large quantities of timber are present on the middle platform and should be removed; and
- Large quantities of green waste, white goods and general refuse are present in the upper tip which does not have a Resource Consent.

Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site in the future. Table 4.1 is attached in Appendix 1.

A tabular conceptual model was developed and it is considered that the contaminants, although elevated, represent a very low to low to risk to human health and groundwater and a low to moderate risk to surface waters. However, the conceptual model is based on the chemical analysis of a limited

number of soil samples (6), which may not be truly representative of the potential contamination issues on site due to the heterogeneous nature of the fill.

The tip is open to the general public, and tipping of waste is based on an honesty system. Further control on the tipping of material on site is required in order to stop unacceptable material reaching the tip face and being buried.

The smaller tip to the south west of the main tip contained large quantities 'unacceptable cleanfill materials' such as wood, metal, fridges and general refuse. The materials should be removed, transported to a suitably licensed landfill and dumping in this area ceased.

A detailed Site Specific Management Plan as laid out in Appendix B of the 'Guide to the Management of Cleanfills, MfE, 2002' covering all operational and management aspects of the cleanfill site should be prepared.

The Resource Consent should be amended to take into account the Ministry for the Environment's Guide to the management of Cleanfills, MFE, dated January 2002.

3. Site 2 - G.R. Lawrence, 141 Kenepuru Road, Linkwater

3.1. Site Description

The subject site, a cleanfill site, is located on Pt Sec 1 Blk SO 288 Bl IX Linkwater SD, on the Kenepuru Road, 1.3 kilometres north of Linkwater and is situated within a rural setting. Linkwater is located approximately 10 kilometres east of the township of Havelock in Marlborough. The cleanfill site is contained within a shallow north east/south west trending gully to the southwest of the Kenepuru Road. Agricultural land and a forestry block surround the cleanfill site. A small-unnamed stream flows under the Kenepuru Road, and is culverted below the cleanfill site into a small wetland area and eventually into the Mahakipawa Sound.

The site is generally used by earthworks and building contractors to dump excavated materials from building sites/road cuttings etc. The site is not open to the general public and a locked gate limits access.

The cleanfill site is approximately 110m from northeast to southwest and 90m wide and slopes gently to the south west (Photos 7 to 9 in Appendix 5). The fill is estimated to be approximately 5m deep at its deepest point. A capping layer of silty clayey soil has been placed over much of the cleanfill site and has been grassed. The tip face is currently in the south west corner of the site and is approximately 2m to 2.5m deep (Photo 7).

The site has Resource Consent for up to '*20,000m^3 of material over 20 years*' and is near to completion.

3.1.1. Resource Consent Conditions

The Resource Consent (No: U 040870) for the site has the following conditions that are relevant to this investigation.

Condition 07:

> the fill material shall be comprised of cleanfill being earth, rock or similar material and that vegetative material shall not comprise more than 5% of the fill. In any case no one truckload shall contain more than 20% non cleanfill material.

Figure 3: Shows the regional location of the cleanfill site near Linkwater, Marlborough.

3.2. Site History

The site's current owner indicates that the site has been used as a cleanfill site since early 2004. Previous to that the site was a shallow gully use for grazing. Aerial photographs dated 1959 do not indicate the presence of a cleanfill site. No other historical evidence was found.

3.2.1. Possible Contaminants Associated with Historical Use

Personnel on site indicate that the material within the cleanfill consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region and some demolition material (bricks, concrete).

Section 4.4.2 of the document 'A Guide to the Management of Cleanfills' indicates that 'organic compounds should not be present on the cleanfill site'; and therefore it should not be necessary to test for these. Testing should focus on heavy metals and would typically be expected to include: arsenic, boron, cadmium, chromium, copper, cobalt, lead, mercury, nickel, tin and zinc.

3.3. Environmental Setting

3.3.1. General Environmental Setting

The site is located in a rural agricultural area with a felled forestry block to the east. An unnamed stream flows under the Kenepuru Road and cleanfill site and emerges at the tip face into a wetland area. From here the stream flows into the Mahakipawa Arm.

Figure 4: Aerial view of the cleanfill site, just north of Linkwater, Marlborough, dated 2008 showing the stream and wetland areas. Note that the large majority of the area between the farm and the road is now filled.

3.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by undifferentiated, poorly sorted, steep fan gravel deposits. Underlying the gravel deposits is the Marlborough Schist.

3.3.3. Hydrogeology

The underlying gravels are not considered to be a valuable groundwater resource in this area.

3.4. Site Investigation

3.4.1. Soil Sampling Methodology

A sampling plan was worked out allowing for the areas that could not be investigated. The sampling plan was compromised by:

- small areas of land that had recently been seeded/grassed which the owner requested not be dug up.

Eleven test pits were excavated on site. An engineer logged the test pits and 20 soil samples were taken from various depths. The test pit locations and logs are presented in Appendices 3 and 4. Five of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

Soil sampling was conducted in accordance with Contaminated Land Guideline No.5 'Site Investigation and Analysis of Soils' prepared by the Ministry for the Environment (Reference A).

3.4.2. Underlying Fill/Geology

Eleven test pits were excavated across the whole of the site. The soils consisted of a heterogeneous mix of brown, dry to moist, very soft to stiff, sometimes sandy, silty clayey fill with varying amounts of angular to sub-angular clasts of weathered bedrock. Wood was noted in most of the test pits but generally there was less than 5% by volume. Test Pits TP5, TP6 and TP7 contained approximately 20 to 30% or more by volume of wood in the form of punga trunks and pine tree trunks. At depth the fill was mottled brown/tan/grey or bluey grey indicating partially saturated or saturated soil conditions at certain times of the year. Underlying the fill the natural ground consisted of a dark, brown, moist, soft, silty clay. Compressed reeds/vegetation and topsoil were often found on the surface of the clay indicating the fill had been deposited directly onto the natural ground level. No groundwater was noted in any of the test pits. Strong natural organic odours were noted in a number of the test pits. The test pit logs are attached in Appendix 4. Recently dumped material on the tip face (Photos 7 to 8) comprised of a heterogeneous mix of colluvium, weathered bedrock, concrete, vegetation, pine trunks and branches and a few car tyres.

3.5. Soil Analysis Criteria - Results

None of the soil samples analysed contained concentrations of contaminants greater than the Marlborough District Councils cleanfill acceptance criteria or the relevant residential guideline values. The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6.

3.6. Preliminary Conceptual Model

The conceptual model (Table 3) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determines if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (5) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 3: Conceptual Model for Cleanfill site at Linkwater.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
No evidence of contaminants present in concentrations greater than the relevant guideline values	Human health	Dermal contact	Very Low	Concentrations lower than MDC cleanfill and residential guideline values
		Ingestion	Very Low	Concentrations lower than MDC cleanfill and residential guideline values
		Inhalation of dust/vapours	Very Low	Contaminant concentrations low.
	Groundwater	Vertical migration	Very low	Contaminant concentrations low.
	Surface water ecology	Vertical and lateral migration	Very low	However if contaminants were present on site there is a direct pathway for them into the stream.

3.7. Conclusions

Some unacceptable cleanfill materials as detailed in Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Large quantities of wood (pine and punga) are present in some of the test pits excavated on site.
- A small number of car tyres

A tabular conceptual model was developed and it is considered that there is a low risk to human health and the wider environment. However, the cleanfill has been placed directly over a small stream that flows into the Mahakipawa Arm. If in the future contaminated material was imported on to site there would be a potentially high risk to surface water and the associated wetland downstream of the cleanfill site.

Resource Consent condition 07 should be amended and the sentence 'In any case no one truckload shall contain more than 20% non cleanfill material' should be removed. The cleanfill site should not be accepting any non cleanfill material due to the sites sensitivity with regard to degradation of the stream.

Generally the cleanfill complies with the conditions set within its current resource consent with regard to the materials it is accepting. The Resource Consent should be amended to reflect the Ministry for the Environment Guide to the Management of Cleanfills. Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site in the future. Table 4.1 is attached in Appendix 1. Disposal of fill at the site is near to completion.

4. Site 3 – Crafar Crouch Construction Limited, 447 Kaituna, Tuamarina Road, Blenheim

4.1. Site Description

The subject site, a cleanfill site, is located on Sec 182 and Pt Sec 8 District of North Bank of Wairau, on the Kaituna–Tuamarina Road, 1.3 kilometres west of State Highway 1 at Tuamarina and is situated within a rural setting. The cleanfill site is located on the raised river terraces between the banks of the Wairau River and the Kaituna – Tuamarina Track. Agricultural land and forestry blocks surround the cleanfill site. The Wairau River flows along the southern boundary of the site.

The site is used specifically by Crafar Crouch Construction Ltd and they allow other contractors to dump waste on the site from time to time. The majority of the material dumped on site is excavated materials from building sites/road cuttings etc and concrete. The site is not open to the general public but there are no restrictions on access.

The cleanfill site is approximately 200m from east to west and 60m wide and is largely flat (Photos 10 to 12 in Appendix 5). The fill is estimated to be approximately 2.5m deep at its deepest point. A capping layer of silty clayey soil has been placed over much of the cleanfill site. The tip face is currently in the eastern part of the site and comprises of large volumes of concrete with rebar and gravel and rock (Photo 10) which has not been covered.

The Resource Consent conditions pertinent to this report state that:

Condition 03

> No landfill material shall be placed outside of the "indicative Fill Area" as demarcated on the aerial photograph which accompanied application U0611260 date stamped as received by council on 20 November 2006.

Condition 04

That the filled area is covered with at least 200mm of topsoil, and sown down with a vegetative cover.

Condition 11

That the filling operation is at least 8.0 metres from the nearest surface water body.

Condition 12

Landfill material containing asphalt shall only be deposited in the two landfill areas to the immediate east and wet of the dwelling as demarcated on the aerial photograph which accompanied application U061260 date stamped as received by Council on 20 November 2006.

Condition 13

No landfilling shall take place in the proposed landfill area to the south of the western wetland area (defined as the area to the west of the raised NNE-SSW trending roadway and adjacent to the south side of the Kaituna-Tuamarina Road) during the months August to November.

The resource consent does define 'cleanfill'.

Figure 5: Shows the regional location of the cleanfill site.

4.2. Site History

The site's current owner indicates that the site has been used as a cleanfill site since early 2007. Previous to that the site was a flat river terrace. Aerial photographs dated 1959 do not indicate the presence of a cleanfill site. No other historical evidence was found.

4.2.1. Possible Contaminants Associated with Historical Use

Personnel on site indicate that as far as they are aware the material within the cleanfill consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region and some demolition material (bricks, concrete). The Resource Consent Decision (U061260) does not detail anywhere the nature of fill that is acceptable at this site.

4.3. Environmental Setting

4.3.1. General Environmental Setting

The site is located in a rural agricultural area with a felled forestry block to the north. The flood plain of the Wairau River is approximately 10 metres from the southern boundary of the site.

Figure 6: Aerial view of the cleanfill site dated 2007 showing the area clear of fill.

4.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by well sorted floodplain gravels.

4.3.3. Hydrogeology

The underlying river gravels are considered to be a valuable groundwater resource in this area.

4.4. Site Investigation

4.4.1. Soil Sampling Methodology

Seven test pits were excavated on site. An engineer logged the test pits and 14 soil samples were taken from various depths. The test pit locations and logs are presented in Appendix 3 and 4. Five of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

Soil sampling was conducted in accordance with Contaminated Land Guideline No.5 'Site Investigation and Analysis of Soils' prepared by the Ministry of the Environment (Reference A).

Due to the highly heterogeneous nature of the types of fill being dumped on site the soil sampling and chemical analysis undertaken provides a limited understanding of the conditions present in the test pits only and conditions may vary considerably over relatively small areas.

4.4.2. Underlying Fill/Geology

Seven test pits were excavated across the whole of the site and logged by a geologist. The test pits are attached in Appendix 4. The soils consisted of a 300mm to 800mm thick, heterogeneous mix of brown/grey, dry to slightly moist, sub-rounded to rounded gravel ranging from 20 to 100mm in size in a silty sandy matrix. Mixed in with the gravels were occasional sub-angular to angular clasts of bedrock and minor amounts of concrete/metal/wood (less than 5%).

Underlying the gravel in the western area of the cleanfill site were large blocks of concrete with rebar (>1m) making up between 20 and 60% of the fill. Surrounding the concrete was a heterogeneous mix of dark grey, slightly moist, silty sandy gravelly fill with occasional patches of silty clay. Minor amounts (<5%) of mesh netting, wood and metal were noted within the fill. The large concrete blocks limited the vertical extent of the excavation.

Underlying the surface layer in the central to eastern parts of the cleanfill site was a heterogeneous brown, dry to slightly moist, slightly clayey in places, silty sandy fill with a sub round to rounded gravel (5% to 15%). Minor amounts of concrete (<5%), vegetable matter – straw (TP5 and TP6), and plastic (<1%) were noted. Test pit TP7 contained a brown, dry, silty sandy sub rounded to rounded gravel (50%) with minor amounts of timber (<1%).

4.5. Soil Analysis Results

The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6. Only contaminant concentrations, which were greater than the acceptance criteria, are presented in Table 4 below. The Marlborough District Council trigger values (Appendix 2) and Residential Guideline Values are also included in Table 4 for the purpose of comparison.

Table 4: Summary of analytical results from the soil sampling greater than the guideline values

Parameter	Sample ID		Guideline Values	
	TP1 S1 (mg/kg)	TP5 S1 (mg/kg)	MDC "trigger levels" (mg/kg)	Residential Guideline values (mg/kg)
Arsenic	28		13	30
Lead	187		57	300
Nickel		34	34	
Zinc	260		139	300

* These are total recoverable figures.

The figures highlighted in Table 4 above indicate the soil sample from TP1 taken from the upper cover layer contains elevated concentrations of arsenic, lead and zinc greater than the MDC 'trigger values'. In addition soil sample TP5 contained elevated concentrations of nickel greater than the MDC 'trigger values'. The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6.

4.6. Preliminary Conceptual Model

The conceptual model (Table 5) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determines if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (5) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 5: Conceptual Model for Cleanfill site at Kaituna-Tuamarina Road, Blenheim.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
Contaminants present in concentrations greater than the relevant guideline values	Human health	Dermal contact	Very Low	Concentrations lower than residential guideline values. Site in a rural area.
		Ingestion	Very Low	Concentrations lower than residential guideline values. Site in a rural area. Ingestion unlikely.
		Inhalation of dust/vapours	Very Low	Concentrations lower than residential guideline values. Site in a rural area. Inhalation of dusts unlikely
	Groundwater	Vertical migration	Low to Moderate	Contaminant concentrations greater than MDC cleanfill guidelines. Direct pathway to the Wairau River plausible.
	Surface water ecology	Vertical and lateral migration	Low to moderate	Direct pathway to the Wairau River plausible. Little evidence of leaching into river however most of the migration would be subterranean. Large dilution rates would minimise any impact.

The Wairau River is a particularly sensitive receptor and a direct pathway to it via vertical and lateral migration of contaminants through the underlying gravels exists. The contaminant concentrations

present on site pose a relatively low to moderate risk to the groundwater and surface water, however careful consideration of the types of waste taken to site needs to be addressed to minimise impact to and to protect the groundwater and the Wairau River.

4.7. Conclusions

Some unacceptable cleanfill materials as detailed in Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Minor amounts of contaminated soils
- Organic material – farm waste – straw/manure
- Large volumes of concrete with rebar

A tabular conceptual model was developed and it is considered that the site, being close to the Wairau River, is in an environmentally sensitive location. The contamination currently on site poses a low to moderate risk to the Wairau River, however a direct pathway does exist and if in the future contaminated material was imported on to site there would be a potentially high risk to surface and groundwater.

The resource consent does not define 'cleanfill' and should be amended to take into account the definition within the Ministry for the Environment Guide to the Management of Cleanfills, MFE, dated January 2002. Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site in the future. Table 4.1 is attached in Appendix 1.

Table 4.1 of the Guide to Management of Cleanfills indicates that reinforced concrete is acceptable only if the rebar is fully encased in concrete. However the likely contamination issues associated with the degradation of the rebar is considered to be minimal and MDC consider that it is acceptable.

Large amounts of concrete with rebar, gravel and rock with no cover material are present in the eastern part of the site. This material should be covered as soon possible.

5. Site 4 Crafar Crouch Construction Limited, State Highway 1, Koromiko

5.1. Site Description

The subject site, a cleanfill site, is located on Lot 1 DP 10225, on eastern side of State Highway 1 at Koromiko and is situated within a rural setting. The cleanfill site is triangular in shape and is located in a shallow boggy depression between two areas of woodland. Agricultural land, woodland, a residential property and associated gardens and a golf course surround the cleanfill site. A 5m high cleanfill bund has been created alongside the eastern side of State Highway 1. On the eastern side of the bund a track allows access to the cleanfill site. The cleanfill site is divided into two halves with a large man made swale separating them. Large volumes of topsoil, gravel and rock are stored on filled areas of the cleanfill site. A small stream flows on the western side of State Highway 1, the surface water from the cleanfill site flows into this stream.

The site is managed and used by Crafar Crouch Construction Ltd and they allow other contractors to dump waste on the site from time to time. The majority of the material dumped on site is excavated materials from building sites/road cuttings etc and concrete. The site is not open to the general public but there are no restrictions on access.

The cleanfill site is approximately 170m from east to west and 100m wide at its widest and is largely flat (Photos 13 and 14 in Appendix 5). The fill is estimated to be approximately 2.5m deep at its deepest point. A capping layer of silty clayey soil has been placed over much of the cleanfill site. The tip face is currently in the eastern part of the site and comprises of large volumes of soil, minor amounts of concrete, gravel and rock (Photo 14). Filling of the site is near to completion.

The Resource Consent conditions pertinent to this report state that:

> ***Condition 01***
>
> Crafar Crouch Construction Ltd seeks consent to place up to 40,000m^3 of cleanfill R. & P. Rawlings property, State Highway 1, Koromiko.

No reference to or definition of cleanfill is given and no limitations on the types of material accepted at the site are made in the Resource Consent.

Figure 7: Shows the regional location of the cleanfill site at Koromiko, south west of Picton, Marlborough.

5.2. Site History

Aerial photographs dated 2007 indicate that the land comprised of a shallow gully with small drainage ditches running across it. No fill had been placed on site prior to this period.

5.2.1. Possible Contaminants Associated with Historic Use

Personnel on site indicate that as far as they are aware the material within the cleanfill consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region and some demolition material (bricks, concrete). The Resource Consent Decision (U041691) indicates that 'cleanfill' will be placed on the property but does not detail anywhere the nature of fill that is acceptable at this site.

5.3. Environmental Setting

5.3.1. General Environmental Setting

The site is located in a rural agricultural area with State Highway 1 to the west, forestry to the north and south, a residential property to the south and a golf course to the east. A small stream flows on the western side of State Highway 1, the surface water from the cleanfill site flows into this stream.

Figure 8: Aerial view of the cleanfill site, dated 2007 showing the approximate area of the clean fill site.

5.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by well sorted flood plain deposits over the Marlborough Schist.

5.3.3. Hydrogeology

The underlying flood plain deposits are not considered to be a valuable groundwater resource in this area.

5.4. Soil Investigation

5.4.1. Soil Sampling Methodology

Nine test pits were excavated on site. An engineer logged the test pits and 16 soil samples were taken from various depths. The test pit locations and logs are presented in Appendix 3 and 4. Five of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

Soil sampling was conducted in accordance with Contaminated Land Guideline No.5 'Site Investigation and Analysis of Soils' prepared by the Ministry of the Environment (Reference A).

Due to the highly heterogeneous nature of the types of fill being dumped on site the soil sampling and chemical analysis undertaken provides a limited understanding of the conditions present in the test pits only and conditions may vary considerably over relatively small areas.

5.5. Underlying Fill/Geology

Four test pits were excavated on both the northern and southern sections of the site and one in the bund on the western part of the site and were logged by a geologist. The test pits are attached in Appendix 4. The soils in test pits TP1, TP3 and TP4 consisted of a 800mm to 2.1m thick heterogeneous, dark brown, dry to slightly moist, slightly sandy, silty clayey fill with up to 50% sub angular to angular clasts of bedrock varying in size from 40 to 80mm. Minor amounts of concrete, wood, plastic netting and plastic (<5%) were noted. Underlying the silty clayey fill in TP1 and TP4 was a 500mm to 700mm thick, dark grey, compact, silty sandy sub rounded to rounded gravel that varied in size from 20 to 40mm. Underlying the gravel was a mottled grey/brown/tan, moist, silty sandy clay fill with up to 30% sub angular to angular clasts of weathered bedrock varying in size from 30 to 100mm. Natural ground was noted in test pits TP1, TP3 and TP4 at a depth of between 2.1m and 2.9m bgl and consisted of a mottled brown/ grey/ tan, moist, soft to firm silty clay.

One test pit, TP2, was excavated on the western bund/embankment. The surface layer comprised of a 1.4m thick, heterogeneous, dark brown, moist, silty clay fill with sub angular to angular clasts of bedrock varying in size from 20 to 80mm and a few marine shells. Underlying the silty clayey fill was a heterogeneous, brown/tan, moist, silty clayey fill with sub rounded to sub angular clasts of weathered bedrock varying in size from 10 to 100mm with minor (<5%) amounts of concrete and wood.

Test pit TP5 was excavated in the side of the bund/embankment on the northern part of the site. The soil comprised of a brown, dry, sandy, silty, clayey fill with minor amounts of sub angular to angular clasts of weathered bedrock varying in size from 10 to 40mm. Underlying the fill was natural ground comprising of a brown/grey, moist, firm, silty clay.

Soil in test pits TP6 to TP9 on the eastern part of the cleanfill site comprised of a 1m to 2.3m thick, heterogeneous, brown, dry, silty clayey fill with between 10 and 25% clasts of sub angular to angular weathered bedrock varying in size from 50 to 100mm. Minor amounts of concrete (<2%) and wood (<5%) were noted. Below the fill was natural ground comprising of a mottled brown/grey/tan, moist, firm to stiff, silty clay.

5.6. Soil Analysis Results

The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6. Only contaminant concentrations, which were greater than the acceptance criteria, are presented in Table 6 below. The Marlborough District Council trigger values (Appendix 2) and Residential Guideline Values are also included in Table 6 for the purpose of comparison.

Table 6: Summary of analytical results from the soil sampling greater than the guideline values

Parameter	Sample ID		Guideline Values	
	TP1 S1 (mg/kg)	TP3 S1 (mg/kg)	MDC "trigger levels" (mg/kg)	Residential Guideline values (mg/kg)
Lead	66	71	57	300

* These are total recoverable figures.

The figures highlighted in Table 6 above indicate the soil samples from TP1 and TP3 contain concentrations of lead marginally greater than the MDC 'trigger values'.

5.7. Preliminary Conceptual Model

The conceptual model (Table 7) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determines if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (5) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 7: Conceptual Model for Cleanfill site at Koromiko.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
Evidence of lead contamination present in concentrations greater than the relevant guideline values	Human health	Dermal contact	Very Low	Concentrations lower than residential guideline values. Dermal contact unlikely once covered
		Ingestion	Very Low	Concentrations lower than residential guideline values. Ingestion of soil very unlikely by contractors.
		Inhalation of dust/vapours	Very Low	Concentrations lower than residential guideline values. Inhalation of contaminated dust possible but once covered unlikely.
	Groundwater	Vertical migration	Low	Contaminant concentrations relatively low. Contaminants have low solubility. Natural clay layer below the fill will inhibit any vertical migration.
	Surface water ecology	Vertical and lateral migration	Low	Contaminant concentrations relatively low. Contaminants have low solubility. Runoff from the site is likely to reach local streams.

The contaminant concentrations present on site pose a very low risk to human health and a relatively low risk to the groundwater and surface water, however careful consideration of the types of waste taken to site needs to be addressed to minimise and protect the nearby surface waters in the future.

5.8. Conclusions

Some unacceptable cleanfill materials as detailed in Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Minor amounts of contaminated soils
- Potential marine sediments

Generally the cleanfill complies with the conditions set within its current resource consent however the consent does not define what materials are acceptable and unacceptable on site and does not take into account the Ministry for the Environment Guide to the Management of Cleanfills, MFE, dated January 2002. The Resource Consent should be amended to reflect these guidelines.

A tabular conceptual model was developed and it is considered that the contamination present poses a very low risk to human health and a low risk to the nearby stream and associated ecology. A direct pathway from the cleanfill to the stream appears to exist and if in the future contaminated material was imported on to site there would be a potentially high risk to surface water. The types of soil imported onto site needs to be more strictly regulated.

Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site in the future. Table 4.1 is attached in Appendix 1.

6. Site 5 – Simcox Construction Limited, Taylor Pass Road

6.1. Site Description

The subject site, a cleanfill site, is located, just north of the junction between Taylor Pass Road and Maxwell Pass Road, 5km south of Blenheim and is situated within a rural setting. The cleanfill site is rectangular in shape and is located on undulating pasture land. The Taylor River flows along the northern boundary of the site where an eight metre plus high, vertical river embankment is located. A small, deeply incised, gully with an ephemeral stream flows along the eastern boundary of the site. Agricultural land surrounds the cleanfill site. Large volumes of topsoil, gravel and rock are stored on filled areas of the cleanfill site (See Photo 15 in Appendix 5).

The site is used exclusively by Simcox Construction Limited. The majority of the material dumped on site is excavated materials from building sites/road cuttings etc and concrete. Personnel on site indicated that soils contaminated with hydrocarbons had been dumped on site previously. The site is not open to the general public. The cleanfill site is secured by a locked gate at the entrance to Taylor Pass Road and farm fences surround the perimeter of the site.

The cleanfill site is approximately 120m from east to west and 70m wide and is largely flat. The fill is estimated to be approximately 5m deep at its deepest point in the north of the site close to the ephemeral stream. A capping layer of silty clayey soil has been placed over much of the cleanfill site. The tip face is currently in the northern part of the site and comprises of large volumes of soil, and minor amounts of concrete, gravel and rock (Photos 15 and 16). Filling of the site is near to completion.

Figure 9: Shows the regional location of the cleanfill site at the junction of Taylor Pass Road and Maxwell Pass Road, south of Blenheim, Marlborough.

6.1.1. Resource Consent Conditions

The Resource Consent (No: U 020092) for the site has the following conditions that are relevant to this investigation.

> **Point 5** - Fill content - The nature of the fill will be clean fill as defined in the Wairau Awatere Resource Management Plan with the exception of a 5% vegetative matter content per truckload. It is not expected that there will be any detectable leachate from the site.
>
> **Point 6** – Stream Protection – There is an ephemeral stream that runs adjacent to the clean fill site. To protect against fill or any runoff entering the stream a fence will be erected 8 metres from the stream and filter cloth will be erected along the fence line to intercept any silt should it be mobilised during any heavy rain.

6.2. Site History

Aerial photographs dated 2007 indicate that the fill was being placed on the northern part of the site close to the ephemeral stream at this time.

6.2.1. Possible Contaminants Associated with Historical Use

Personnel on site indicate that as far as they are aware the material within the cleanfill consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region and some demolition material (bricks, concrete).

6.3. Environmental Setting

6.3.1. General Environmental Setting

The site is located in a rural agricultural area with an unnamed ephemeral stream on the northern boundary, Taylor Pass Road and grazing land on the eastern and southern boundary, and the Taylor River on the western boundary.

Figure 10: Aerial view of the cleanfill site dated 2007 showing the approximate area of the cleanfill site.

6.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by both undifferentiated poorly sorted steep fan gravel deposits and the Hillersden Gravel which comprises of a poorly sorted and poorly bedded clay bound greywacke gravel with minor amounts of silt, sand and clay.

6.3.3. Hydrogeology

The underlying flood plain deposits are considered to be a valuable groundwater resource in this area.

6.4. Site Investigation

6.4.1. Soil Sampling Methodology

Nine test pits were excavated on site. An engineer logged the test pits and 18 soil samples were taken from various depths. The test pit locations are presented in Appendix 3. Six of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

Due to the highly heterogeneous nature of the types of fill being dumped on site the soil sampling and chemical analysis undertaken provides a limited understanding of the conditions present in the test pits only and conditions may vary considerably over relatively small areas.

6.5. Underlying Fill/Geology

Nine test pits were excavated on the site and were logged by a geologist. The test pits are attached in Appendix 4. The fill in the test pits consisted of a 500mm to 1.3m thick heterogeneous, grey/brown dry, compact, silty, sandy, clayey in places, sub rounded to rounded gravel and cobbles which varied in size from 10 to 300mm. The gravel content varied from 10% to 50%. In amongst the gravel were large

blocks of concrete with rebar up to a meter in size and minor amounts of sub-angular to angular weathered bedrock, and in places small amounts of wood (<5%) and plastic (<2%) and metal (<2%). The concrete blocks limited the extent of the vertical extent of the excavations in a number of test pits. Underling the gravel fill was a brown, dry, compact, slightly clayey, silty, sandy fill with large blocks of concrete up to a meter in size and minor amounts of gravel (5% to 15%) and weathered bedrock. A grey/brown/bluish, moist, soft, silty clay fill with minor amounts of gravel was noted in Test pits TP1 and TP6.

Test Pit 4 contained a 700mm to 900mm thick layer of brownish pink, dry, loose, fine to medium grained sand with minor amounts of cut metal objects (Photo 19 in Appendix 5). The sand is thought to be from a sand blasting process. Samples of the sand were taken for chemical analysis the results of which are discussed in Section 6.6 below.

Test Pit 9 was excavated in the area of shallow fill in the southern part of the cleanfill site. Natural ground was found at a depth of 500mm bgl. The ground consisted of a brown/tan, very stiff to hard, slightly moist, silty clay.

The steep face of the river bank on the western side of the cleanfill site was logged (Photo 22). The bank comprised of a 900mm to 1.5m thick layer of brown/tan, dry, hard, silty clay over a substantial thickness of brown, compact, silty, sandy, sub-rounded to rounded gravels varying in size from 20mm to 100mm.

Colloidal iron rich leachate was noted emanating from the base of the cleanfill site (Photo 17 and 18) and flowing into the ephemeral stream. Sediment samples were taken for chemical analysis the results of which are detailed in Section 6.6 below.

6.6. Soil Analysis Results

The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6. Only contaminant concentrations, which were greater than the acceptance criteria, are presented in Table 8 below. The Marlborough District Council trigger values (Appendix 2) and Residential Guideline Values are also included in Table 8 for the purpose of comparison.

Table 8: Summary of analytical results from the soil sampling greater than the guideline values

Parameter	Sample ID				Guideline Values	
	TP2S2 (mg/kg)	TP4 S1 (mg/kg)	TP5 S2 (mg/kg	TP7 S1 (mg/kg)	MDC "trigger levels" (mg/kg)	Residential Guideline values (mg/kg)
Chromium		760			47	
Copper	2,200				77	130
Lead			240	210	57	300
Nickel		400			34	
Zinc			300	196	139	300

* These are total recoverable figures.

Parameter	Sample ID		Guideline Values	
	TP8S2 (mg/kg)	Sludge (mg/kg)	MDC "trigger levels" (mg/kg)	Residential Guideline values (mg/kg)
Chromium	57		47	
Lead	105	103	57	300
Zinc	3,500	250	139	300

The figures highlighted in Table 8 above indicate the soil samples TP2, TP4, TP5, TP7, TP8 and the sludge samples all contain elevated concentrations of one or more contaminants in concentrations greater than the MDC 'trigger values' and in some cases the residential guideline values.

6.7. Total Characteristic Leaching Procedure (TCLP) analysis

Due to the elevated concentrations of contaminants detected in soil samples TP2 and TP8, Total Characteristic Leaching Procedure (TCLP) analysis was undertaken in order to determine the potential for the contamination to seep or "leach" into the groundwater or surface water.

The results of the TCLP analysis are detailed below in Table 9 and are compared against the ANZECC (2000) Water Quality Guidelines – Chemical Trigger Values for Freshwater – level of protection 95% and 90%.

Table 9: Summary of TCLP analysis

Parameter	Sample ID		Guideline Values	
	TP2S2 (µg/kg)	**TP8 S1 (µg/kg)**	**ANZECC Freshwater 95% Guidelines (µg/kg)**	**ANZECC Freshwater 90% Guidelines (µg/kg)**
Arsenic	<21	<21	13	42
Cadmium	<1.1	**3.8**	0.2	0.4
Chromium	<11	**21**	1	6
Copper	<11	**18**	1.4	1.8
Lead	<5	**40**	3.4	5.6
Nickel	<11	**96**	11	13
Zinc	**76**	**3100**	8	15

The results of the TCLP analysis indicates that contamination in fill on site has the potential to seep or "leach" out and migrate into the ground or surface water. This analysis backs up the analysis undertaken on the sludge samples.

6.8. Preliminary Conceptual Model

The conceptual model (Table 10) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determines if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (6) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 10: Conceptual Model for Cleanfill site at Taylor Pass Road, Blenheim.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
Evidence of contaminants present in concentrations greater than the MDC and residential guideline values	Human health	Dermal contact	Low to moderate	Concentrations higher than residential guideline values but site in a rural area. Workers likely to have minimal contact
		Ingestion	Low	Concentrations higher than residential guideline values. Site in a rural area. Workers highly unlikely to ingest soil
		Inhalation of dust/vapours	Low	Concentrations higher than residential guideline values. Site in a rural area. Workers likely to have minimal contact. Contaminated soils covered with soil. Inhalation unlikely
	Groundwater	Vertical migration	Moderate to High	Highly contaminated soil and leachate present. Obvious pathway for leachate into groundwater. Groundwater used for irrigation.
	Surface water ecology	Vertical and lateral migration	High	Highly contaminated soil and leachate present. Obvious pathway for leachate into ephemeral stream and river. Runoff from the site is likely to reach local streams.

Proven source-pathway-receptor linkages exist. The contaminant concentrations present on site pose a low to moderate risk to human health and a moderate to high risk to the groundwater and surface water.

6.9. Conclusions

Some unacceptable cleanfill materials as defined in the Proposed Wairau/Awatere Resource Management Plan and Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Highly contaminated soils
- Scrap metal

- Sand blasting materials

The cleanfill does not comply with the conditions set within its current resource consent with regard to the materials it is accepting. The site investigation, chemical analysis and conceptual model undertaken have identified that contaminants present on site pose a potential risk to human health and have the 'potential to produce harmful effects on the environment.'

The soils containing highly elevated concentrations of metals should be excavated and removed or another form of remediation undertaken on site as soon as possible. The site is located in an environmentally sensitive location with the Taylor River close by and the base of the tip face being within 8m of an ephemeral stream. No protective measures were in place to protect the ephemeral stream from sediment runoff. The results of chemical analysis indicates that the leachate from the tip poses a moderate to high risk to the surface water and the wider environment.

The consent does not take into account the Ministry for the Environment Guide to the management of Cleanfills, MFE, dated January 2002. The Resource Consent should be amended to reflect these guidelines in order for the owner to better understand the types of material allowed to be tipped on site. The types of soil imported onto site needs to be more strictly regulated.

Only materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site in the future. Table 4.1 is attached in Appendix 1.

Filling at the site is near to completion.

7. Site 6 – Ontrack, Leased to Powells Contracting, between main north railway and Lot 1 DP 2387, south of SH1

7.1. Site Description

The subject site, an unauthorised 'cleanfill site', is located, just to the east of State Highway 1 and the Main North Railway, in-between Aberharts Road and Lower Wairau Road, 2km north of Blenheim town centre. The site is owned by Ontrack and leased to Powell Contracting and HEB Construction Limited. The cleanfill site is elongated rectangular in shape and is located on waste ground. A residential property and vineyards are present on the northern and eastern boundaries of the property, an industrial property to the south and State Highway 1 and the railway to the east. A large pond is present approximately 60m east of the site.

The cleanfill site is approximately 260m from north to south and 20m east to west and is largely flat. The site is currently being used for storing large volumes (>1,000m^3) of topsoil, old turf, soil, gravel and rock from various locations within Marlborough (Photos 23 and 24 in Appendix 5). The majority of the material dumped on site is excavated materials from building sites/road cuttings etc and concrete. The site is not open to the general public however there is no security limiting public access.

Figure 11: Shows the regional location of the cleanfill site just north of Blenheim

7.1.1. Resource Consent Conditions

The site does not currently have a Resource Consent for storing fill in volumes greater than 1,000m^3.

7.2. Site History

Aerial photographs dated 2007 indicate that the fill was being placed on site during this time.

7.2.1. Possible Contaminants Associated with Historical Use

Personnel on site indicate that as far as they are aware the material on site consists of soil/rock material from excavations/road cuttings etc from the Marlborough Region, turf, gravel, stone chip and some demolition material (bricks, concrete). During the site inspection small amounts of tarmac, tyres, scrap metal (empty drums), wood and plasterboard were noted.

7.3. Environmental Setting

7.3.1. General Environmental Setting

The site is located in a rural agricultural area with vineyards on the eastern boundary of the site and a small lake 60m west of the site.

Figure 12: Aerial view of the cleanfill site dated 2007 showing the approximate area of the cleanfill site.

7.3.2. Geology

The Institute of Geological and Nuclear Sciences (2001) Geological Map 10, scale 1:250,000, indicates the site is underlain by swamp deposits comprising of poorly consolidated silt, mud, peat and sand.

7.3.3. Hydrogeology

The underlying swamp deposits are not considered to be a valuable groundwater resource in this area.

7.4. Site Investigation

7.4.1. Soil Sampling methodology

Nine test pits were excavated on site, seven in various spoil heaps and three in the actual ground (TP1, TP2 and TP3). An engineer logged the test pits and 11 soil samples were taken from various depths. The test pit locations are presented in Appendix 3. Five of the samples were placed in a refrigerated cool box and sent to Hills Laboratories Ltd, Hamilton for chemical analysis.

Due to the highly heterogeneous nature of the types of fill being dumped on site the soil sampling and chemical analysis undertaken provides a limited understanding of the conditions present in the test pits only and conditions may vary considerably over relatively small areas.

7.5. Underlying Fill/Geology

Three test pits were excavated in the underlying ground and were logged by a geologist. The test pits are attached in Appendix 4. The fill in the test pits consisted of a 250 to 400mm thick heterogeneous, dark grey/grey, dry, compact, sub angular to angular aggregate fill with a silty sandy matrix. The aggregate varied from 10 to 40mm in size. Underlying the fill was a natural, dark grey, very hard, dry slightly clayey, sandy, silt which appeared to be stained from the materials above. Below the stained layer was a natural, dark brown/brown, hard, dry, slightly clayey, silty, sand. The spoil heaps on site limited the extent of the excavations.

The nature of the spoil heaps varied from silty sandy gravels, silty sandy soil and topsoil through to aggregate fill and gravel.

7.6. Soil Analysis Results

The results of the soil sample analyses from Hills Laboratories Ltd. are included as Appendix 6. Only contaminant concentrations, which were greater than the acceptance criteria, are presented in Table 11 below. The Marlborough District Council trigger values (Appendix 2) and Residential Guideline Values are also included in Table 11 for the purpose of comparison.

Table 11: Summary of analytical results from the soil sampling greater than the guideline values

Parameter	Sample ID		Guideline Values	
	TP1S1 (mg/kg)	**Spoil heap 9 (mg/kg)**	**MDC "trigger levels" (mg/kg)**	**Residential Guideline values (mg/kg)**
Arsenic		33	13	30
Nickel	35		34	

* These are total recoverable figures.

The figures highlighted in Table 11 above indicate the soil samples TP1S1 and Spoil heap 9 contain elevated concentrations of arsenic and nickel respectively in concentrations greater than the MDC 'trigger values'. However the concentrations of nickel are only marginally in excess of MDC trigger levels whilst arsenic concentrations, in addition to exceeding MDC trigger levels also exceed residential guideline values.

7.7. Preliminary Conceptual Model

The conceptual model (Table 12) represents the characteristics of the site in a simplified tabular format based on the research carried out to date and the results of analysis. It identifies all the potential contaminants, pathways and receptors associated with the site and determine if they are significant to human health and the wider environment. Development of the conceptual model forms the main part of the Preliminary Site Investigation, and the model is subsequently refined or revised as more information and understanding is obtained. The conceptual model is based on the chemical analysis of a limited number of soil samples (5) and may not be truly representative of the site as a whole due to the heterogeneous nature of the fill.

Table 12: Conceptual Model for Cleanfill site at Ontrack cleanfill, Blenheim.

Contaminants	Receptor	Pathway	Potential Risk (Low, Medium, High)	Justification of Risk
Evidence of contaminants present in concentrations greater than the MDC guideline values	Human health	Dermal contact	Low	Concentrations lower than residential guideline values. Site in a rural area. Workers likely to have minimal contact
		Ingestion	Very Low	Concentrations lower than residential guideline values. Site in a rural area. Workers highly unlikely to ingest soil
		Inhalation of dust/vapours	Very Low	Concentrations lower than residential guideline values. Site in a rural area. Workers likely to have minimal contact
	Groundwater	Vertical migration	Low	Concentrations greater than MDC trigger values. Pathway to groundwater possible. Leaching of contaminants considered to be minimal
	Surface water ecology	Vertical and lateral migration	Very Low	Concentrations greater than MDC trigger values. Pathway to surface water unlikely. Leaching of contaminants considered to be minimal.

Proven source-pathway-receptor linkages exist. The contaminant concentrations present on site pose a very low to low risk to human health and a low and very low risk to groundwater and surface water.

7.8. Conclusions

The Wairau Awatere Resource Management Plan states that the filling of land is a Permitted Activity provided that:

The material does not contain any:

- Hazardous substances;
- Combustible or organic materials;
- Any other contaminant subject to chemical or biological breakdown;
- Liquids or sludges.

And that the volume of material does not exceed 1,000 m^3. The site breaches both conditions and therefore requires a Resource Consent if the practice of storing/placing cleanfill on the site continues.

Some unacceptable cleanfill materials as defined in the Wairau Awatere Resource Management Plan and Table 4.2 of the 'Guide to the Management of Cleanfills' dated 2002 are present on site. These include:

- Contaminated soils
- Scrap metal, drums
- Tyres
- Building materials such as wood, plasterboard

If a Resource Consent application is made for the site as a 'cleanfill' it is important that a feasibility study is undertaken to determine whether the site is suitable as a consented 'Cleanfill Site' taking into consideration the impacts on the local community, the site specific characteristics and the wider environment. If granted the Resource Consent should take into account the guidelines detailed in the Ministry for the Environment Guide to the Management of Cleanfills, MfE, dated January 2002.

Only materials detailed in Table 4.1 (attached in Appendix 1) of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of on site. Unacceptable materials including the contaminated soil in Spoil Heap 9 should be removed from site and disposed of at a suitably licensed landfill. The types of soil imported onto site needs to be more strictly regulated.

The site investigation, chemical analysis and conceptual model undertaken have identified that contaminants present on site pose a very low risk to human health and a very low and low risk to surface water and groundwater respectively and are unlikely to have the potential to produce harmful effects on the environment.

8. Overall Conclusions and Recommendations

Conclusions and recommendations specific to each individual site are detailed in the above text. The conclusions and recommendations detailed below are more general to the overall cleanfill project itself.

A minimum of five soil samples were taken from each cleanfill site for chemical analysis. The results of chemical analysis were compared against contaminant concentrations contained within the document entitled 'Recommended limits for selected trace elements in cleanfills in Marlborough' produced by Marlborough District Council and residential guideline values. Many of the cleanfill sites contained soil/fill with concentrations of contaminants greater than the aforementioned guidelines.

A conceptual model was developed for each cleanfill site taking into consideration the concentrations of contaminants found and the potential receptors identified including human health and the wider environment. Complete Source-Pathway-Receptor linkages were identified and the risk posed to both human health and the wider environment was assessed. Many of the cleanfill sites investigated are located in environmentally sensitive areas and the risk posed to certain receptors assessed as moderate to high. Future cleanfill sites should be located more carefully in order to minimise the potential impacts on human health and the wider environment.

The primary control on contaminant free cleanfill sites is acknowledgment and recognition of the waste acceptance criteria. If these criteria are adhered to and other management practices are implemented the potential for adverse effects on human health and the wider environment will be minimal.

Most of the Resource Consents for the cleanfill sites do not contain a definition for 'cleanfill' and if so, one that does not meet the definition contained within the MfE's document titled 'The Guide to the Management of Cleanfills' dated 2002. The Resource Consents for the investigated sites and any other cleanfill sites in the area should be amended to reflect the aforementioned MfE document. Only

materials detailed in Table 4.1 of the 'Guide to the Management of Cleanfills' dated 2002 should be disposed of at the cleanfill sites in the future. Table 4.1 is attached in Appendix 1.

In all cases the types of materials and soil imported onto site needs to be more strictly regulated. A detailed Site Specific Management Plan as laid out in Appendix B of the 'Guide to the Management of Cleanfills, MfE, 2002' covering all operational and management aspects of the cleanfill site should be prepared for all new cleanfill sites in the future and ones with significant ongoing life. This investigation has established the extent of the cleanfill sites and tip faces and recommends six monthly monitoring involving soil sampling and basic chemical analysis to be undertaken on the new tip face in order to regulate the types of soil imported onto site.

Owners of the cleanfill sites need to be more rigorous when regulating the types of soils imported on to site by:

- ensuring that the users of the cleanfill facility understand the waste acceptance criteria and sign a declaration that the load disposed of meets that criteria;
- undertaking a suitable inspection regime, checking and providing evidence of where the soil has come from and what is the sites former land use? (e.g. industrial or horticultural land use) before allowing the material to be placed on site;
- identifying noticeable characteristics of the waste. Whether there are any odours or discolouration. Does it look or smell contaminated i.e. diesel or household refuse? If so reject the soils; and
- determining the quantity of waste and where it was unloaded.

If the owners of the site suspect that the material being disposed of does not meet the definition of cleanfill they should contact the MDC or otherwise talk to an environmental consultancy for advice about testing for contaminants and the appropriate action to take.

The Ministry for the Environment states that, "as a minimum, at least one sample per 1,000m^3 of fill material should be taken and analysed." As a guideline, testing undertaken by an experienced contaminated site investigator should screen for a range of contaminants and should include:

- heavy metals such as arsenic, cadmium, chromium, copper , lead, nickel, zinc

Testing for other contaminants may be required depending on the source of the waste.

Disclaimer

This report has been prepared solely for the benefit of you as our client with respect to the particular brief given to us, and data or opinions contained in it may not be used in other contexts or for any other purpose without our prior review and agreement.

This disclaimer shall apply notwithstanding that the report may be made available to any other person in connection with any application for permission or approval, or pursuant to any requirement of law.

This report is based on conditions found on site at the time of the site investigation and is consistent with standards currently being applied. The soil sampling undertaken provides an understanding of the conditions present but conditions may vary considerably over relatively small areas due to the nature of the site and the contamination.

9. Glossary/References

A. Auckland Regional Council (2002), Draft Soil Sampling Protocol for Horticultural Sites – Preliminary Draft 2b. Copy obtained from Sarah Harvey of the Auckland Regional Council in February 2005.

B. Cavanagh, J.E. [of Landcare Research] (a) (2004), Review of Soil Acceptance Criteria for Lead. Copy obtained from Eryn Shields of the Waitakere City Council in February 2005.

C. Cavanagh, J.E. [of Landcare Research] (b) (2004), Review of Soil Acceptance Criteria for Dieldrin. Copy obtained from Eryn Shields of the Waitakere City Council in February 2005.

D. Cavanagh, J.E. [of Landcare Research] (c) (2004), Review of Soil Acceptance Criteria for Copper and DDT. Copy obtained from Eryn Shields of the Waitakere City Council in February 2005.

E. Ministry for the Environment (2005); Personal communication with the Ministry for the Environment officials regarding contamination of residential properties with horticultural chemicals.

F. Ministry for the Environment, Contaminated Land Management Guidelines

G. Ministry for the Environment, A Guide to the Management of Cleanfills

Appendix 1: A guide to the Management of Cleanfills (MfE, 2002)

Table 4.1: Cleanfills – acceptable materials

Material	Discussion
Asphalt (cured)	Weathered (cured) asphalt is acceptable: After asphalt has been exposed to the elements for some time, the initial oily surface will have gone and the asphalt is considered inert.
Bricks	Inert – will undergo no degradation.
Ceramics	Inert.
Concrete – un-reinforced	Inert material. Ensure that other attached material is removed.
Concrete –reinforced	Steel reinforcing bars will degrade. However, bars fully encased in intact concrete will be protected from corrosion by the concrete. Reinforced concrete is thus acceptable provided protruding reinforcing steel is cut off at the concrete face.
Fibre cement building products	Inert material comprising cellulose fibre, Portland cement and sand. Care needs to be taken that the product does not contain asbestos, which is unacceptable.
Glass	Inert, and poses little threat to the environment. May pose a safety risk if placed near the surface in public areas, or if later excavated. The safety risk on excavation should become immediately apparent, so glass is considered acceptable provided it is not placed immediately adjacent to the finished surface.
Road sub-base	Inert.
Soils, rock, gravel, sand, clay, etc	Acceptable if free of contamination (see 4.3.2 for definition of contaminated soil in this context).
Tiles (clay, concrete or ceramic)	Inert.

Table 4.2: Unacceptable waste

Material	Discussion
Abrasive blasting sand/agents	May contain metals, paint and other contaminants.
Asbestos (including asbestos sheeting)	Potentially hazardous. Although an inert compound, future excavation could cause significant health effects.
Asphalt (new)	New asphalt or asphalt that has been ground or pulverised may release oily substances that could leach into the environment.
Bark	Degradable; leaches tannins.
Cables	Metal cables will degrade (see Metals).
Car bodies	Contain metals, oils, plastics, asbestos and other potential contaminants.
Carpet	Degradable. May also contain formaldehyde residue from flooring.
Cesspit/stormwater sump cleanings	Contain various metal contaminants and organics.
Containers	To avoid any potential confusion, all containers are considered unacceptable. Containers may degrade or be punctured, releasing their contents or the remnants of their contents. The containers themselves may be detrimental to the environment (see plastics and metal).
Cork tiles	Degradable.
Corrugated iron	Degradable steel and zinc.
Electrical equipment and insulation	For example, fluorescent light tubes could contain PCBs (also see Plastics).
Formica	Generally stable (it is a melamine-formaldehyde polymer), but may be bonded with urea formaldehyde. This is water soluble and may leach formaldehyde compounds into groundwater. Often attached to particleboard.
Foundry sand	Contains metals.
Greenwaste (e.g. grass dippings, tree trimmings)	Will degrade and release contaminants such as ammonia and nitrates into the soil and groundwater, and may generate gases such as methane and carbon dioxide. The resulting leachate may mobilise other contaminants in the fill.
Hardboard	Degradable; contains phenol resorcinol formaldehyde.

Table 4.2 (contd.): Unacceptable waste

Material	Discussion
Household waste	Typically contains large amounts of putrescible and degradable waste that will degrade and cause odour problems, and create soluble compounds causing leachate. Also contains some hazardous components.
MDF (medium-density fibreboard – customwood)	Degradable; may use urea formaldehyde as a bonding agent. This is water soluble and may leach formaldehyde compounds into groundwater (see Particleboard). Some modern MDF boards use phenol formaldehydes and other resins that may be acceptable, but the board itself is unacceptable.
Medical and veterinary waste	Unsafe if excavated (health hazard); may generate leachate.
Metals	For example, structural steel, roofing, window frames, building components, etc; degradable, can leach into the ground or groundwater. Soluble metals may be toxic depending on the concentration.
Paint	Hazardous waste. Liquid paints may contain significant quantities of volatile organic carbon compounds. These will contaminate soils and groundwater, causing detrimental effects to the environment (e.g. killing aquatic life) and human health. Some paints contain metals. Water-based paints contain preservatives and biocides which may include mercury, or other compounds that can cause dermatological problems.
Painted materials	Lead-based paint is hazardous and must be taken to a hazardous waste facility. Once paint has dried, the potential for contaminants in the paint to migrate through the soil is minimised, so all dried paint other than lead-based is relatively inert. However, to avoid any doubt all painted materials should be rejected.
Paper and cardboard	Paper and cardboard are degradable and present a fire hazard.
Particleboard (chipboard)	Contains urea formaldehyde as a bonding agent. This is water soluble and may leach formaldehyde compounds into the groundwater. Formaldehyde is known to cause many adverse health reactions and has been classified as a "probable human carcinogen" by the USEPA.
Plywood – structural / external grade	Uses phenol resorcinol formaldehyde as a bonding agent. This is not water-soluble and is relatively inert. However, the board itself is degradable and the difference between internal and external grade may not be apparent to the cleanfill operator.
Plywood – internal grade	Uses urea formaldehyde glue as a bonding agent. This is water-soluble and may leach formaldehyde compounds into groundwater (see Particleboard).
Road sweepings	Contain various metal contaminants and organics.
Sawdust	Degradable and could contain timber treatment chemicals.
Tar	Can contain a variety of compounds, many of which have been found to be carcinogenic. Many of the compounds do not bind to soil and can migrate directly to groundwater; potential for groundwater contamination with hydrocarbon compounds.
Timber (processed)	All sawn, gauged or dressed timber is considered unacceptable, as the cleanfill operator will not be able to determine easily if it is treated or untreated. Chemicals used for timber treatment can leach out and contaminate soils and groundwater. The chemicals used include copper-chrome-arsenic (CCA), light organic solvent preservatives (LOSP), creosote, boron and pentachlorophenol (PCP). These can all have a detrimental effect on human health and the environment.
Wood chips	Degradable.

Note: If a substance or waste is not included in this table it does not imply it is suitable for acceptance at a cleanfill.

Appendix 2: Marlborough District Council Guideline Values for Cleanfills

Recommended limits for selected trace elements in cleanfills in Marlborough
In order to define what may or may not meet the Marlborough District Council Plan definition of cleanfill according to its trace element content (including heavy metals and metalloids), several factors need to be taken into account. These include:

i) regulatory and statutory definitions of cleanfill, hazardous substances and contaminated land;
ii) natural concentrations of various trace elements in soil;
iii) the range of soil guideline values that are available, their status, and what they are designed to protect.

Ideally cleanfill should not create contaminated land in relation to the most sensitive receptor class at a site. However any decision around cleanfill that takes this as a principle also needs to allow an adequate margin for sample heterogeneity (spatial differences in concentrations), sampling error, and analytical error, to avoid inadvertent deposition of contaminated soil. Conversely it would not be justifiable to reject material for cleanfill disposal that contained less of a naturally occurring hazardous substance than is usually found as part of the upper end of the local background range.

Cleanfill thresholds therefore should be:

- Below guideline values that could be used to define significant adverse effects for the most sensitive receptor class;
- Allow an adequate margin for error, so that exceeding a cleanfill threshold by a minor margin will not inadvertently allow deposition of contaminated soil;
- Not be lower than the 95th percentile of the local background range.

The local concentration range
Estimated average and 95th percentile concentrations of seven trace elements in the Marlborough surface soils Table 1. Based on SoE monitoring in soils undertaken each year in the region.

Table 1. Average and 95th percentile concentrations (mg/kg) of seven trace elements in Marlborough surface (0 – 10cm) soils n = 46

Element	Symbol	Average concentration (mg/kg)	95th percentile concentration
Chromium	Cr	22.37	25.75
Copper	Cu	16.26	18.16
Lead	Pb	13.02	14.21
Nickel	Ni	16.29	18.64
Zinc	Zn	72.54	77.91
Cadmium	Cd	0.17	0.20
Arsenic	As	3.95	4.29

Relevant guideline values
For guideline values, a number of sources are relevant. These include:

- Guidelines mostly based on human health guideline values, and are already derived with regard to a general methodology outlined by the Ministry for the Environment.
- Guidelines that could be regarded as 'fill up to' limits for various trace elements in soils suggested by the authors of the Biosolids Guidelines (2003). Although these guidelines are an industry document (published by the New Zealand Water and Waste Association), they also come with endorsement from three Ministries (Environment, Health and Agriculture and Forestry).
- Two recent reports written by Landcare Research for the Auckland Regional Council (Cavanagh and O'Halloran, 2006; Cavanagh, 2006). These include a suggested risk-based methodology for deriving guidelines for the protection of ecological receptors, and suggested 'minimal risk' and 'serious risk' guideline values (SRGVs) for eight trace elements. These guidelines nominally provide protection for 95% and 50% of ecological receptors, respectively. Guidelines

referenced in this assessment are the higher 'serious risk' levels, in keeping with the fact that the RMA definition of contaminated land requires a reasonable likelihood of significant adverse effects.

The guideline values are listed below (Table 2).

Table 2. Guidelines used as points of reference in deriving cleanfill thresholds in this assessment

Element	Symbol	Residential soil screening values	Biosolids guidelines (2003)	Ecological 'serious risk' guideline value
Chromium	Cr	600	600	68
Copper	Cu	370	100	135
Lead	Pb	300	300	100
Nickel	Ni	50	60	110
Zinc	Zn	7000	300	200
Cadmium	Cd	1	1	12
Arsenic	As	30	20	22

Chromium
For chromium, a suggested cleanfill threshold of 47 mg/kg is recommended as a generic limit. This limit is equidistant between the 95th percentile value for chromium in Marlborough surface soils (26 mg/kg) and Landcare Research's 2006 guideline for protection of ecological receptors (68 mg/kg).

Copper
For copper, a suggested cleanfill threshold of 77 mg/kg is recommended as a generic limit. This limit is equidistant between the 95th percentile value for copper in Marlborough surface soils (18 mg/kg) and Landcare Research's 2006 guideline for protection of ecological receptors (135 mg/kg).

Lead
For lead, a suggested cleanfill threshold of 57 mg/kg is recommended as a generic limit. This limit is equidistant between the 95th percentile value for lead in Marlborough surface soils (14 mg/kg) and Landcare Research's 2006 guideline for protection of ecological receptors (100 mg/kg).

Nickel
For nickel, a suggested cleanfill threshold of 34 mg/kg is recommended in this case. This limit is equidistant between the 95th percentile value for nickel in Marlborough surface soils (18 mg/kg) and the best applicable human health guideline we currently have for nickel (50 mg/kg). For nickel, the risk-based human-health guideline selected according to the recommended best-practice approach (MfE) (50 mg/kg) is slightly lower than the limit proposed by the authors of the Biosolids Guidelines (60 mg/kg). Landcare Research's SRGV for ecological receptors is higher again at 110 mg/kg. The human health guideline has priority as it is lower than the other two values.

Zinc
For zinc, a suggested cleanfill threshold of 139 mg/kg is recommended as a generic limit. This limit is equidistant between the 95th percentile value for lead in Marlborough surface soils (78 mg/kg) and Landcare Research's 2006 guideline for protection of ecological receptors (200 mg/kg).

Cadmium
For cadmium, a suggested cleanfill threshold of 1 mg/kg is recommended in this case. This is our current residential soils screening level, which is the UK figure for residential soils of our pH, and was selected according to a guideline selection hierarchy developed by the Ministry for the Environment. 1 mg/kg is also the limit suggested by the New Zealand Water and Wastes Association for agricultural land receiving biosolids.

Arsenic
For arsenic, a suggested cleanfill threshold of 13 mg/kg is recommended for this case. This limit is equidistant between the 95th percentile value for lead in Marlborough surface soils (4 mg/kg) and Landcare Research's 2006 guideline for protection of ecological receptors (22 mg/kg).

Table 3 gives limits for 7 trace elements in cleanfill. They are designed to ensure that the cleanfill would unlikely to meet a definition of contaminated soil as per the definition in the RMA.

Table 3. Thresholds concentrations (mg/kg dry weight) for 7 trace elements

Element	Symbol	(mg/kg)
Chromium	Cr	47
Copper	Cu	77
Lead	Pb	57
Nickel	Ni	34
Zinc	Zn	139
Cadmium	Cd	1
Arsenic	As	13

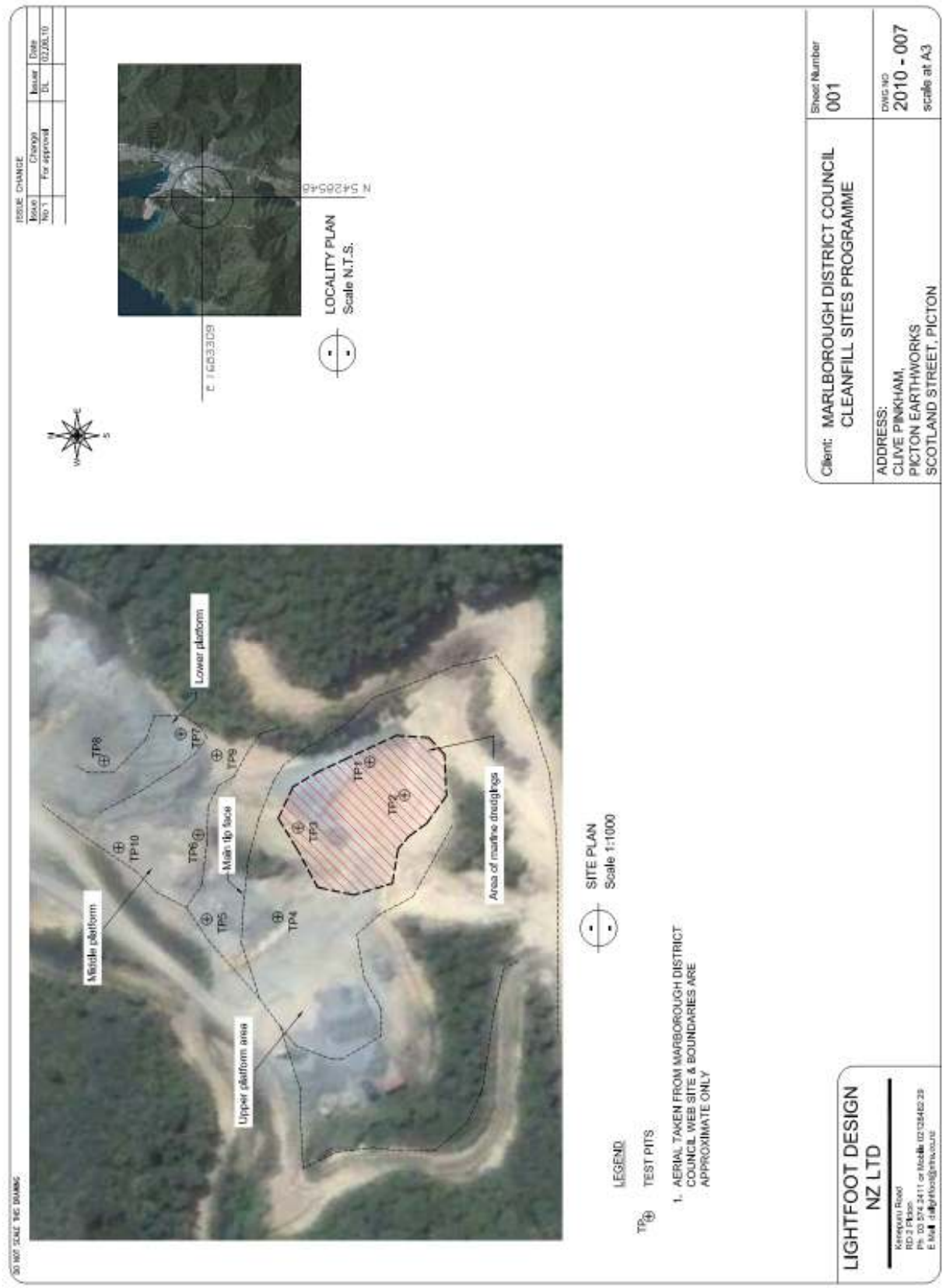
References

New Zealand Water and Wastes Association (2003). Guidelines for the safe application of biosolids to land in New Zealand.

Cavanagh, J.E. and O'Halloran, K. (2006). Landcare Research. Development of soil guideline values protective of ecological receptors in the Auckland Region.

Cavanagh, J.E. (2006). Landcare Research. Development of soil guideline values protective of ecological receptors in the Auckland region: Part 2.

Appendix 3: Test Pit Location Plans

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TP2
TP3
TP4
TP5
TP6
TP7
TP8
TP9
TP10
TP11
To Linkwater
Tip face
Stream
SITE PLAN
Scale 1:1000
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DO NOT SCALE THIS DRAWING
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CLEANFILL SITES PROGRAMME
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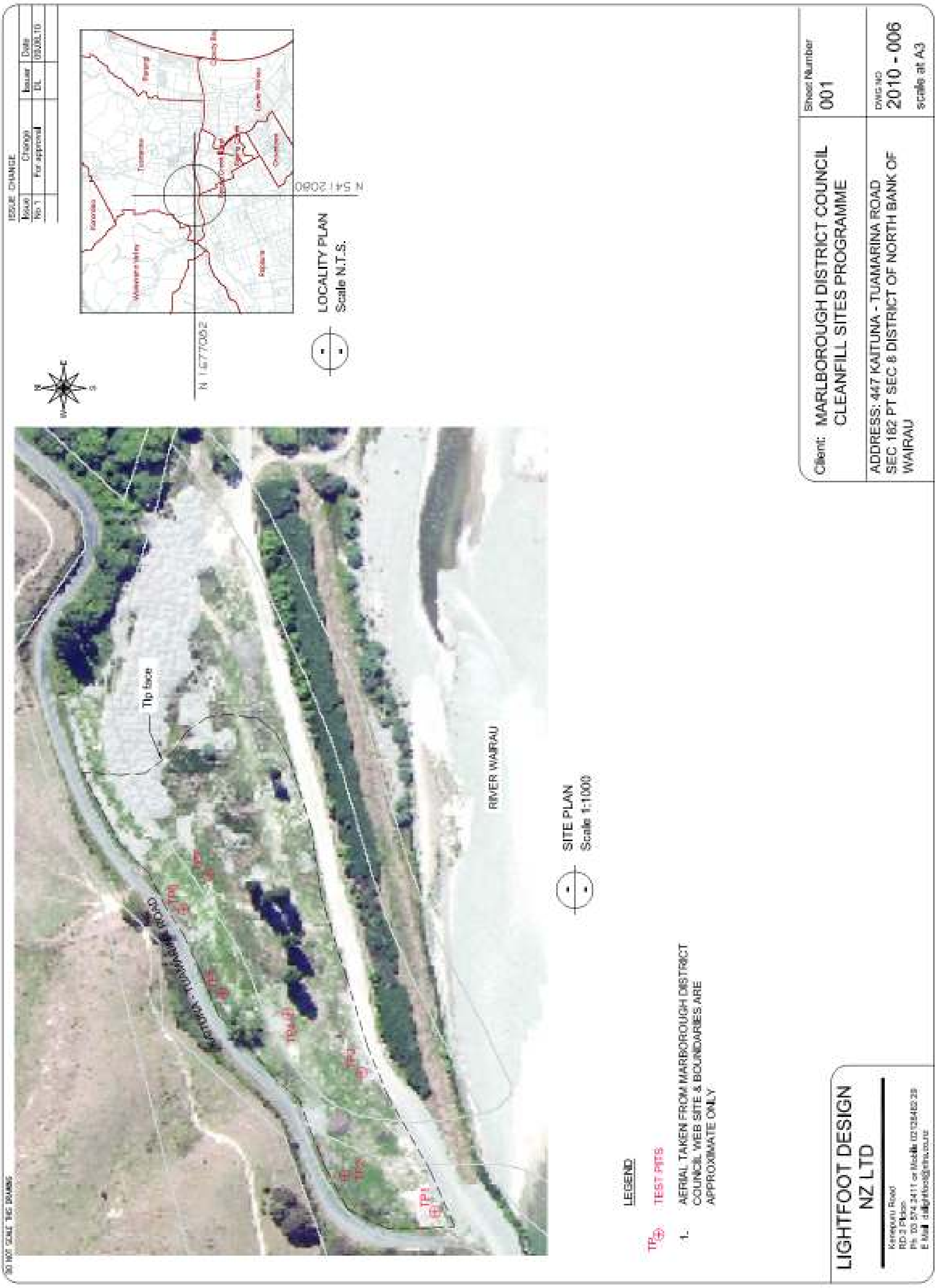
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Scale N.T.S.
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Tip face
KAITUNA - TUAMARINA ROAD
LEGEND
TEST PITS
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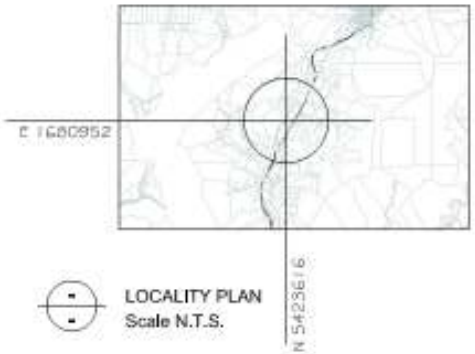

LOCALITY PLAN
Scale N.T.S.

LEGEND

⊕ TEST PITS

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LIGHTFOOT DESIGN NZ LTD
Kenepuru Road
RD 2 Picton
Ph 03 574 2411 or Mobile 02128462 29
E Mail dalightfoot@xtra.co.nz

Client: MARLBOROUGH DISTRICT COUNCIL
CLEANFILL SITES PROGRAMME

Sheet Number
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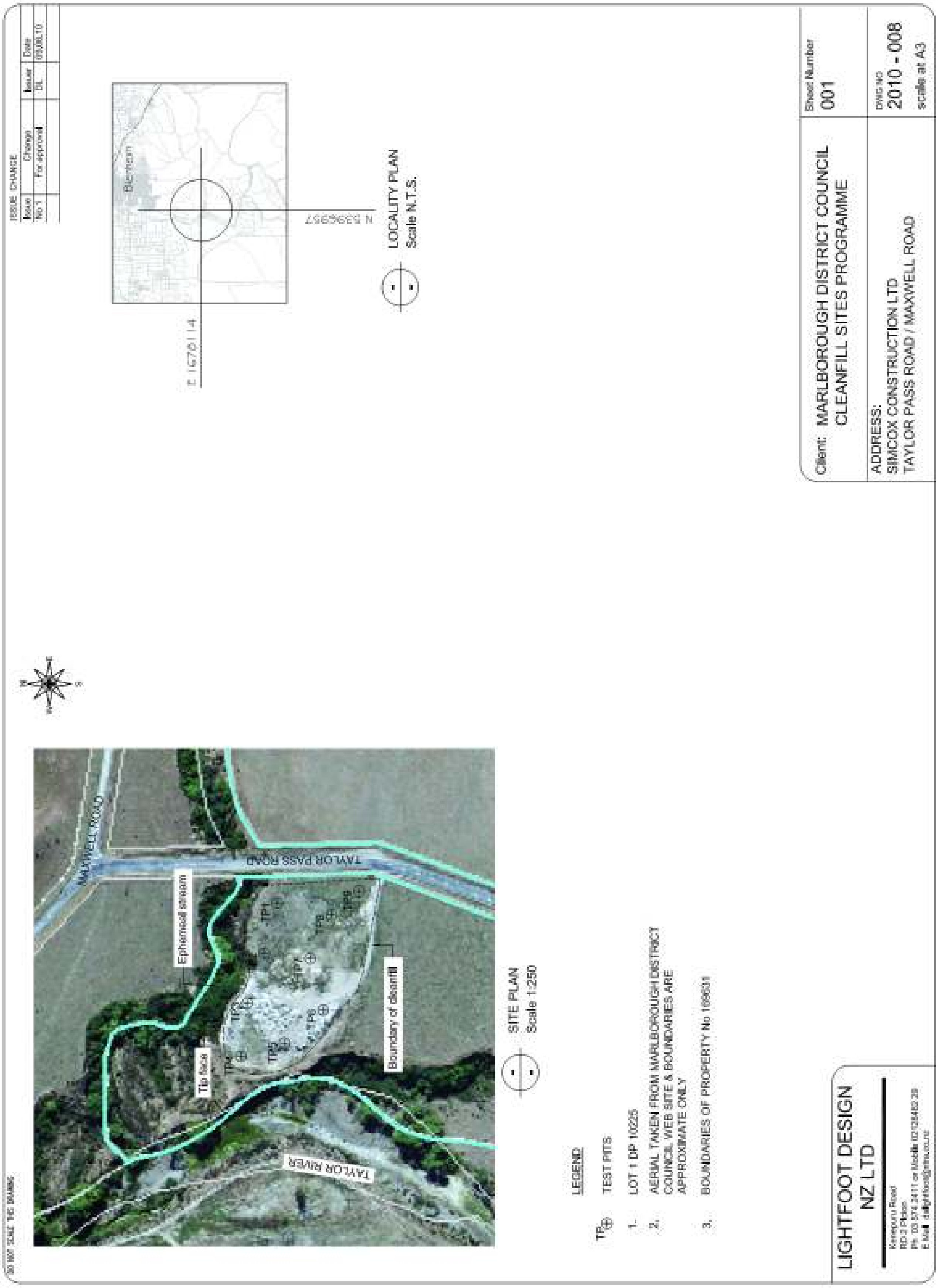
ADDRESS:
STATE HIGHWAY 1
LOT 1 DP 10225

DWG NO
2010 - 005
scale at A3


DO NOT SCALE THIS DRAWING
ISSUE CHANGE
Issue | Change | Issuer | Date
No 1 | For approval | DL | 09.08.10
MAXWELL ROAD
TAYLOR PASS ROAD
Ephemeral stream
Tip face
TAYLOR RIVER
Boundary of cleanfill
TP1
TP3
TP4
TP5
TP6
TP7
TP8
TP9
SITE PLAN
Scale 1:250
LEGEND
TEST PITS
1. LOT 1 DP 10225
2. AERIAL TAKEN FROM MARLBOROUGH DISTRICT COUNCIL WEB SITE & BOUNDARIES ARE APPROXIMATE ONLY
3. BOUNDARIES OF PROPERTY No 169631
Blenheim
E 1678114
N 5396957
LOCALITY PLAN
Scale N.T.S.
LIGHTFOOT DESIGN NZ LTD
Kenepuru Road
RD 2 Picton
Client: MARLBOROUGH DISTRICT COUNCIL
CLEANFILL SITES PROGRAMME
ADDRESS:
SIMCOX CONSTRUCTION LTD
TAYLOR PASS ROAD / MAXWELL ROAD
Sheet Number
001
DWG NO
2010 - 008
scale at A3

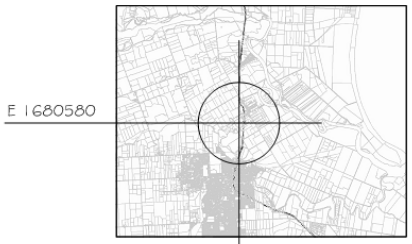
DO NOT SCALE THIS DRAWING

SITE PLAN
Scale 1:2000

N
W E
S

ISSUE CHANGE

Issue	Change	Issuer	Date
No 1	For approval	DL	22.06.10



LOCALITY PLAN
Scale N.T.S.

LEGEND

TP TEST PITS

SPOIL HEAPS

1. LOT 1 DP 2387
2. AERIAL TAKEN FROM MARLBOROUGH DISTRICT COUNCIL WEB SITE & BOUNDARIES ARE APPROXIMATE ONLY

LIGHTFOOT DESIGN NZ LTD
Kenepuru Road
RD 2 Picton
Ph 03 574 2411 or Mobile 0212848229
E Mail dalightfoot@xtra.co.nz

Client: MARLBOROUGH DISTRICT COUNCIL
CLEANFILL SITES PROGRAMME

Sheet Number 001

ADDRESS:
ONTRACK
STATE HIGHWAY 1

DWG NO 2010 - 009
scale at A3

Appendix 4: Geological Logs

Test Pit Logs – Picton Earthworks, Picton

Test Pit 1 – Dredging area		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/tan, moist, firm, silty clayey FILL with sub angular to angular blocks of weathered bedrock varying in size from 20 to 150mm (10%)	0 to 1	
FILL – Dark grey, moist, firm, slightly clayey, sandy, silty, FILL with marine shells and sub angular to angular blocks of weathered bedrock varying in size from 20 to 70mm (10%). Strong organic odour. Sediments dredged from Picton Marina	1 to 3.2	S1 – 1.5 S2 – 2.8
COMMENTS - No groundwater, did not reach natural ground, pit collapsing in on itself		

Test Pit 2 – Dredging area		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/tan, dry, firm, slightly clayey, sandy, silty FILL with sub angular to angular blocks of weathered bedrock varying in size from 20 to 400mm (15%)	0 to 0.6	
FILL – Dark grey, slightly moist, firm, slightly clayey, sandy, silty, FILL with marine shells. Strong organic odour. Sediments dredged from Picton Marina	0.6 to 2.8	S1 – 2
COMMENTS - No groundwater, did not reach natural ground		

Test Pit 3 – Dredging area		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark grey, moist, firm, slightly sandy, silty clayey FILL with marine shells. Strong organic odour. Sediments dredged from Picton Marina	0 to 2m+	S1 – 0.6 S2 – 1.1

COMMENTS - No groundwater, did not reach natural ground		

Test Pit 4		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, compact, silty sandy FILL with sub angular to angular blocks of weathered bedrock varying in size from 10 to 100mm (15%) and minor amounts of wood (<5%).	0 to 1.1	
FILL – Brown/grey, dry, compact, silty sandy FILL with sub angular to angular blocks of weathered bedrock varying in size from 30 to 120mm (10%) and minor amounts of wood and large blocks of concrete (<10%)	1.1 to 2.6	S1 – 1.8
COMMENTS - No groundwater, no visual signs of contamination, no odours. Co		

Test Pit 5 – Edge of tip face		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, dry, silty sandy FILL with heterogeneous mix of gravel (40%), tarmac, stones and shells.	0 to 0.15	
FILL – Brown, moist, compact, silty sandy gravel FILL with tarmac and shells. Sub rounded to rounded gravel making up 50% of soil.	0.15 to 0.9	
FILL – Brown, moist, soft to firm, silty clayey FILL with minor amounts of roots (<2%).	0.9 to 3	S1 – 1.2 S2 – 2.4
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 6 – Middle platform		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, silty sandy FILL with heterogeneous mix of gravel (40%), loose tarmac, concrete, sub angular to angular clasts of rock and	0 to 0.6	

lumps of mottled brown/tan/grey, firm, moist, clay.		
FILL – Brown/grey, moist, slightly clayey, silty sandy FILL with minor amounts of sub angular to angular weathered bedrock varying in size from 50 to 100mm.	0.6 to 3.3	S1 – 1.2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 7 – Bottom platform		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, slightly moist, firm, silty clayey FILL with concrete (20%) and sub rounded to rounded gravels ranging from 10 to 25% (10% vol) and minor amounts of wood (<1%).	0 to 2.5	S1 – 1.9
FILL – Dark brown, organic rich, moist, silty sandy, peaty FILL	2.5 to 2.8	S2 – 2.7
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 8 – Bottom platform		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – dark grey, loose, dry, silty sandy FILL with, sub rounded to rounded clasts of gravel (10%) varying in size from 15mm to 40mm and some large blocks of concrete (<10%) and minor amounts of glass (<1%).	0 to 1.2	
FILL – Brown/tan, loose, dry, silty sandy clayey FILL with large clasts of bedrock up to 600mmminor amounts of sub angular to angular weathered bedrock varying in size from 50 to 100mm.	1.2 to 2.6	S1 – 1.6 S1 – 2.1
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 9 – Tip Face		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, silty sandy FILL with clasts of sub angular to angular bedrock ranging from 20 to 60mm and minor amounts of tree roots. One sheet of corrugated iron.	1.2 to 2.6	S1 – 1.6 S1 – 2.1
COMMENTS - No groundwater, no visual signs of contamination, no odours. To dangerous to take sample from pit face. Pit collapsing.		

Test Pit 10 – Tip Face		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, slightly moist, silty sandy clayey FILL with clasts of sub angular to angular bedrock ranging from 20 to 60mm	0 to 2.5	S1 – 1.4 S1 – 2.3
COMMENTS - No groundwater, no visual signs of contamination, no odours.		

Test Pit Logs – Koromiko

Test Pit 1		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry to slightly moist, firm, silty sandy clayey FILL with minor amounts of concrete, plastic netting, plastic (<5%)	0 to 0.9	
FILL – Dark grey, dry, silty, sandy, sub angular to angular gravel (10 to 30mm) fill.	0.9 to 1.6	
FILL – Brown, slightly moist, silty sandy clayey fill with minor amounts of sub angular to angular clasts of weathered bedrock varying in size from 30 to 100mm (10%)	1.6 to 2.1	S1
NATURAL GROUND – Mottled grey/tan/brown, moist, stiff, silty clay	2.1 to 2.3	S2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 2		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark brown, moist, firm, silty clay FILL with sub angular to angular clasts of weathered bedrock varying in size from 20 to 80mm (10%) and some broken sea shells	0 to 1.4	S1
FILL – Dark brown/tan, moist, firm, silty clay fill with sub rounded to sub angular clasts of weathered bedrock varying in size from 10 to 100mm (10%) and some concrete and wood (<5%)	1.4 to 3.2	S2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 3		
Soil description	**Depth BGL (m)**	**Sample Depth**

		(m)
FILL – Brown, dry, compact, silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 40 to 60mm (50%) and concrete/brick/wood (5%).	0 to 2.1	S1
NATURAL GROUND – Mottled grey/brown/tan, moist, soft to firm, silty CLAY	2.1 to 2.6	S2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 4		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry to slightly moist, firm, silty clayey FILL with sub angular to angular clasts of weathered bedrock ranging from (30 to 60mm) and minor amounts of wood (<2%)	0 to 0.8	
FILL – Dark grey, dry to slightly moist, firm, silty clayey fill with sub rounded to rounded gravel ranging from (20 to 40mm)	0.8 to 1.3	
FILL – Mottled brown/grey/tan, moist, firm, silty clayey fill with minor amounts of sub angular to angular clasts of weathered bedrock varying in size from 30 to 100mm (30%) and minor amounts of concrete and gravel	1.3 to 2.9	S1 & S2
NATURAL GROUND – Mottled grey/tan/brown, moist, stiff, silty clay	2.9 to 3.2	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 5		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, compact, silty clayey FILL with sub angular to angular clasts of weathered bedrock ranging from (50 to 150mm) and minor amounts of	0 to 1	S1

gravel (<2%)		
FILL – Brown/grey/tan, moist, soft to firm, silty clayey FILL with sub angular to angular clasts of weathered bedrock ranging from (10 to 60mm)	1 to 2.5	S2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 6		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, sandy silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 40 to 110mm (10 to 15%) and concrete/breeze blocks (<5%) and wood (5%) and minor amounts of wire .	0 to 1.6	S1
NATURAL GROUND – Mottled grey/brown/tan, moist, soft to firm, silty CLAY	1.6 to 2.4	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 7		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, sandy silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 10 to 40mm (<5%).	0 to 1	S1
NATURAL GROUND – Mottled grey/brown, moist, firm, silty CLAY	1 to 1.4	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 8		
Soil description	**Depth BGL (m)**	**Sample Depth**

		(m)
Topsoil – Brown, dry, loose, silty sandy topsoil	0 to 0.1	
FILL – Brown/tan, dry, firm, silty clayey fill with sub angular to angular clasts of weathered bedrock ranging from 10 to 40mm with minor amounts of concrete and wood (<2%)	0.1 to 0.9	
FILL – Brown, dry, firm, silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 50 to 100mm (50%)	0.9 to 1.3	S1
FILL – Dark grey, moist, silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 10 to 40mm (10 to 20%) and old field drain	1.3 to 2.3	
NATURAL GROUND – Mottled grey/tan/brown, moist, stiff, silty clay	2.3 to 2.5	S2
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 9		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
Topsoil – Brown, dry, loose, silty sandy topsoil	0 to 0.1	
FILL – Brown/grey, dry, firm, silty clayey fill with sub angular to angular clasts of weathered bedrock ranging from 10 to 40mm (<50%) and minor amounts of concrete and wood (<4%).	0.1 to 1.1	S1
FILL – Dark brown/grey/tan, silty clayey fill with sub angular to angular clasts of weathered bedrock varying in size from 50 to 80mm (20%)	1.1to 1.9	S2
NATURAL GROUND – Mottled grey/tan/brown, moist, stiff, silty clay	1.9 to 2.4	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit Logs – Linkwater

Test Pit 1		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, moist, firm, silty clayey FILL with tee roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 30 to 900mm (15%)	0 to 2.4	S1 – 1.8
FILL – Mottled grey/brown, moist, very soft to soft, silty clayey FILL with tree roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 30 to 900mm (10%). Strong organic odour – rotting vegetation	2.4 to 3.7	S2 – 2.6 S3 – 3.2
COMMENTS - No groundwater, did not reach natural ground		

Test Pit 2		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, loose, slightly clayey, silty sandy FILL with tree roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 10 to 150mm (10%)	0 to 2.8	S1 – 2
NATURAL GROUND – Dark brown, moist, soft, organic rich (Reeds), silty clayey TOPSOIL	2.8 to 3.1	S2 – 3.1
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 3		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, loose, slightly clayey, silty sandy FILL with tree roots (<5%), and sub angular to	0 to 2.7	S1 – 1.5

angular blocks of weathered bedrock varying in size from 50 to 600mm (40%)		
NATURAL GROUND – Blue/grey, moist, soft, organic rich (Reeds), silty CLAY	2.7 to 2.9	S2 – 2.8
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 4		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, loose, slightly clayey, silty sandy FILL with tree roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 50 to 160mm (5%)	0 to 1.2	
FILL – Mottled brown/grey/tan, moist, soft to firm, slightly clayey, silty sandy FILL with tree roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 40 to 100mm (5%)	1.2 to 2.4	S1 – 1.5
NATURAL GROUND – Dark brown, moist, soft, silty clayey TOPSOIL	2.4 to 2.6	S2 – 2.5
NATURAL GROUND – Mottled brown/grey, moist, firm to stiff, silty CLAY	2.6 to 3.6	S3 – 3.1
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 5		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, moist, firm, slightly clayey, silty FILL, with tree roots (<5%), and sub angular to angular blocks of weathered bedrock varying in size from 30 to 160mm (10%)	0 to 2.2	S1 – 1.6

FILL – Dark brown, moist, soft to firm, slightly clayey, silty FILL with large amounts of tree stumps (>30%).	2.2 to 3.1	S2 – 2.4
NATURAL GROUND – Mottled brown/grey/tan, moist, soft to firm, silty CLAY	3.1 to 3.4	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 6		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Gey/brown, dry to moist, firm, slightly clayey, silty FILL, with punga trunks and roots (>30%), and sub angular to angular blocks of weathered bedrock varying in size from 30 to 80mm (10%)	0 to 1.6	S1 – 1.3
NATURAL GROUND – Mottled brown/grey/tan, moist, soft to firm, silty CLAY	1.6 to 2.4	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 7		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Gey/brown, dry to moist, firm, slightly clayey, silty FILL, with punga trunks and roots (>30%), and sub angular to angular blocks of weathered bedrock varying in size from 30 to 80mm (10%)	0 to 200	
NATURAL GROUND – Mottled brown/grey/tan, moist, soft to firm, silty CLAY	200 to 1.5	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 8		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, moist, soft, silty clayey FILL, with sub angular to angular blocks of weathered bedrock varying in size from 30 to 160mm (50%)	0 to 1.8	S1 – 1.2
FILL – Dark grey, moist, soft, silty clayey FILL with minor amounts of wood (<50%).	1.8 to 3.5	S2 – 2.3
NATURAL GROUND – Mottled brown/grey/tan, moist, soft to firm, silty CLAY	3.5 to 3.7	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 9		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
NATURAL GROUND – Brown, dry, crumbly silty clayey TOPSOIL	0 to 400	
NATURAL GROUND – Mottled brown/grey/tan, moist, soft to firm, silty CLAY	400 to 1.5	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 10		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark grey, moist, soft to firm, silty clayey FILL, with sub angular to angular blocks of weathered bedrock varying in size from 30 to 200mm (10%) and large tree trunks.	0 to 4.2	S1 – 2 S2 – 3.9
NATURAL GROUND – Dark brown, organic rich (peaty material), moist, soft to firm, silty CLAY	4.2 to 4.4	S3 – 4.3
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 11		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown, dry, loose, silty clayey FILL, with sub angular to angular blocks of weathered bedrock varying in size from 50 to 300mm (15%) and wood (<5%).	0 to 1m	
FILL – Grey, dry, more compact, silty clayey FILL, with sub angular to angular blocks of weathered bedrock varying in size from 30 to 200mm (10%) and minor amounts of treated timber and wood (<5%)	1 to 1.7	S1 – 1.5
FILL – Mottled brown/grey, moist, silty clayey FILL, with sub angular to angular blocks of weathered bedrock varying in size from 50 to 120mm (10%)	1.7 to 2.2	S2 – 2.1
NATURAL GROUND – Dark brown, moist, soft, silty CLAY	2.2 to 2.8	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Kaituna – Tuamarina Road, Blenheim – Test pit Logs

Test Pit 1		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (50%) measuring 20 to 100mm in a silty sandy matrix.	0 to 0.3	S1 – 0.2
FILL – 50 to 60% large concrete blocks up to 1m wide with a dark grey, fine, loose, silty sandy FILL matrix. Minor amounts of wood (<2%)	0.3 to 2.1	S2 – 1.8
COMMENTS – Concrete blocks stopped further excavation, No groundwater, did not reach natural ground, no odours, no visual sign of contamination		

Test Pit 2		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (50%) measuring 20 to 100mm in a silty sandy matrix.	0 to 0.8	S1 – 0.6
FILL – 20 to 30% large concrete blocks with rebar, up to 1m wide, within a dark grey, fine, loose, silty sandy gravely FILL matrix. Patches of clay in areas. Minor amounts of wood, metal (<2%)	0.8 to 2.1	S2 – 1.8
COMMENTS - Concrete blocks stopped further excavation, no groundwater, did not reach natural ground, no odours, no visual sign of contamination		

Test Pit 3		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**

FILL – Brown/grey, slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (50%) measuring 20 to 100mm in a silty sandy matrix. Some minor amounts of concrete, metal, wood <5%	0 to 0.6	S1 – 0.5
FILL Dark grey, slightly moist, loose, silty sandy gravely (10 to 30%) FILL with large lumps of concrete and silty clay patches.	0.6 to 2.2	S2 – 1.8
COMMENTS - Concrete blocks stopped further excavation, no groundwater, did not reach natural ground, no odours, no visual sign of contamination		

Test Pit 4		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, dry to slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (30 to 40%%) measuring 20 to 100mm in a silty clayey matrix. Some angular clasts of weathered bedrock.	0 to 0.6	S1 – 0.4
FILL Brown, slightly moist, soft to firm, silty sandy slightly clayey FILL with gravel (10 to 20%). Softer silty clay patches throughout. Mix of concrete (<5%), wood (<1%) and plastic pipe (<1%) .	0.6 to 2.5	S2 – 1.8
COMMENTS – Test pit collapsing in on itself. no groundwater, did not reach natural ground, no odours, no visual sign of contamination		

Test Pit 5		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, dry to slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (20 to 30%%) measuring 20 to 100mm in a silty sandy matrix.	0 to 0.6	S1 – 0.4
FILL Brown, slightly moist, compact, slightly clayey silty sandy FILL with sub-rounded gravel (10 to 15%).	0.6 to 2.5	S2 – 1.8

FILL Yellow brown, organic rich decomposed straw/vegetation. Possible farm waste. Very strong organic odour	2.5 to 2.7	S3 – 2.5
FILL Brown, slightly moist, compact, slightly clayey silty sandy FILL with sub-rounded gravel (10 to 15%).	2.7 to 2.9	
COMMENTS – No groundwater, did not reach natural ground		

Test Pit 6		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, dry to slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (10 to 20%) measuring 20 to 50mm in a silty sandy matrix.	0 to 0.7	
FILL Brown, slightly moist, compact, slightly clayey silty sandy FILL with sub-rounded gravel (5 to 10%). Concrete blocks (<5%) and decomposed vegetation/straw (<5%) and some building plastic	0.7 to 3	S1 – 1.8 S2 – 2.6
POSSIBLE NATURAL - Brown/grey, loose, slightly moist, silty sandy GRAVEL	3 to 3.2	
COMMENTS – No groundwater, no odours, no visual sign of contamination		

Test Pit 7		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Brown/grey, dry to slightly moist, loose to moderately compacted, sub rounded to rounded GRAVEL (80%) measuring 20 to 70mm in a silty sandy matrix.	0 to 0.8	

FILL Brown, dry, loose, silty, sandy sub-rounded gravel (50%) with concrete blocks (<5%) and timber (<5%)	0.8 to 2.2	S1 – 1.8 S2 – 2.6
COMMENTS – No groundwater, no odours, no visual sign of contamination		

Test Pit Logs – Taylor Pass

Test Pit 1		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, silty sandy sub rounded to rounded gravel (10 to 20%) varying in size from 10 to 40mm with large blocks of concrete (1m) and patches of blue/grey, moist, soft clay and minor amounts of angular clasts of bedrock, wood (<5%), metal and plastic (<1%).	0 to 1.3	S1 – 1m
FILL Grey/bluey grey, moist, soft, silty clayey fill with large lumps of concrete.	1.3 to 1.5	S2 – 1.4
COMMENTS - No groundwater, no visual signs of contamination, no odours Presence of concrete halted test pit		

Test Pit 2		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, slightly clayey, silty sandy sub rounded to rounded gravel (20 to 30%) varying in size from 10 to 140mm with large blocks of concrete (1m) and minor amounts of angular clasts of bedrock	0 to 1.3	S1 – 0.9 S2 – 1.2
FILL Brown/tan, dry, compact, slightly clayey, silty, sandy, sub rounded to sub angular gravel (40 to 50%) varying in size from 20 to 100mm.	1.3 to 2	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 3		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
Dark brown, dry, organic rich, silty, sandy topsoil	0 to 0.2	
Grey, dry, loose, fine to medium grained sandy gravel FILL varying in size from (10 to 20mm) with large blocks of concrete (>0.8m).	0.2 to 0.45	
Brown, dry, compact, slightly clayey, silty FILL with large blocks of concrete (1m) and minor amounts of sub angular to angular gravel varying in size from 20mm to 80mm (<5%), angular clasts of bedrock (<2%).	0.45 to 1.8	S1 – 0.6 S2 – 1m
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 4		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, slightly clayey, silty, sandy sub rounded to sub angular gravel (20 to 30%) fill with cobbles and large clasts of bedrock and concrete (>1m).	0 to 0.4	
FILL Browny pink, dry, loose, fine to medium grained sand with metal objects and large blocks of concrete (>1m).	0 to 1.1	S1 – 0.6
Dark brown, moist, compact, slightly clayery, silty, sandy FILL with 5 to 10% sub angular to angular gravels varying in size from 10mm to 50mm and grey, moist, soft, clayey patches. Large blocks of concrete (>1m)	1.1 to 1.6	S2 – 1.3
COMMENTS - No groundwater, visual signs of contamination – pink sands, no odours		

Test Pit 5		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, silty sandy, sub rounded to sub angular gravel varying in size from 30 to 40% and cobbles >200mm, and minor amounts of weathered bedrock	0 to 0.7	S1 – 0.6
FILL Brown, slightly moist, compact, silty, sandy, sub rounded to sub angular gravel (10 to 20%) varying in size from 10 to 40mm and large blocks of concrete (0.5m to 1.2m with rebar.	0.7 to 1.8	S2 – 1.3
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 6		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, silty, sandy, sub rounded to sub angular gravel (25 to 35%) varying in size from 20 mm to 80mm and minor amounts of weathered bedrock.	0 to 0.4	
Brown/grey, dry to slightly moist, compact, silty, sandy FILL with patches of soft clay and sub rounded to rounded gravel (10 to 15%) and large blocks of concrete (1m plus) and minor amounts of brick and wood (<5%)	0.4 to 1.2	S1 - 0.7
FILL Brown/dark brown, moist, silty, clay with minor amounts of gravel (<5%) and small lumps of concrete <600mm.	1.2 to 1.6	S2 – 1.4
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 7		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
Brown, slightly moist, compact, slightly sandy, silty, clay FILL with minor amounts of sub rounded to sub angular gravel (<5%) varying in size from 10 to 40mm	0 to 0.6	
FILL Brown/tan, slightly moist, compact, slightly clayey, silty, sandy, sub rounded to angular gravel (40 to 50%) ranging from 10 to 50mm	0.6 to 1.2	S1 – 1.3
FILL Brown/tan, slightly moist, compact, slightly clayey silty, sandy sub rounded to sub angular gravel varying in size from 10 to 30mm and large blocks of concrete (>1m) with minor amounts of brick and weathered bedrock	1.2 to 2.1	S2 – 1.8
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 8		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL - Brown, dry, compact, slightly clayey, silty, sandy sub rounded to rounded gravel varying in size from 10 to 50mm	0 to 0.7	
FILL Brown, slightly moist, compact, slightly clayey, silty, sub rounded to rounded gravel (15 to 20%) varying in size from 10 to 30mm with large blocks of concrete (>0.5m) and minor amounts of wood (<2%) and soft clay patches.	0.7 to 1.8	S1 – 0.8 S2 – 1.3
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 9		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL Brown, dry, compact, slightly clayey, silty, sandy, sub angular to sub rounded gravel (20 to 25%) varying in size from 20 to 80mm.	0 to 0.5	
NATURAL GROUND – Brown/tan, slightly moist, very stiff to hard, silty CLAY.	0.5 to 0.9	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit Logs – Ontrack

Test Pit 1		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark grey, hard, sub angular to angular aggregate fill (10 to 40mm) in a silty sandy matrix	0 to 0.35	S1 – 0.3
NATURAL GROUND – Dark brown, consolidated, slightly moist, stiff to very stiff, silty sand	0.35 to 0.9	
COMMENTS - No groundwater, did not reach natural ground		

Test Pit 2		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark grey, hard, sub angular to angular aggregate fill (10 to 40mm) in a silty sandy matrix	0 to 0.4	S1 – 0.3
NATURAL GROUND – Dark brown, consolidated, slightly moist, stiff to very stiff, silty sand	0.4 to 1.1	S2 – 0.6
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Test Pit 3		
Soil description	**Depth BGL (m)**	**Sample Depth (m)**
FILL – Dark grey, hard, sub angular to angular aggregate fill (20 to 40mm) in a silty sandy matrix	0 to 0.4	S1 – 0.3
NATURAL GROUND – Dark brown, consolidated, slightly moist, stiff to very stiff, silty sand	0.4 to 1.2	
COMMENTS - No groundwater, no visual signs of contamination, no odours		

Spoil heap 2	
Soil description	**Sample**
FILL – Brown, slightly moist, silty sandy fill	Soil sample S2

Spoil heap 3	
Soil description	**Sample**
FILL – Brown, slightly moist, silty sandy fill	Soil sample S3

Spoil heap 4	
Soil description	**Sample**
FILL – Brown, slightly moist, silty clay fill with minor amounts of aggregate	Soil sample S4

Spoil heap 5	
Soil description	**Sample**
FILL – Brown, slightly moist, silty sandy gravel fill	Soil sample S5

Spoil heap 6	
Soil description	**Sample**
FILL – Brown, slightly moist, silty sandy gravel fill	Soil sample S6

Spoil heap 7	
Soil description	**Sample**
FILL – Brown, slightly moist, silty sandy fill	Soil sample S7

Spoil heap 8	
Soil description	**Sample**
FILL – Brown, slightly moist, slightly sandy, silty sandy fill	Soil sample S8

Spoil heap 9	
Soil description	**Sample**
FILL – Brown, slightly moist, slightly sandy, silty sandy fill	Soil sample S9

Appendix 5: Site Photos

Photo 1: Picton Earthworks. View looking north east over the upper platform of the cleanfill site

Photo 2: Picton Earthworks. View of materials on the upper platform - tip face

Photo 3: Picton Earthworks. View of the upper platform tip face and the middle platform with large quantities of timber placed on it

Photo 4: Picton Earthworks. View of the Picton Marine dredged sediments

Photo 5: Picton Earthworks. Test Pit 9 typical materials in the tip face

Photo 6: Picton Earthworks - Upper Tip

Photo 7: Linkwater – Tip Face

Photo 8: Linkwater – Tip

Photo 9: Linkwater – View looking south across the surface of the tip.

Photo 10: Tuamarina Track – Tip Face

Photo 11: Tuamarina Track – Tip Face

Photo 12: Tuamarina Track – Test Pit 1 – showing large blocks of concrete

Photo 13: Koromiko Cleanfill Site

Photo 14: Koromiko Cleanfill Site, Tip Face

Photo 15: Taylor Pass Road – View looking north at the cleanfill site and various types of stored materials.

Photo 16: Taylor Pass Road- View of the tip face showing the depth of fill and the close proximity of the ephemeral stream

Photo 17: Taylor Pass Road – View showing leachate migrating from the base of the cleanfill site

Photo 18: Taylor Pass Road – View showing leachate from the cleanfill site flowing into the unnamed ephemeral stream

Photo 19: Taylor Pass Road – TP4 – Sand blasting materials

Photo 20: Taylor Pass Road – Test Pit 1 – showing nature of the underlying fill materials

Photo 21: Taylor Pass Road – Test Pit 2

Photo 22: Banks of the Taylor River showing the underlying geological sequence below parts of the cleanfill site

Photo 23: On-track – Powell Contracting - View of the site looking south

Photo 24: On-track. Powell Contracting. View of the site looking south from the middle of the site

Appendix 6: Hills Laboratories Report

Hill Laboratories
BETTER TESTING BETTER RESULTS

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ANALYSIS REPORT

Page 1 of 2

Client:	Sustainable Environmental Engineering Ltd	**Lab No:**	790505	SPv1
Contact:	Mark Davies	**Date Registered:**	07-May-2010	
	C/- Sustainable Environmental Engineering Ltd	**Date Reported:**	20-May-2010	
	6 Pukenui Road	**Quote No:**		
	RD 1	**Order No:**		
	PICTON 7281	**Client Reference:**		
		Submitted By:	Mark Davies	

Sample Type: Soil

Sample Name:		Ontrack TP2S1	Ontrack TP1S1	Spoilheap 2	Spoilheap 5	Spoilheap 9
Lab Number:		790505.1	790505.2	790505.3	790505.4	790505.5
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	3.9	3.2	10.4	4.3	33
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.102	< 0.10
Total Recoverable Chromium	mg/kg dry wt	18.1	18.2	22	17.4	27
Total Recoverable Copper	mg/kg dry wt	8.5	10.5	19.2	11.7	49
Total Recoverable Lead	mg/kg dry wt	8.6	14.2	52	17.7	18.7
Total Recoverable Mercury	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Nickel	mg/kg dry wt	18.8	35	27	15.4	23
Total Recoverable Zinc	mg/kg dry wt	40	54	109	69	104

Sample Name:		Taylor Pass TP2 782048/14	Taylor Pass TP8 782048/16			
Lab Number:		790505.6	790505.7			
Individual Tests						
TCLP Weight of Sample Taken	g	100	70	-	-	-
TCLP Initial Sample pH	pH Units	7.9	8.9	-	-	-
TCLP Acid Adjusted Sample pH	pH Units	1.6	1.7	-	-	-
TCLP Extraction Fluid Description*		NaOH/Acetic acid at pH 4.93 +/- 0.05	NaOH/Acetic acid at pH 4.93 +/- 0.05	-	-	-
TCLP Extraction Fluid pH	pH units	5.0	5.0	-	-	-
TCLP Post Extraction Sample pH	pH Units	5.1	5.2	-	-	-

Sample Type: Aqueous

Sample Name:		Taylor Pass TP2 782048/14 (TCLP Extract)	Taylor Pass TP8 782048/16 (TCLP Extract)			
Lab Number:		790505.8	790505.9			
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.021	< 0.021	-	-	-
Total Cadmium	g/m³	< 0.0011	0.0038	-	-	-
Total Chromium	g/m³	< 0.011	0.021	-	-	-
Total Copper	g/m³	< 0.011	0.0180	-	-	-
Total Lead	g/m³	0.0050	0.040	-	-	-
Total Nickel	g/m³	< 0.011	0.098	-	-	-
Total Zinc	g/m³	0.078	31	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil

Test	Method Description	Default Detection Limit	Samples

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Individual Tests			
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction.	-	1-5
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-5
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-5
TCLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311	-	8-7
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	8-7
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	8-7
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	8-7
TCLP Extractant Type*	US EPA 1311.	-	8-7
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH units	8-7
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	8-7

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Samples**
Individual Tests			
Total Digestion of Extracted Samples*	Nitric acid digestion. APHA 3030 E 21st ed. 2005.	-	8-9
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level.	-	8-9

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

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

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Ara Heron BSc (Tech)
Client Services Manager - Environmental Division

Hill Laboratories
BETTER TESTING BETTER RESULTS

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Web www.hill-labs.co.nz

ANALYSIS REPORT

Client:	Sustainable Environmental Engineering Ltd	**Lab No:**	782048 SPv1
Contact:	Mark Davies	**Date Registered:**	09-Apr-2010
	C/- Sustainable Environmental Engineering Ltd	**Date Reported:**	19-Apr-2010
	6 Pukenui Road	**Quote No:**	40188
	RD 1	**Order No:**	
	PICTON 7281	**Client Reference:**	MDC
		Submitted By:	Mark Davies

Sample Type: Soil

Sample Name:		Koromiko TP 9 S1	Linkwater TP 2 S1	Linkwater TP 4 S1	Linkwater TP 8 S1	Linkwater TP 10 S1
Lab Number:		782048.1	782048.2	782048.3	782048.4	782048.5
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	5.5	5.1	3.2	4.3	5.4
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	19.4	15.9	17.7	19.5	17.9
Total Recoverable Copper	mg/kg dry wt	43	50	24	20	34
Total Recoverable Lead	mg/kg dry wt	42	21	16.5	13.8	19.8
Total Recoverable Mercury	mg/kg dry wt	0.54	0.28	0.134	0.43	0.97
Total Recoverable Nickel	mg/kg dry wt	15.1	11.5	11.4	14.1	14.2
Total Recoverable Zinc	mg/kg dry wt	94	130	58	75	93

Sample Name:		Linkwater TP 11 S2	Picton TP 1 S1	Picton TP 2 S1	Picton TP 3 S1	Picton TP 7 S1
Lab Number:		782048.6	782048.7	782048.8	782048.9	782048.10
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	5.4	5.5	4.5	7.9	3.2
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	< 0.10	< 0.10	0.135	0.120
Total Recoverable Chromium	mg/kg dry wt	22	17.7	18.5	20	13.3
Total Recoverable Copper	mg/kg dry wt	49	103	114	49	22
Total Recoverable Lead	mg/kg dry wt	16.3	46	92	41	84
Total Recoverable Mercury	mg/kg dry wt	0.28	1.43	1.38	1.25	0.88
Total Recoverable Nickel	mg/kg dry wt	16.7	11.7	9.9	13.0	7.7
Total Recoverable Zinc	mg/kg dry wt	91	101	99	108	112

Sample Name:		Taylor Pass TP 4 S1	Taylor Pass TP 7 S2	Taylor Pass TP 2 S2	Taylor Pass TP 5 S2	Taylor Pass TP 8 S2
Lab Number:		782048.12	782048.13	782048.14	782048.15	782048.16
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	< 2	9.7	3.0	9.7	5.4
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.23	< 0.10	0.31	0.38
Total Recoverable Chromium	mg/kg dry wt	780	24	13.4	25	57
Total Recoverable Copper	mg/kg dry wt	29	23	2,200	30	30
Total Recoverable Lead	mg/kg dry wt	1.80	210	17.7	240	105
Total Recoverable Mercury	mg/kg dry wt	< 0.10	0.33	0.140	0.28	0.118
Total Recoverable Nickel	mg/kg dry wt	400	23	10.5	23	21
Total Recoverable Zinc	mg/kg dry wt	13.9	198	70	300	3,500

Sample Name:		Koromiko TP 1 S1	Koromiko TP 3 S1	Koromiko TP 6 S1	Koromiko TP 8 S1	Picton TP 6 S1
Lab Number:		782048.17	782048.18	782048.19	782048.20	782048.21
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	4.7	4.4	8.2	5.0	7.6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.115	0.100	< 0.10	0.24

Sample Type: Soil						
Sample Name:		Koromiko TP 1 S1	Koromiko TP 3 S1	Koromiko TP 6 S1	Koromiko TP 8 S1	Picton TP 8 S1
Lab Number:		782048.17	782048.18	782048.19	782048.20	782048.21
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Chromium	mg/kg dry wt	21	28	22	18.4	24
Total Recoverable Copper	mg/kg dry wt	41	35	22	27	42
Total Recoverable Lead	mg/kg dry wt	88	71	38	56	182
Total Recoverable Mercury	mg/kg dry wt	0.30	0.68	0.165	0.40	0.29
Total Recoverable Nickel	mg/kg dry wt	18.2	19.1	12.7	13.6	20
Total Recoverable Zinc	mg/kg dry wt	117	113	103	88	280

Sample Name:		Picton TP 5 S1	Tuamarina Tray TP 1 S1	Tuamarina Tray TP 3 S1	Tuamarina Tray TP 5 S1	Tuamarina Tray TP 4 S2
Lab Number:		782048.22	782048.23	782048.24	782048.25	782048.26
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	< 2	28	5.3	4.0	3.6
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.27	< 0.10	< 0.10	< 0.10
Total Recoverable Chromium	mg/kg dry wt	13.6	41	24	21	21
Total Recoverable Copper	mg/kg dry wt	8.5	40	19.7	17.0	16.9
Total Recoverable Lead	mg/kg dry wt	29	187	34	18.4	18.2
Total Recoverable Mercury	mg/kg dry wt	0.110	0.33	0.198	0.178	0.128
Total Recoverable Nickel	mg/kg dry wt	4.8	26	32	34	29
Total Recoverable Zinc	mg/kg dry wt	25	280	103	73	89

Sample Type: Sludge						
Sample Name:		Taylor Pass Sludge				
Lab Number:		782048.11				
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg						
Total Recoverable Arsenic	mg/kg dry wt	12.7	-	-	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.32	-	-	-	-
Total Recoverable Chromium	mg/kg dry wt	19.8	-	-	-	-
Total Recoverable Copper	mg/kg dry wt	32	-	-	-	-
Total Recoverable Lead	mg/kg dry wt	103	-	-	-	-
Total Recoverable Mercury	mg/kg dry wt	0.25	-	-	-	-
Total Recoverable Nickel	mg/kg dry wt	22	-	-	-	-
Total Recoverable Zinc	mg/kg dry wt	250	-	-	-	-

SUMMARY OF METHODS

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil			
Test	Method Description	Default Detection Limit	Samples
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction.	-	1-28
Heavy metals, screen As,Cd,Cr,Cu,Ni,Pb,Zn,Hg	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, screen level.	-	1-28
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	1-28

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

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

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