REPORT

Determination of Common Pollutant Background Soil Concentrations for the Wellington Region

Prepared for

Greater Wellington the Regional Council

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Wellington

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Executive Summary

The objective of this Greater Wellington investigation was to establish background concentrations ranges for a number of common pollutants in soils within the Wellington Region. Where "background" has been defined, for the purposes of this investigation, as being representative of "pristine" conditions, i.e. soil quality not impacted by human activities.

Geographically, the investigation focused on areas where significant human land use activity has, and is, likely to occur. These areas are where Greater Wellington will have a predominant need to monitor human impacts on soil quality. Within this context, the sampling design comprised near-surface sampling with further geographical categorisation of target soils based on the underlying rock type. This resulted in the identification of five (5) Main Soil Type areas.

In each of these Main Soil Type areas, specific sample sites were chosen to gain: a relatively even spatial distribution, soils best representing background soil quality, ease of access and some integration of sites that had been previously sampled by Greater Wellington for the Soil Quality Indicators Programme.

Surficial (0-150 mm depth) soil samples were collected from forty (40) locations during June 2003. The collected samples were analysed by relevant methods for the following analytes: arsenic (As), soluble boron (B), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), zinc (Zn), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH).

The works undertaken have established a good initial dataset for the Wellington Region, but the individual Main Soil Types datasets are limited by their sample sizes. Further soil sampling to increase the sample size (improving statistical robustness) and validation of any identified outliers and extreme values is considered necessary before these data can be considered fully representative of background soil quality for the Wellington Region.

A statistical assessment of the laboratory analytical results yielded the following background concentration ranges for each of the analytes.

Table ES - 1: Target Analyte Background Soil Concentration Ranges for the Wellington Region

Element	Detection Level	Main Soil Type 1 (Sand)	Main Soil Type 2 (Greywacke)	Main Soil Type 3 (Hutt Alluvium)	Main Soil Type 4 (Wairarapa Alluvium)	Main Soil type 5 (Mudstone/Siltstone)
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soluble Boron	3	0.3 - 2.1	0.9 - 2.2	0.3 - 1.6	0.7 - 2.7	1 - 2.6
Arsenic	2	<2 - 7	<2 - 7	2 - 7.0	2 - 7	<2 - 4
Cadmium	0.1	<0.1 - 0.1	<0.1 - 0.1	<0.1 - 0.2	<0.1 - 0.2	<0.1 - 0.2
Chromium	1	7 - 12	6 - 16	9 - 18	11- 21	8 - 15
Copper	1	4 - 10	3 - 25	5 - 19	7 - 19	6 - 19
Mercury	0.1	<0.1 - 0.1	<0.1 - 0.2	<0.1 - 2.6	<0.1 - 0.1	<0.1- 0.1
Nickel	1	4 - 9	4 - 13	5.0 - 14.0	6 - 21	5 - 13
Lead	1	4.5 - 180.0	5.9 – 78.6	16.7 - 73.3	9.4 - 34.0	10.8 - 38.1
Zinc	1	28 - 79	24 - 105	38 - 201	44 - 121	31 - 72
TPH (C_7 - C_{44})	8 - 60	<40 - 110	<30 - 190	<40 - 260	<30 - 820	<40 - 460
Anthracene	0.002 - 0.005	<0.002 - 0.01	<0.002 - 0.05	<0.002 - 0.04	<0.002 - 0.05	< 0.002 - 0.01
Benzo[a]pyrene	0.002 - 0.005	<0.002 - 0.08	<0.002 - 0.27	0.004 - 0.33	<0.002 - 0.31	<0.002 - 0.01
Fluoranthene	0.002 - 0.005	<0.002 - 0.14	<0.002 - 0.55	0.007 - 0.39	<0.002 - 0.57	<0.002 - 0.02
Naphthalene	0.002 - 0.005	<0.002 - 0.01	<0.002 - 0.01	<0.002 - 0.01	<0.002 - 0.02	<0.004
Phenanthene	0.002 - 0.005	<0.002 - 0.07	<0.002 - 0.26	0.005 - 0.12	<0.002 - 0.35	<0.002 - 0.01
Pyrene	0.002 - 0.005	<0.002 - 0.12	<0.002 - 0.57	0.008 - 0.46	<0.002 - 0.60	<0.002 - 0.02

1.1 Terms of Reference

This report has been prepared by URS New Zealand Limited (URS) for Greater Wellington the Regional Council (Greater Wellington) in accordance with the URS scope of works and cost estimate provided to Greater Wellington in April 2003 (Greater Wellington PO# M33556)[1]. It documents the soil investigation undertaken by URS during June 2003.

1.2 Background

The Greater Wellington Regional Plan for Discharges to Land defines a contaminated site as:

> *A site at which hazardous substances occur at concentrations above background levels and where assessment indicates it poses or is likely to pose an immediate or long-term hazard to human health or the environment.*

Currently, information on background levels of potentially hazardous substances in soils for the Wellington Region is not available. Reliance is therefore placed on soil background levels developed offshore. In particular, the ANZECC guidelines[2] provide background or screening levels of potential soil contaminants. These levels are commonly applied in New Zealand as generic screening criteria or trigger levels for deciding whether further site investigation is required.

The available generic screening criteria are not always applicable to soils in New Zealand and the Wellington Region. Greater Wellington has therefore identified that establishing the background concentrations of certain common pollutants in the main soil types in the Wellington Region is a valuable tool that will assist the Council with determining the contamination status of sites and to set appropriate remedial levels for different land uses across the Wellington Region.

1.3 Project Objective

The main objective of this investigation was to determine background concentration ranges for some common pollutants within selected major soil types of the Wellington Region. This information may be used as a reference when assessing environmental effects from human activities in relation to the contamination of land.

1.4 Investigation Scope

The soil investigation comprised the following scope of works:

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[1] *Background Soil Survey – Proposal*, prepared for Greater Wellington Regional Council by URS New Zealand Limited, dated 11 April 2003.

[2] Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, January 1992, Australian and New Zealand Environment and Conservation Council (ANZECC) and the National Health and Medical Research Council (NHMRC)

1. The identification of a number of representative major soil types within the Wellington Region.
2. A scoping meeting between URS and Greater Wellington to confirm the final terms of references.
3. A review of literature and other readily available information sources to determine what existing information was available in relation to background concentrations of metals and hydrocarbon compounds in soils in the Wellington Region.
4. The selection of sample sites considered to be representative of each main soil type and, as far as is practicably achievable, having soils unaffected by human activity.
5. The identification of landowners, and acquisition of permission to access sites and collect soil samples.
6. Confirmation of the site soil type by excavating a test pit to 500 mm below ground level (bgl) and logging the soil profile.
7. Sampling surficial soils (0-150 mm bgl) at each site.
8. Laboratory analysis of the collected samples for the selected metals and organic compounds.
9. Assessment of the laboratory analysis results to determine the background concentration ranges for each of the analytes in each of the Major Soil Types.
10. Production of this report summarising the results of the investigation and providing recommendations for any further work that would improve the dataset.

1.5 Report Format

The report comprises four sections as follows:

Section One - Sets out the project terms of reference, objectives, scope and limitations.

Section Two - Details the soil sampling and analytical results assessment methodologies.

Section Three - Outlines the investigation results, including the background concentration ranges determined for each analyte.

Section Four - Provides a summary of the background concentration ranges determined for the Wellington Region and the recommendations for possible further work.

1.6 Limitations

URS New Zealand Ltd (URS) has prepared this report for the use of Greater Wellington the Regional Council in accordance with the usual care and thoroughness of the consulting profession. It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with

the scope of work and for the purpose outlined in the Proposal, *Background Soil Survey Proposal*, dated 11 April 2003.

The methodology adopted and sources of information used by URS are outlined in this report. URS has made no independent verification of this information beyond the agreed scope of works and URS assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to URS was false.

The information contained within this report is valid as at the data of the site investigation referenced in this report. Site conditions, and hence the validity of the information contained within this report, will very with time and the user needs to satisfy themselves of the current validity of the information at any subsequent use.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. This document and the information contained herein have been prepared solely for use of Greater Wellington and any reliance on this report by third parties shall be at such party's sole risk. No excerpts of this report shall be deemed to be representative of the results and conclusions presented in this report.

This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

2.1 Introduction

Background concentrations of trace metals, other elements and compounds in surface soils are primarily the result of geological and soil forming factors and commonly reflect the composition of the parent rock material. Different parent rocks give rise to distinctive soil types with characteristic compositions. Soil type and composition can, therefore, vary locally or regionally, depending upon the composition of the parent rock. For example, in the Auckland Region the isthmus volcanic field has a naturally high level of nickel, generally exceeding published investigation levels.

Accumulation or dilution of trace elements within the environment occurs due to physical deposition, natural events such as lightning strikes, geo/hydro-chemical processes, forest fires etc. In addition, certain elements or compounds of anthropogenic origin are widespread in the environment and accumulate in soils and are also present at what are effectively *background* levels. Such compounds include trace metals, hydrocarbons, including polycyclic aromatic hydrocarbons (PAH), and dioxins.

For example, areas such as the Hutt Valley and Wellington City may have levels of metal and organic contaminants that are elevated compared to those found in other soils within the same areas and which are of the same geological origin, but which are in a natural or pristine state. Any comparatively elevated levels within the same 'natural' soil type would tend to be specifically related to human activities, such as the contribution of vehicle emissions and lead based paint removal to lead concentrations.

To determine background concentration ranges for soil constituents consideration needs to be given to how concentration differences can occur naturally within a region and the concentration effects that may be caused by the impacts of human activities. The methodology used in this investigation has been designed to account for both of these considerations as is detailed below.

2.2 Identification of the Main Soil Types

The soil type groupings to be used in this investigation were identified by reviewing the major parent rock formations present in the Wellington Region. This was conducted by using the information provided in the 1:250,000 Geological Maps of New Zealand, 1:1,000,000 North Island Soil Map of New Zealand and the *Regional Soil Plan for the Wellington Region* (the Regional Soil Plan). The Main Soil Types selected are:

1. The Coastal and Terrace Soils North of Paekakariki, which mostly comprise Brown Soils associated with the Holocene dune sand and flood plain, estuarine and beach deposits of the Kapiti Coast (Main Soil Type 1, Sandy soils).

2. The Rugged Axis Soils, mainly to the west of the Wairarapa Fault, which comprise mainly Brown Soils associated with the Greywacke bedrock (Main Soil Type 2, Greywacke Soils - the most widely distributed main soil type in the Region) and Ultic Soils associated with the Holocene flood plain deposits of the Hutt Valley (Main Soil Type 3, Hutt Alluvium).

3. The Wairarapa Soils, located to the east of the Wairarapa Fault, which comprise Gley and immature Pallic Soils associated with Holocene flood plain and terrace deposits (Main Soil Type 4, Wairarapa Alluvium) and Pallic Soils associated mainly with the Tertiary mudstones and siltstones (Main Soil Type 5, Mudstone/siltstone).

Figure 2-1 presents the main geological units of the Wellington Region and the Main Soil Types described above.

2.3 Preliminary Review and Project Kick Off Meeting

A project kick off meeting was held with Greater Wellington following receipt of approval to proceed. This meeting was attended by Bruce Croucher (Greater Wellington), Kevin Tearney (URS), David Whitty (URS) and Carmen Sulzberger (URS) on 14 May 2003. The agreed terms of reference are incorporated into the relevant sections of this report. This meeting confirmed the terms of reference for the project in respect of the following key items:

1. Project definition of the term "background" was defined to be pristine, i.e. excluding background concentration effects in an area caused by human activities.

2. The Main Soil Types to be used in this investigation are the five types listed in Section 2.2.

3. The investigation was to collect background soil quality data in areas where Greater Wellington has a dominant requirement to monitor effects on soil quality. This is in areas where significant human land use development has, or is likely to occur. The areas to be targeted in this investigation were to include Wellington, Porirua, the Kapiti Coast, the Hutt Valley, and the Wairarapa.

4. The elements and compounds to be sampled and analysed for, and the levels of analytical detection to be achieved, are those listed in Table 2-2.

5. The target number of sample analyses to be conducted was determined to be between 40 and 45, as outlined in Section 2.6.

6. Sampling was to target surface soils over a sampling depth of 0-150 mm. This sampling depth was chosen as it represents the soil that humans are most commonly exposed to.

S:\Adv Jobs\48253\002\6400\WR002Fig2-1
Rev A 19/08/03 RB

MAIN SOIL TYPE 1

MAIN SOIL TYPE 2

MAIN SOIL TYPE 3

MAIN SOIL TYPE 4

MAIN SOIL TYPE 5

N

N32 N42
N31 N41

CROSS SECTIONS

N31 N41

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MAP SOURCE: NEW ZEALAND GEOLOGICAL SURVEY, WELLINGTON, SHEET 12, 1967.

Title
MAIN GEOLOGICAL UNITS OF THE WELLINGTON REGION

Figure No. **2-1**

2.4 Elements and Compounds to be Assessed

The common pollutants targeted in this investigation consist of the metals and hydrocarbon compounds listed in Table 2-1. Analytical limits of detection (LOD) were selected for each analyte based on the: current understanding of the risk it poses to human health; existing knowledge of expected background concentration levels; current analytical detection capability; and analysis cost. The overall aim was to maximise the amount of useful data obtained during the project. The respective LOD for each analyte are summarised in Table 2-1.

Table 2-1: Target Analytes and Limits of Detection

Analyte	LOD (mg/kg)
Arsenic	2
Boron (Soluble)	3
Cadmium	0.1
Chromium	1
Copper	1
Lead	1
Mercury	0.1
Nickel	1
Zinc	1
TPH (C7 to C44)	8 - 60
PAH	0.002 – 0.005

2.5 Review of Available Background Soil Quality Information

A review of readily available background soil quality information was conducted by sourcing relevant documents held by Greater Wellington. This was primarily conducted by meeting with Dave Cameron, a Land Management Officer with Greater Wellington (Wairarapa), to discuss the project objectives and methodology, and to identify information sources relating to previous and proposed soil sampling programmes for the Wellington Region.

Relevant documents obtained included:

- Implementing Soil Quality Indicators for Land: Wairarapa and Otaki Districts 2001 - 2002, Landcare Research Contract Report: LC0102/158, 20 August 2002 (conducted for the Ministry for the Environment's Soil Indicators Programme).

- Physical soil data collected by Landcare Research, for the areas of Horowhenua, Wellington and Wairarapa, Report for Wellington Regional Council. Only the analytical data component of the report was received by URS.

No existing information relating to the target analytes and compatible with the objectives of this investigation was obtained. However, a number of the sites previously sampled could be reused in this investigation.

2.6 Desktop Sample Site Selection

Prior to undertaking the fieldwork, a baseline list of sites to be used for the collection of soil samples was established. Sites were selected within each of the five Main Soil Type areas based on their compliance with the following criteria:

1. Sample sites were to be located in the target areas of Wellington, Porirua, the Kapiti Coast, the Hutt Valley, and the Wairarapa.

2. The approximate number of sample sites to be located in each Main Soil Type area was to be:

   i) 5 - 10 sample sites for Main Soil Type 1 (Sandy soils -Kapiti Coast).

   ii) 10 sample sites for Main Soil Type 2 (Greywacke soils, Wellington through to Pukerua Bay).

   iii) 10 sample sites for Main Soil Type 3 (Hutt Alluvium - the Hutt Valley).

   iv) 10 sample sites for Main Soil Type 4 (Wairarapa Alluvium - western Wairarapa).

   v) 5 sample sites for Main Soil Types 5 (Mudstone/siltstone - eastern Wairarapa).

3. To provide soil quality information as close as practically achievable to being representative of background ("pristine") concentrations in the target areas. In practice, sites were targeted only if their soils were assessed to have been undisturbed for a significant period of time and they appeared to be the sites in an area least likely to have been exposed to contaminants. This was done with reference to the location of roads, industrial areas, contaminated sites (including landfills) and other potential sources of contamination. The Greater Wellington Selected Land Use Register was referenced in this assessment.

4. Sites previously used for soil sampling (i.e. sites identified from the Indicator Programme and Landcare Research investigations referenced in Section 2.5) and assessed as complying with these site selection criteria were reused. This was done to provide some correlation between different sampling programmes and potentially create a wider application for the data collected.

5. The sites selected needed to achieve a relatively even spatial coverage over each target area.

6. Approval to access and sample soil from each site had to be obtained from the landowner for the site to be included.

7. After URS had conducted the initial selection of the soil sample sites, a Sampling Plan was prepared for each Main Soil Type area. The Sampling Plans described the sampling methodology to be followed and listed the proposed sample sites. The Sampling Plans were submitted to Greater Wellington for final approval prior to sampling works being undertaken.

The final sampling locations are shown on Figures 2-2 through 2-6. A description of each selected sample site is provided in Appendix A. Copies of the Sampling Plans are attached in Appendix B.

2.7 Site Investigation Works

2.7.1 Field Verification of Sample Site Suitability

Each sample site was visually checked for potential anthropogenic impacts upon arrival at site to verify the site's compatibility with the project objectives. If the sample site proved unsuitable or a more appropriate sample site was identified nearby, the original sample site was replaced with a new site within the same target soil type.

Similarly, a suitability verification process was followed in selecting the specific sampling locations at each sample site. This comprised:

- Avoiding the collection of samples from low-lying areas, as these soils could have higher than background levels of the target analytes due to the concentrating effect of receiving run-off from surrounding raised areas.
- Staying away from potential sources of contamination, such as roads, buildings, drains, etc.
- Avoiding areas where the ground surfaces showed signs of disturbance.
- Relocating to another area if subsurface signs of soil disturbance (such as interrupted stratigraphy or anthropogenic inclusions) were observed in the pit excavated for soil profiling purposes.

2.7.2 Soil Profiling

A test pit was dug with a spade to a depth of 500 mm (ground conditions permitting) at each sample site, to determine the soil profile. The soil profile was then photographed and logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System.

The soil logs are included in the sample site briefs in Appendix A and the soil profile photographs are presented in Appendix E.

2.7.3 Positional Location of Sample Sites

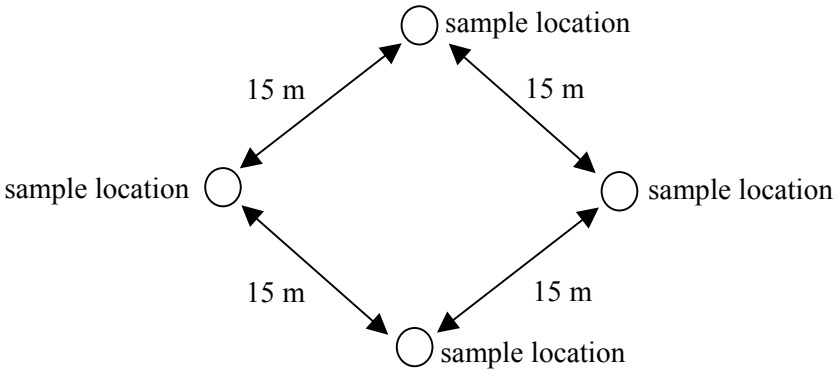
At each sample site the location of the test pit was recorded using a geographical positioning system (GPS) handheld receiver. Where dense forest canopy prevented satellite reception a GPS reading was collected at the bush entrance/exit point.

Where sites previously sampled were being revisited in this investigation, the original sampling locations were relocated using the GPS receiver.

The site locations are recorded on the sample site briefs in Appendix A.

2.7.4 Sample Collection

Four soils samples were collected at each sample site using a cardinal sampling layout as shown below. Sampling locations were spaced approximately 15 m apart, unless site access constraints dictated otherwise. Due to the gravely nature and/or firmness of the soils in most sample locations, a stainless steel hand auger was selected to collect soil samples in place of a push-tube. Soil was collected from a sample depth ranging between 0-150 mm. At some sample locations more than one auger progression was required in order to obtain enough soil mass to fill the sample collection jar from within the top 150 mm of soil profile. Any dense root or thick leaf litter material at the surface was excluded from the sample by taking a shallow hand auger sample and discarding the unwanted surface material



The sample references used consisted of: the Main Soil Type number (the sample site letter) and the sample number. For example, the samples collected at Main Soil Type 1, sample site A was labelled 1(A)1, 1(A)2, 1(A)3 and 1(A)4. The four samples were laboratory composited and analysed accordingly.

2.7.5 Field Quality Control (QC) Samples

Field QC samples were collected during the site sampling work as follows:

- One set of duplicate soil samples was collected from each of the Main Soil Types 1, 3,4, and 5.

- Equipment rinsate blanks comprising rinse water from the hand auger were collected at one sample site in each of the Main Soil Types 1, 3, 4, 5.
- One trip blank was included with the sample containers dispatched from the laboratory, stored with the collected samples and then returned to the laboratory for analysis.

The results of the QC sample analyses are included in Section 3.

2.7.6 Sample Handling and Transport

All samples obtained were handled and transported to the laboratory in accordance with URS Field Procedures. The procedures include:

- The use of laboratory supplied containers fit for purpose, which were 350 ml glass jars with polyethylene seals.
- Use of clean nitrile gloves at each site when handling the soils.
- Prior to sampling soils at each site, the hand auger was cleaned using a scrubbing brush and a three (3) bucket potable water wash system comprising dirty rinse, Decon rinse and a final clean rinse. The hand auger was then left to air dry.
- Labelling soil samples with unique numbers.
- Storage and transport of samples in dedicated chilly bins chilled to a target nominal temperature of $4^{o}C$.
- The use of Chain of Custody documentation to provide an auditable trail of sample transport history.

The samples collected were dispatched by courier to the laboratory on the day of collection for analysis.

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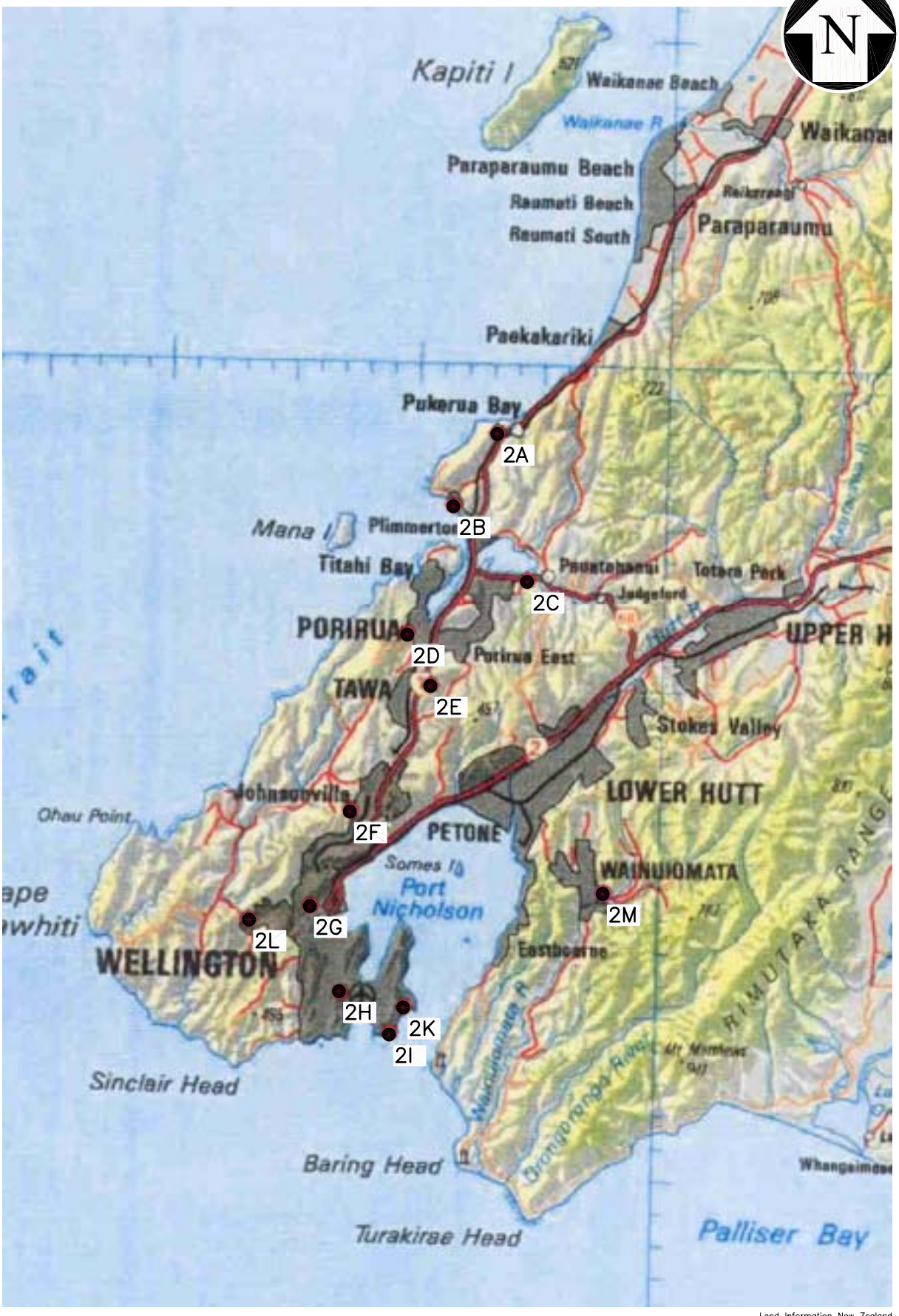

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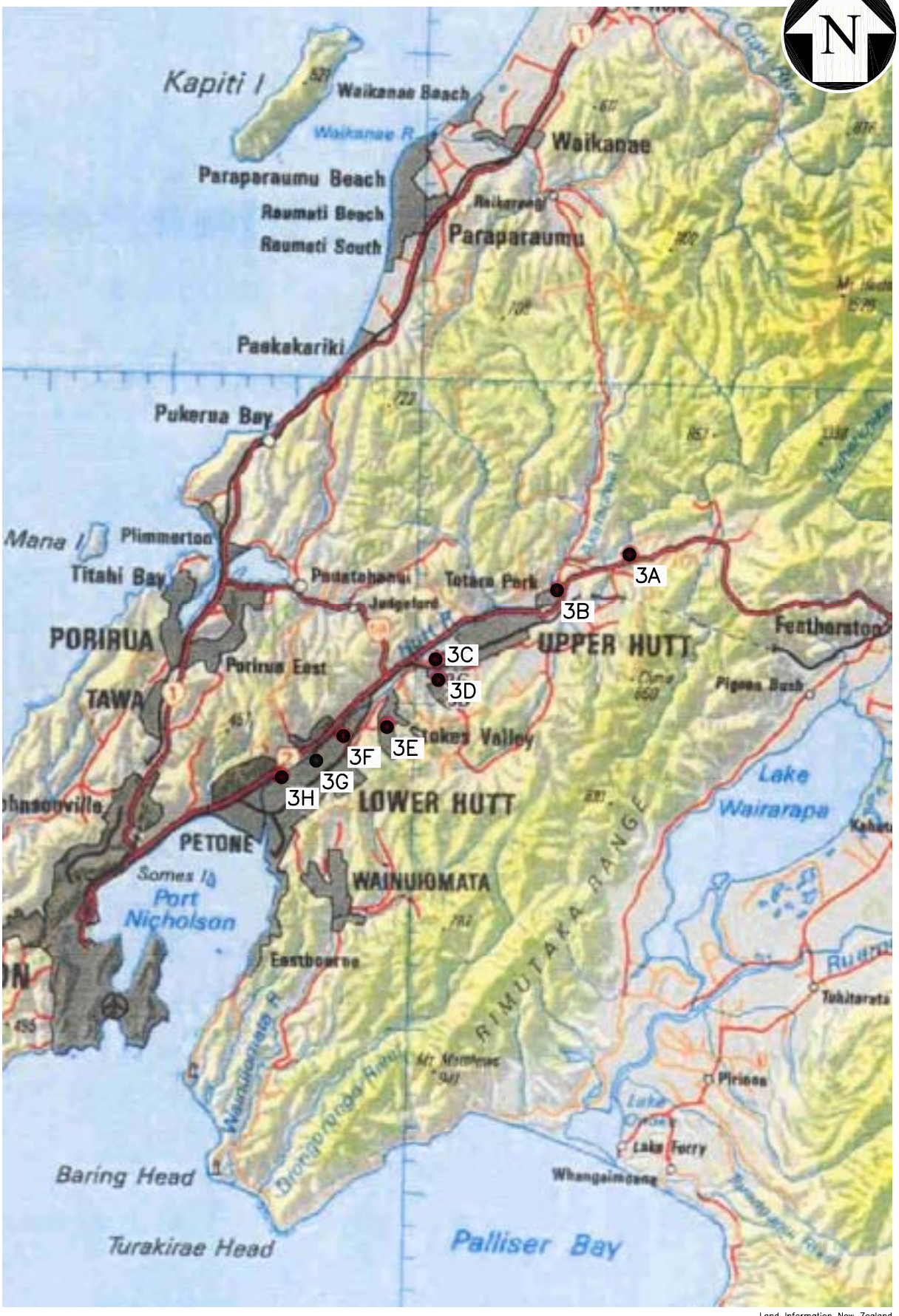
Title
MAIN SOIL TYPE 2
SITE SAMPLE LOCATIONS

Figure No. **2-2**

S:\Adv Jobs\48253\002\6400\WR002Fig2-3
Rev A 3/07/03 RB



0km 5km

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Title
MAIN SOIL TYPE 3
SITE SAMPLE LOCATIONS

Figure No. **2-3**

S:\Adv Jobs\48253\002\6400\WR002Fig2-4
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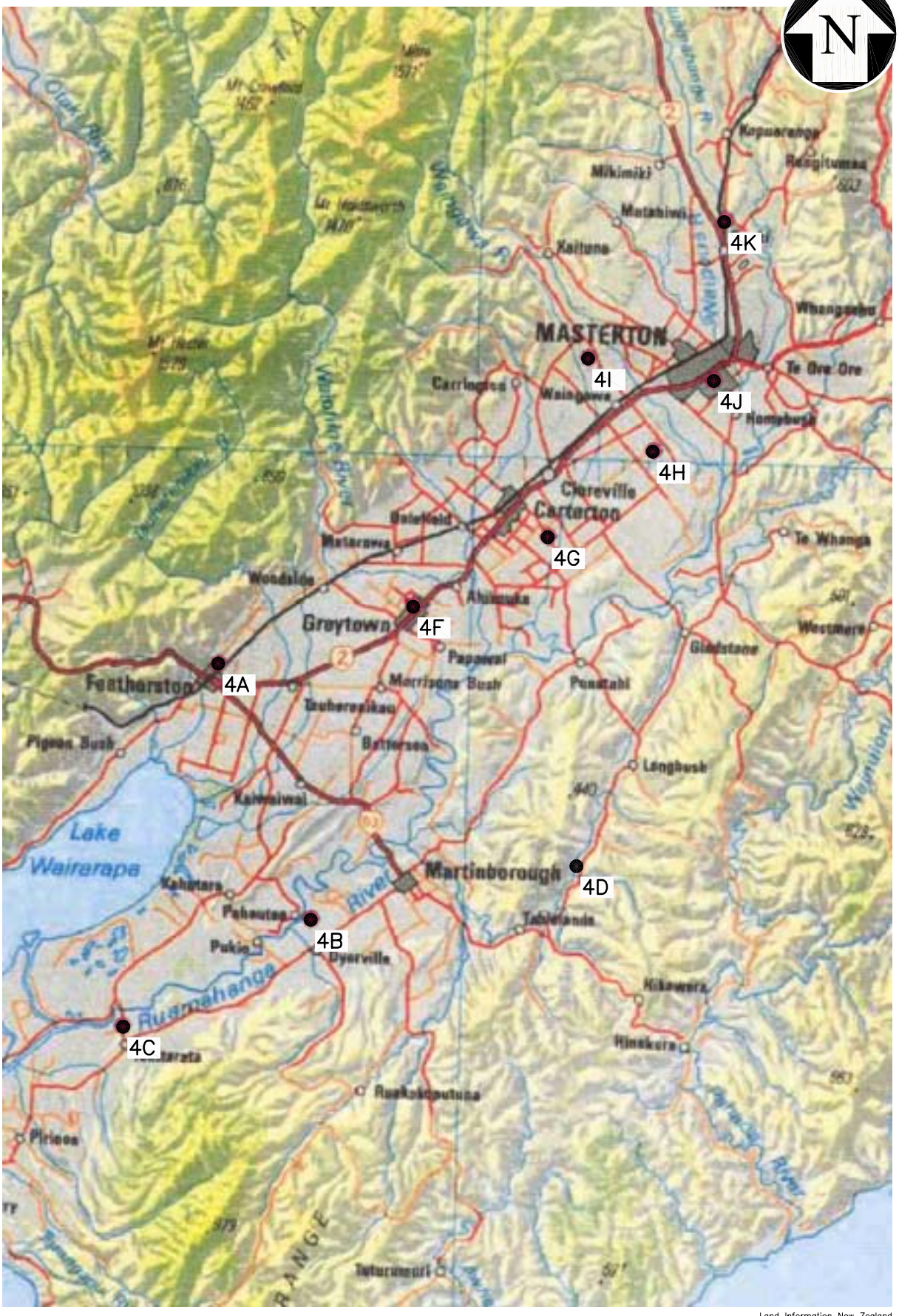

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Title
MAIN SOIL TYPE 4
SITE SAMPLE LOCATIONS

Figure No. **2-4**

S:\Adv Jobs\48253\002\6400\WR002Fig3-5
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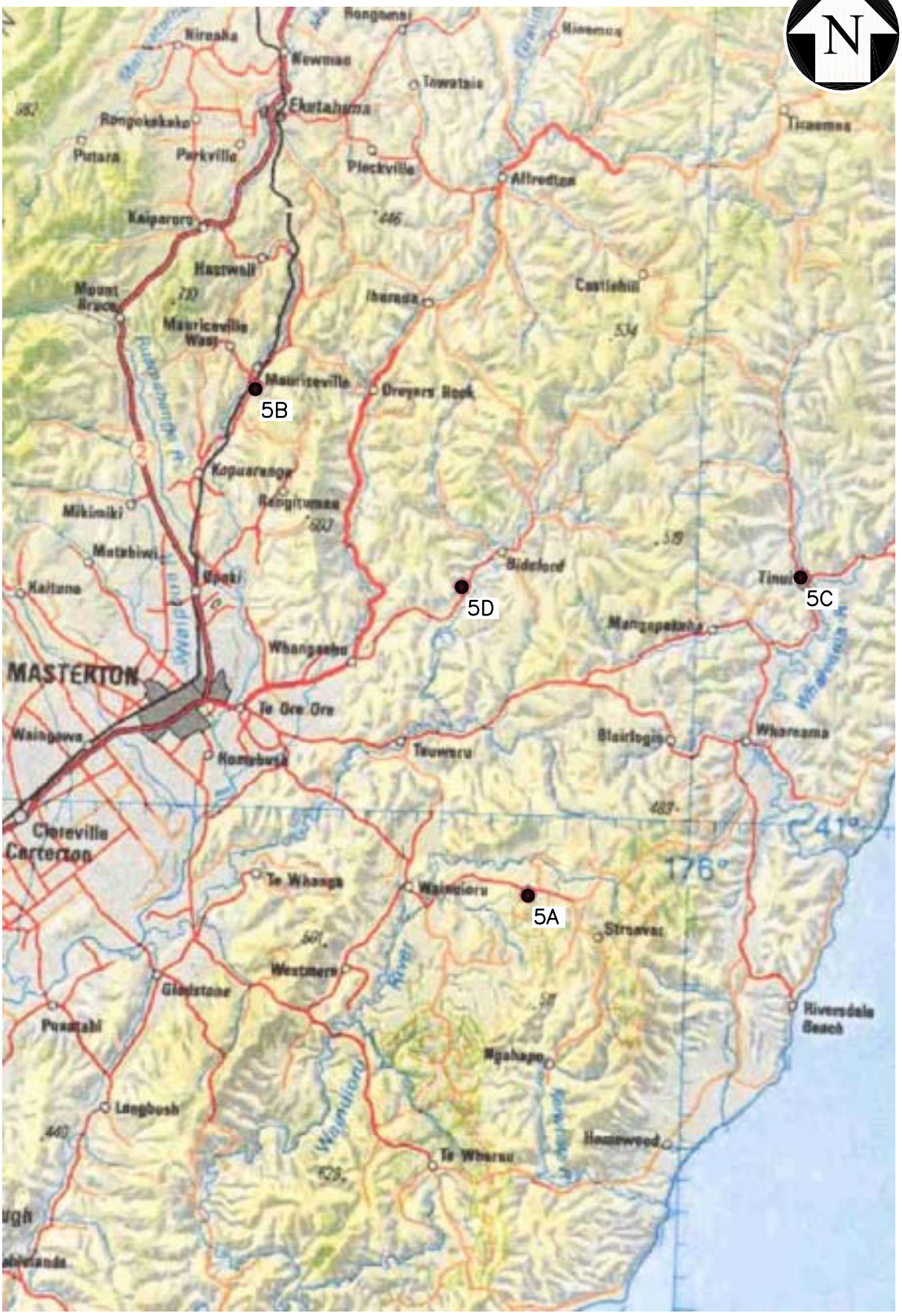

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Title
MAIN SOIL TYPE 5
SITE SAMPLE LOCATIONS

Figure No. **2-5**

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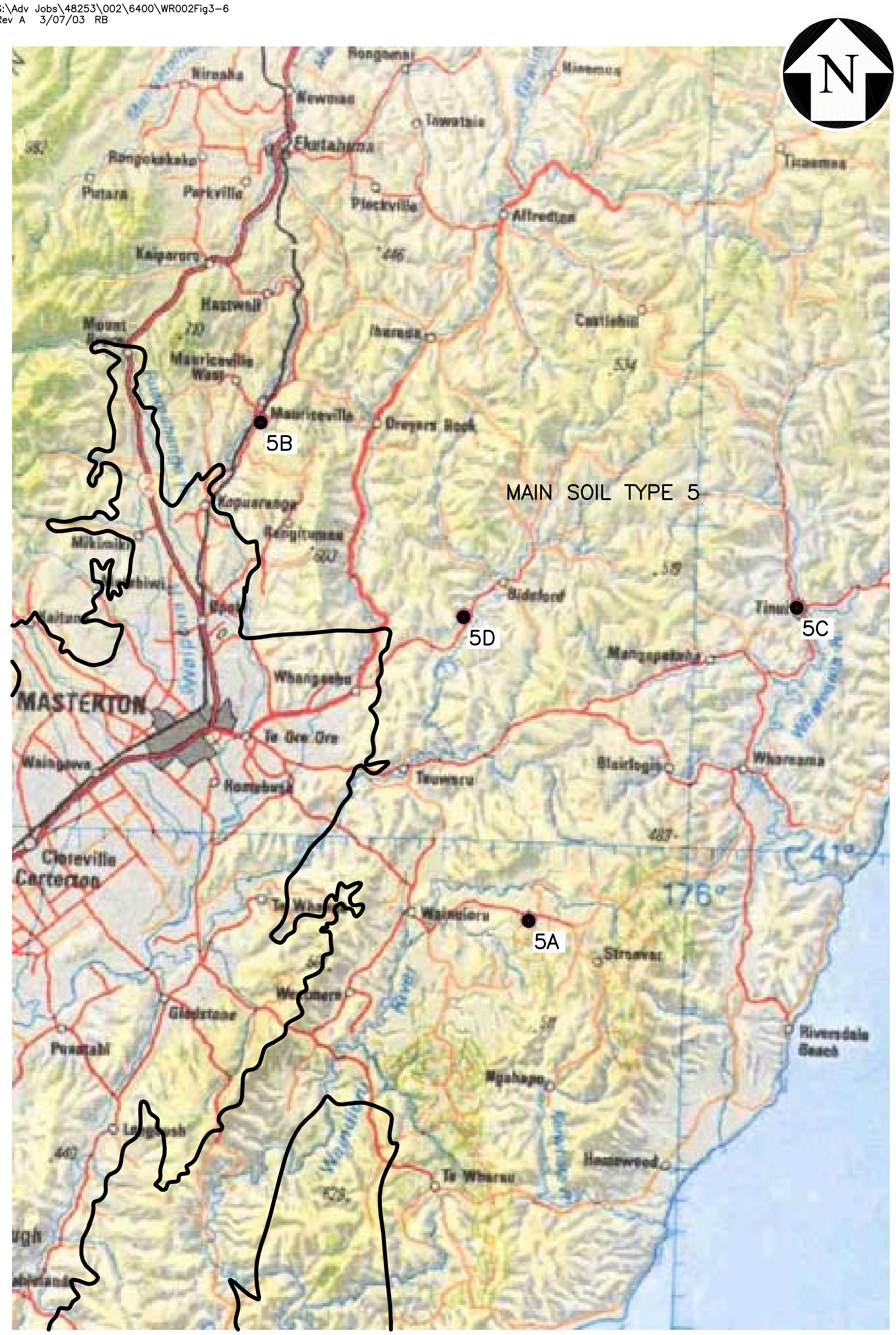
Rev A 3/07/03 RB



0km 5km
APPROXIMATE SCALE

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APPROXIMATE GEOLOGICAL BOUNDARY (AS PER NEW ZEALAND GEOLOGICAL SURVEY SHEET 12)

Title
MAIN SOIL TYPE 5
SITE SAMPLE LOCATIONS

Figure No. **2-6**

2.8 Sample Laboratory Analysis

Hill Laboratories of Hamilton provided the laboratory services used in this investigation. Hill Laboratories is an IANZ accredited laboratory.

A total of 160 samples, excluding quality control samples, were collected from 40 sampling sites. The four samples from each site were combined in the laboratory to form a single composite sample prior to analysis. The composite soil samples were analysed by relevant methods for the following analytes: arsenic (As), soluble boron (B), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), zinc (Zn), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH).

The laboratory sample preparation and analysis methodologies can be found in the laboratory reports included in Appendix C. The sample transport chain of custody forms are also included in Appendix C.

2.9 Statistical Assessment of Analytical Results

With recognition of the limitations presented by the size of the individual Main Soil Type datasets, a statistical assessment was carried out on the laboratory analysis results for each analyte to determine background concentration ranges for each Main Soil Type. The principal process for this comprised:

1. **Raw data was tabulated for each Main Soil Type.**

   Refer Appendix C.

2. **For the purposes of statistical analysis all reported non-detectable concentrations were halved. Data is referenced as evaluated data if it was subject to this action.**

   Refer Appendix D.

3. **A statistical analysis for each element within the resultant evaluated dataset was carried out to determine the form of data distributions.**

   Many statistical methods assume that datasets have a normal distribution. The ability to undertake distribution analysis of the different soil datasets is limited owing to the small statistical sample sizes for each Main Soil Type. A Shapiro-Wilkes test for normality was carried out on all datasets for each element analysed. The test indicated that none of the element datasets were normally distributed and hence nonparametric statistical methods were utilised to assess the data.

4. **A statistical analysis for each element within the resultant evaluated dataset to identify any outlier or extreme values.**

   To identify analyte concentrations that lie outside the expected distribution range (based on the total sample set) box and whisker plots were constructed (Refer Appendix D).

Please note that, in order to make the statistical data plots more user-friendly each of the Main Soil Types has been replaced by its characteristic soil type as follows.

- Main Soil Type 1 is labelled as Sandy soils.
- Main Soil Type 2 is labelled as Greywacke soils.
- Main Soil Type 3 is labelled as Hutt Alluvium.
- Main Soil Type 4 is labelled as Wairarapa Alluvium.
- Main Soil Types 5 is labelled as Mudstone/siltstone.

The median values are represented by the small central box, while the large outer box represents the 25th to 75th percentile range. The whiskers represent the 'non-outlier range', which is defined here as 1.5 times the large outer box height (i.e. the interquartile range). Values that exceed the expected distribution range are referred to as outliers and extreme values.

A data point is deemed to be an **outlier** if the following conditions hold:

Data point value > UBV + OC x (UBV - LBV)

A data point is deemed to be an **extreme** value if the following conditions hold:

Data point value > UBV + (2 x OC) x (UBV - LBV)

Where **UBV** is the upper value of the box in the box plot (i.e. the 75th percentile).

LBV is the lower value of the box in the box plot (i.e. the 25th percentile).

OC is the outlier coefficient (1.5 is used for this dataset).

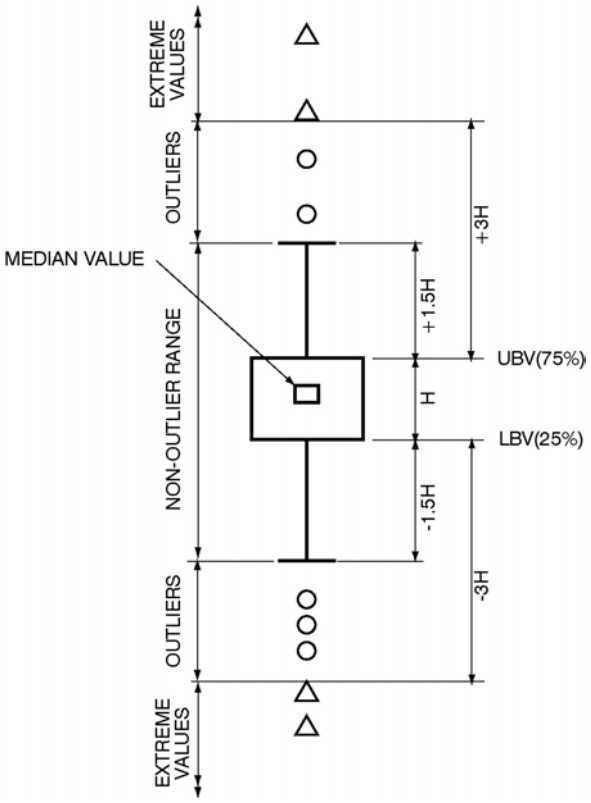
This definition of outliers and extremes, calculated using a co-efficient of 1.5 is brought about by the use of the median as the mid-point rather than the mean. If the mean was employed, the standard deviation would be used to calculate outlier and extreme values, instead of the interquartile range. Thus the value of 1.5 multiplied by the interquartile range approximates 2 standard deviations (i.e. 95%, values above which are 'outliers') and 3 multiplied by the interquartile range approximates 3 standard deviations (i.e. 99%, values above which are 'extremes'). The median is used in this investigation because of the non-normal distribution of the data, as discussed below.

Outliers and extreme values are measurements that are extremely large or small relative to the rest of the data, and may misrepresent the population from which they were collected. They may represent analytical or sampling errors, or true elevated values of a distribution (e.g. hotspots), indicating more variability in the population than was expected. Not removing true outlier and extreme values, and

removing false outlier and extreme values can lead to a distortion of estimates of population parameters.

A visual interpretation of outlier and extreme values is shown in Figure 2-7.

Figure 2-7: Definition of Outliers and Extremes



Outlier and extreme values required further investigation. It is considered good practice not to discard any data based solely on the statistical test. However, if a sound reason is found to support that the data point is in error or non-representative of background, then the value should be excluded from further analysis.

In this investigation all outliers or extreme values were assessed by reviewing the data and considering the sites surrounding environment and history (if known) and whether recent disturbances that may have interfered with background element concentrations. Ideally, the site's exhibiting outliers and extreme values should be resampled. This revalidation could indicate possible sampling or analytical error, or the presence of a 'hotspot'. However, this is beyond the scope of this investigation.

STATISTICA Version 6 software (Statsoft Inc) was used to perform the statistical analyses for this investigation and the outlier and extreme value definitions described above were also sourced from STATISTICA documentation.

5. Assessment of the validity of the identified outliers and extreme values.

All identified outliers and extreme values have been included in the datasets. Validation sampling is required to determine whether the outlier or extreme values belong in the dataset or should be excluded

The outliers and extreme values included in the data require further validation to determine whether they should be removed from the dataset. This is beyond the scope of works for this investigation and hence samples requiring validation have been tagged in Section 3.

6. Statistical analysis of the Evaluated Dataset for each element was undertaken.

As the data was not normally distributed within each of the main soil types, nonparametric statistics were used. Kruskal-Wallis ANOVAs (analysis of variance) tested for differences between the Main Soil Types. If the dataset indicated that the concentrations of a particular element were significantly different across the five Main Soil Types, then a Fisher LSD[3] test was undertaken to determine which soil types best exhibited similar concentrations. The Main Soil Types reporting similar concentrations are indicated on the Box and Whisker plots (Appendix D) by the identical symbols i.e. 'A', 'B' and 'C'. Descriptive statistics for each element within each Main Soil Type was also undertaken.

[3] Least significant difference.

3.1 Laboratory Analysis Results

A total of 40 composite soil samples were analysed for the target analytes. The individual sample laboratory analysis results are contained within the laboratory reports included in Appendix C. Tables summarising the results are also included in Appendix C.

3.2 Analyte Background Soil Concentrations Ranges

A statistical assessment was conducted on the raw laboratory analytical dataset in accordance with the methodology described in Section 2.9.

Descriptive statistics are presented for each target analyte in the following sections. The results are reported against each of the five Main Soil Type groupings and are assessed against the corresponding ANZECC guideline background levels, where applicable, for comparative purposes. Corresponding Box and Whisker Plots, Kruskal-Wallis ANOVA and Fisher LSD[4] tests are presented in Appendix D. A summary of the total target background soil concentration ranges for the Wellington Region is found in Table 3-3.

3.2.1 Soluble Boron

Descriptive statistics for soluble Boron for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.93	0.55	0.30	2.10	0.77
Main Soil Type 2	12	1.41	1.30	0.90	2.20	0.38
Main Soil Type 3	8	0.76	0.75	0.30	1.60	0.43
Main Soil Type 4	10	1.75	1.75	0.70	2.70	0.69
Main Soil Type 5	4	1.95	2.10	1.00	2.60	0.75

All soil samples yielded soluble boron concentrations at detectable concentrations.

A difference in Boron concentrations across the Main Soil Types is evident (Kruskal-Wallis test: H^5 (4, N = 40) = 14.66 p = 0.005). Boron concentrations are similar between Main Soil Types 1 and 2 and similar between Main Soil Types 4 and 5, while Main Soil Type 3 reported different boron concentrations

[4] Least significant difference

[5] H = test statistic; N = sample size; p = probability.

again (Fisher LSD test). Refer to Appendix D for the Box Plots, which graphically present the Main Soil Types with similar concentrations, denoted by an 'A', 'B' or 'C' and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

No outliers or extreme boron concentrations were identified.

Comparison of the reported boron concentrations with the ANZECC guidelines has not be undertaken, as ANZECC guidelines do not report soluble boron.

3.2.2 Arsenic

The descriptive statistics for Arsenic for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	3.67	3.50	1.00	7.00	2.16
Main Soil Type 2	12	4.58	5.00	1.00	7.00	1.83
Main Soil Type 3	8	4.75	5.00	2.00	7.00	1.75
Main Soil Type 4	10	4.20	4.00	2.00	7.00	1.69
Main Soil Type 5	4	3.25	4.00	1.00	4.00	1.50

Main Soil Type 1, 2 and 5 each reported one arsenic concentration below the analytical detection level of 2 mg/kg.

All soil types showed similar Arsenic concentrations (Kruskal-Wallis test: H (4, N = 40) = 3.33 p = 0.5048). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

No outliers or extreme arsenic concentrations were identified in the evaluated data.

All the soil groups reported concentrations that fall within the background range as specified by ANZECC (0.2 – 30 mg/kg).

3.2.3 Cadmium

Descriptive statistics for Cadmium for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.06	0.05	0.05	0.10	0.02
Main Soil Type 2	12	0.06	0.05	0.05	0.10	0.02
Main Soil Type 3	8	0.09	0.075	0.05	0.20	0.05
Main Soil Type 4	10	0.11	0.075	0.05	0.20	0.07
Main Soil Type 5	4	0.10	0.075	0.05	0.20	0.07

Main Soil Type 1 reported five non-detectable concentrations at <0.1 mg/kg and one detectable concentration at 0.1 mg/kg. Main Soil Type 2 reported ten non-detectable concentrations at <0.1 mg/kg and two detectable concentrations at 0.1 mg/kg. Main Soil Type 3 reported five non-detectable concentrations at <0.1 mg/kg, one detect at 0.1 mg/kg and one detect at 0.2 mg/kg.

All soil types showed similar Cadmium concentrations (Kruskal-Wallis test: H (4, N = 40) = 5.671 p = 0.2249). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

The evaluated data reported one extreme value for both Main Soil Type 1 and 2 and one outlier for Main Soil Type 3. The halving of non-detectable concentrations has caused the values to appear as outliers and extreme values and therefore the outliers and extreme values have not been tagged for follow-up validation sampling. All the soil groups reported concentrations that fall within the background range as specified by ANZECC (0.04 – 2 mg/kg).

3.2.4 Chromium

Descriptive statistics for Chromium for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	8.50	8.0	7.0	12.0	1.87
Main Soil Type 2	12	12.50	13.5	6.0	16.0	2.94
Main Soil Type 3	8	14.75	15.5	9.0	18.0	3.01
Main Soil Type 4	10	16.00	15.0	11.0	21.0	3.33
Main Soil Type 5	4	10.75	10.0	8.0	15.0	2.99

All chromium concentrations were reported at detectable levels.

A difference in Chromium concentrations across the Main Soil Types is evident (Kruskal-Wallis test: H (4, N = 40) = 17.30 p = 0.0017). Chromium concentrations are similar between Main Soil Types 1 and 5, Main Soil Types 2 and 3, while Main Soil Type 4 reported different chromium concentrations again (Fisher LSD test). See Appendix D for the Box Plots, which graphically present the Main Soil Types with similar concentrations, denoted by an 'A', 'B' or 'C' and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

No outliers or extreme chromium concentrations were identified.

All the soil groups reported concentrations that fall within the background range as specified by ANZECC (0.5 - 110 mg/kg).

3.2.5 Copper

Descriptive statistics for Copper for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	7.00	6.50	4.00	10.00	2.19
Main Soil Type 2	12	10.67	9.00	3.00	25.00	6.10
Main Soil Type 3	8	12.25	13.00	5.00	19.00	4.98
Main Soil Type 4	10	12.90	12.00	7.00	19.00	4.41
Main Soil Type 5	4	10.75	9.00	6.00	19.00	5.91

All copper concentrations were reported at detectable levels.

All soil types showed similar Copper concentrations (Kruskal-Wallis test: H (4, N = 40) = 7.32 p = 0.1197). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

The evaluated dataset reported one outlier for Main Soil Type 2. This outlier of the Main Soil Type 2 soils should be tagged for future validation sampling to confirm its outlier status.

All the soil groups reported copper concentrations that fall within the background range as specified by ANZECC (1 – 90 mg/kg).

3.2.6 Lead

Descriptive statistics for Lead for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	36.25	7.10	4.50	180.00	70.50
Main Soil Type 2	12	23.78	20.95	5.90	78.60	18.91
Main Soil Type 3	8	38.83	32.90	16.70	73.30	19.44
Main Soil Type 4	10	20.42	18.20	9.40	34.00	7.47
Main Soil Type 5	4	20.40	16.35	10.80	38.10	12.55

All lead concentrations were reported at detectable levels.

A difference in Lead concentrations across the Main Soil Type is evident (Kruskal-Wallis test: H (4, N = 40) = 9.79 p = 0.0442). Additionally, the Fisher LSD test did not indicate any similarities between the Main Soil Types. See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

The evaluated data reported one extreme value of 180 mg/kg for Main Soil Type 1, one extreme value of 78.6 mg/kg for Main Soil Type 2, and two outliers of 34.0 and 32.0 mg/kg for Main Soil Type 4. The outliers and extreme values listed above should be tagged for future validation sampling.

All the soil groups reported concentrations that fall within the background range as specified by ANZECC (<2 – 200 mg/kg).

3.2.7 Mercury

Descriptive statistics for Mercury for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.06	0.05	0.05	0.10	0.02
Main Soil Type 2	12	0.08	0.08	0.05	0.20	0.04
Main Soil Type 3	8	0.41	0.10	0.05	2.60	0.89
Main Soil Type 4	10	0.06	0.05	0.05	0.10	0.02
Main Soil Type 5	4	0.05	0.05	0.05	0.05	0.00

Twenty-six of the Mercury analysis results reported concentrations below the analytical detection level of 0.1 mg/kg.

A difference in Mercury concentrations across the Main Soil Types is evident (Kruskal-Wallis test: H (4, N = 40) = 11.03 p = 0.0256). Additionally, the Fisher LSD test did not indicate any similarities between the Main Soil Types. See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

The evaluated data reported one extreme value for Main Soil Type 3 at 2.6 mg/kg. Main Soil Type 1 and Main Soil Type 4 also indicated extreme values at 0.1 mg/kg and Main Soil type 2 indicated an outlier at 0.2 mg/kg. None of the latter data points were removed, as again the halving of non-detectable concentrations has caused the values to appear as outliers and extreme values. However, the extreme value of 2.6 mg/kg should be tagged for future validation sampling.

Three of the five soil groups reported mercury concentrations that fall within the background range as specified by ANZECC (0.001 – 0.1 mg/kg), while two reported concentrations exceed with 0.2 mg/kg.

3.2.8 Nickel

Descriptive statistics for Nickel for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	6.50	6.00	4.00	9.00	2.1
Main Soil Type 2	12	8.33	8.00	4.00	13.00	2.8
Main Soil Type 3	8	10.37	11.00	5.00	14.00	3.8
Main Soil Type 4	10	13.80	12.00	6.00	21.00	5.4
Main Soil Type 5	4	8.25	7.50	5.00	13.00	3.4

All nickel concentrations were reported at detectable levels.

A difference in Nickel concentrations across the Main Soil Types was evident (Kruskal-Wallis test: H (4, N = 40) = 12.54 p = 0.0137). Nickel concentrations are similar between Main Soil Types 2 and 5 and similar between Main Soil Types 3 and 4, while Main Soil Type 1 reported different Nickel concentrations (Fisher LSD test). See Appendix D for the Box Plots, which graphically present the Main Soil Types with similar concentrations, denoted by an ‘A’, ‘B’ or ‘C’ and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

No outliers or extreme nickel concentrations were identified.

All the soil groups reported concentrations that fall within the background range as specified by ANZECC (2 - 400 mg/kg).

3.2.9 Zinc

Descriptive statistics for Zinc for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	49.83	46.50	28.00	79.00	21.24
Main Soil Type 2	12	53.17	52.50	24.00	105.00	23.47
Main Soil Type 3	8	90.25	81.00	38.00	201.00	51.05
Main Soil Type 4	10	78.30	68.50	44.00	121.00	25.35
Main Soil Type 5	4	53.00	54.50	31.00	72.00	16.95

All zinc concentrations were reported at detectable levels.

A difference in Zinc concentrations across the Main Soil Types is evident (Kruskal-Wallis test: H (4, N = 40) = 10.29 p = 0.0357). Zinc concentrations are similar between Main Soil Types 1, 2 and 5, and similar between Main Soil Types 3 and 4 (Fisher LSD test). See Appendix D for the Box Plots, which graphically present the Main Soil Types with similar concentrations, denoted by an 'A', 'B' or 'C' and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

One outlier was identified within Main Soil Type 3. This data point should be tagged for validation sampling in the future.

Four of the five reported concentrations fall within the background range as specified by ANZECC guidelines (2 - 180 mg/kg).

3.2.10 TPH

Descriptive statistics for TPH for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	76.67	80.00	20.00	110.00	31.41
Main Soil Type 2	12	74.17	50.00	15.00	190.00	57.72
Main Soil Type 3	8	88.13	40.00	20.00	260.00	92.81
Main Soil Type 4	10	128.00	42.50	15.00	820.00	246.22
Main Soil Type 5	4	145.00	50.00	20.00	460.00	210.48

Fifteen of the 40 TPH analysis results reported concentrations below the analytical detection limit of 30 to 70 mg/kg.

All soil types showed similar TPH concentrations (Kruskal-Wallis test: H (4, N = 40) = 0.99 p = 0.91). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

One outlier was identified within Main Soil Type 1 of 20 mg/kg (a reported non-detect value of <40 mg/kg that has been halved for the purposes of statistical analysis) and one extreme value of 820 mg/kg was identified within Main Soil Type 4. The extreme value data point of 820 mg/kg should be tagged for validation sampling in the future.

Further review of the reported $C_7 – C_{44}$ carbon bands as reported by the laboratory primarily indicates non-detectable or negligible $C_7 – C_{25}$ hydrocarbons, while most of the heavy ends have all reported detectable concentrations. Sample analysis chromatograms are attached in Appendix C.

TPH concentrations are not included in the ANZECC guidelines.

3.2.11 PAH

Only the PAH determinants most commonly assessed in environmental investigations have been statistically analysed and reported below. Raw data for a wider set of PAH can be found in the appended laboratory reports.

Anthracene

Descriptive statistics for Anthracene for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0026	0.0004	0.0004	0.0130	0.0051
Main Soil Type 2	12	0.0059	0.0007	0.0004	0.0481	0.0136
Main Soil Type 3	8	0.0098	0.0041	0.0009	0.0362	0.0134
Main Soil Type 4	10	0.0094	0.0010	0.0004	0.0456	0.0177
Main Soil Type 5	4	0.0006	0.0005	0.0004	0.0009	0.0002

Seventeen of the 40 Anthracene analysis results reported concentrations below the analytical detection limit of 0.0007 to 0.0009 mg/kg.

All soil types showed similar Anthracene concentrations (Kruskal-Wallis test: H (4, N = 40) = 7.47 p = 0.1129). See Appendix E for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

Four extreme values were identified within Main Soil Types 1, 2 and 4, and one outlier also reported for Main Soil Type 2. These values should be tagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported anthracene concentrations as only Total PAH values are given.

Benzo[a]pyrene

Descriptive statistics for Benzo[a]pyrene for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0140	0.0012	0.0004	0.0779	0.0313
Main Soil Type 2	12	0.0323	0.0052	0.0004	0.2700	0.0763
Main Soil Type 3	8	0.0723	0.0148	0.0048	0.3280	0.1129
Main Soil Type 4	10	0.0562	0.0038	0.0004	0.1313	0.1141
Main Soil Type 5	4	0.0021	0.0013	0.0004	0.0054	0.0023

Seven of the 40 Benzo[a]pyrene analysis results reported concentrations below the analytical detection limit of 0.0008 to 0.001 mg/kg.

A difference in Benzo[a]pyrene concentrations between all Main Soil types was shown (Kruskal-Wallis test: H (4, N = 40) = 10.10 p = 0.0387). Additionally, the Fisher LSD test did not indicate any similarities. See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

Four extreme values were identified within Main Soil Types 1, 2 and 3, and one outlier was also reported for Main Soil Type 3. These values should be tagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported benzo[a]pyrene concentrations as only Total PAH values are given.

Pyrene

Descriptive statistics for Pyrene for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min (mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0220	0.0021	0.0004	0.1220	0.0490
Main Soil Type 2	12	0.0673	0.0108	0.0012	0.5740	0.1631
Main Soil Type 3	8	0.1147	0.0289	0.0083	0.4610	0.1610
Main Soil Type 4	10	0.0899	0.0125	0.0004	0.5950	0.1898
Main Soil Type 5	4	0.0076	0.0076	0.0005	0.0146	0.0058

Three of the forty pyrene analysis results reported concentrations below the analytical detection limit of 0.0008 to 0.0009 mg/kg.

All soil types showed similar Pyrene concentrations (Kruskal-Wallis test: H (4, N = 40) = 9.22 p = 0.0558). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

Five extreme values were identified within Main Soil Types 1, 2 and 4, and one outlier was also reported for Main Soil Type 3. These values should be tagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported pyrene concentrations as only Total PAH values are given.

Fluoranthene

Descriptive statistics for fluoranthene for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0247	0.0028	0.0004	0.1360	0.0546
Main Soil Type 2	12	0.0655	0.0111	0.0013	0.5470	0.1555
Main Soil Type 3	8	0.1039	0.0255	0.0071	0.3860	0.1424
Main Soil Type 4	10	0.0859	0.0103	0.0004	0.5680	0.1812
Main Soil Type 5	4	0.0058	0.0041	0.0005	0.0147	0.0064

Three of the 40 fluoranthene analysis results reported concentrations below the analytical detection limit of 0.0008 to 0.0009 mg/kg.

All soil types showed similar Fluoranthene concentrations (Kruskal-Wallis test: H (4, N = 40) = 8.63 p = 0.0711). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

Five extreme values were identified within Main Soil Types 1, 2 and 4and these values should be tagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported fluoranthene concentrations as only Total PAH values are given.

Naphthalene

The results of the statistical assessment of the naphthalene analytical results for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0060	0.0060	0.0020	0.0100	0.0036
Main Soil Type 2	12	0.0029	0.0020	0.0020	0.0120	0.0029
Main Soil Type 3	8	0.0045	0.0020	0.0020	0.0120	0.0038
Main Soil Type 4	10	0.0038	0.0020	0.0020	0.0190	0.0053
Main Soil Type 5	4	0.0020	0.0020	0.0020	0.0020	0.0000

Thirty-two of the 40 naphthalene analysis results reported concentrations below the analytical detection limit of 0.004 to 0.005 mg/kg.

All soil types showed similar Naphthalene concentrations (Kruskal-Wallis test: H (4, N = 40) = 5.90 p = 0.2068). See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test calculations.

Five extreme values were identified within Main Soil Types 2 and 4and these values should be flagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported naphthalene concentrations as only Total PAH values are given.

Phenanthrene

Descriptive statistics for phenanthrene for each Main Soil Type are:

Area	Number of Samples	Mean (mg/kg)	Median (mg/kg)	Min mg/kg)	Max (mg/kg)	Std. Dev. (mg/kg)
Main Soil Type 1	6	0.0113	0.0004	0.0004	0.0660	0.0268
Main Soil Type 2	12	0.0326	0.0029	0.0004	0.2570	0.0753
Main Soil Type 3	8	0.0418	0.0240	0.0049	0.1180	0.0470
Main Soil Type 4	10	0.0489	0.0084	0.0004	0.3500	0.1077
Main Soil Type 5	4	0.0024	0.0010	0.0004	0.0073	0.0033

Ten of the 40 phenanthrene analysis results reported concentrations below the analytical detection limit of 0.0007 to 0.0009 mg/kg.

Phenanthrene concentrations are significantly different between all Main Soil Types (Kruskal-Wallis test: H (4, N = 40) = 12.04 p = 0.0171). Additionally, the Fisher LSD test did not indicate any similarities between the Main Soil types. See Appendix D for the Box Plots, which graphically present the Main Soil Types and the appropriate Kruskal-Wallis test and Fisher LSD test calculations.

Four extreme values were identified within Main Soil Types 1, 2 and 4and these values should be tagged for validation sampling in the future.

No comparison with the ANZECC guidelines has been made for reported phenanthrene concentrations as only Total PAH values are given.

3.3 QC Sample Analysis Results

Laboratory analysis of the field QC samples yielded results indicating that the sample collection techniques had achieved a satisfactory level of consistency and cross-contamination control.

The Relative Percent Difference (RPD) between the duplicates has been calculated and is shown in Table 3-1. This provides an indication of the accuracy, precision and representativeness of the data. Generally, RPD values of between 30% and 50% are acceptable. The RPD can be expected to be higher for organic analyses than for inorganic analyses. The PAH analysis results are also expected to give higher RPD values owing to their very low detection levels and the number of significant figures used in their reported results. The reported soil duplicate samples for PAH are assessed to be acceptable.

The equipment rinsate and trip blanks yielded results at least one order of magnitude below the concentration levels detected in the soil analyses (Table 3-2).

Table 3 - 1 : QC Analytical Results and Duplicate Calculated Relative Percent Difference (RPD)

Sample ID	1(A)	1(A2)	RPD %	3(F)	3(F2)	RPD %	4(F)	4(F2)	RPD%	5(B)	5(B2)	RPD%
Location	Forest Lakes	Duplicate		Fraser Park, Lower Hutt	Duplicate		Solider Memorial Park, Greytown	Duplicate		Clarke Memorial, Mauriceville	Duplicate	
Landuse	Private Bush	Private Bush		Public Reserve	Public Reserve		Public Bush Reserve	Public Bush Reserve		Public Bush Reserve	Public Bush Reserve	
Lab No	313773 / 30	313773 / 34		314144 / 47	314144 / 48		314571 / 52	314571 / 53		314688/29	314688/30	
Units	mg/kg	mg/kg		mg/kg	mg/kg		mg/kg	mg/kg		mg/kg	mg/kg	
Date	9/06/03	9/06/03		37785	37785		37793	37793		37792	37792	
Soluble Boron	2.1	2	10	0.4	0.3	29	2.7	2.8	4	1	1.1	10
Total Recoverable As	< 2	< 2	NA	5	5	0	7	7	0	4	3	29
Total Recoverable Cd	< 0.1	< 0.1	NA	< 0.1	< 0.1	NA	0.1	0.1	0	0.1	0.1	0
Total Recoverable Cr	7	7	0	16	17	6	20	20	0	15	15	0
Total Recoverable Cu	6	6.00	0	13	13	0	18	18	0	11	9	20
Total Recoverable Hg	< 0.1	< 0.1	NA	0.1	0.1	0	0.1	0.1	0	< 0.1	0.1	NA
Total Recoverable Ni	4	4	0	13	13	0	20	20	0	13	12	8
Total Recoverable Pb	5.7	5.3	7	33.1	31.6	5	32	31.3	2	20.5	20.2	1
Total Recoverable Zn	38	31	20	73	72	1	121	125	-3	52	52	0
TPH (C7 - C44)	<40	60	NA	100	120	18	60	<40	NA	50	<40	NA
Acenaphthene	0.001	< 0.0008	NA	< 0.0007	< 0.0008	NA	0.001	< 0.0009	NA	< 0.0009	< 0.0009	NA
Acenaphthylene	< 0.0008	< 0.0008	NA	0.002	0.0018	11	0.0023	0.0009	88	< 0.0009	< 0.0009	NA
Anthracene	< 0.0008	< 0.0008	NA	0.0009	< 0.0008	NA	0.003	0.0024	22	< 0.0009	0.001	NA
Benzo[a]anthracene	0.0017	0.0009	62	0.0032	0.0024	29	0.0071	0.0092	-26	0.0024	0.0051	-72
Benzo[a]pyrene (BAP)	0.0027	0.0018	40	0.0049	0.0039	23	0.007	0.0132	-61	0.0022	0.0041	-60
Benzo[b]fluoranthene	0.0042	0.003	33	0.0082	0.0065	23	0.0205	0.0342	-50	0.0074	0.0094	-24
Benzo[g,h,i]perylene	0.0016	0.0013	21	0.0052	0.0046	12	0.0067	0.0146	-74	0.0041	0.0048	-16
Benzo[k]fluoranthene	0.0015	0.0009	50	0.0027	0.0021	25	0.0052	0.01	-63	0.0029	0.0029	0
Chrysene	0.0055	0.0042	27	0.0056	0.0064	-13	0.0153	0.0183	-18	0.003	0.004	-29
Dibenzo[a,h]anthracene	< 0.0008	< 0.0008	NA	0.0016	0.0011	37	0.0018	0.0038	-71	< 0.0009	0.0009	NA
Fluoranthene	0.0047	0.0022	72	0.0071	0.0062	14	0.0277	0.0236	16	0.0061	0.0088	-36
Fluorene	0.0011	< 0.0008	NA	< 0.0007	< 0.0008	NA	0.0036	0.0044	-20	< 0.0009	< 0.0009	NA
Indeno(1,2,3-c,d)pyrene	0.0024	0.0017	34	0.0053	0.0043	21	0.005	0.0117	-80	0.0031	0.004	-25
Naphthalene	< 0.004	< 0.004	NA	< 0.004	< 0.004	NA	< 0.004	< 0.004	NA	< 0.004	< 0.004	NA
Phenanthrene	< 0.0008	< 0.0008	NA	0.0049	0.0048	2	0.032	0.034	-6	0.0016	0.0024	-40
Pyrene	0.0044	0.0021	71	0.0083	0.0072	14	0.0217	0.0287	-28	0.0068	0.0101	-39

Table: 3 - 2: Rinsate and Trip Blank Analytical Results

	Main Soil Type 1	Main Soil Type 2	Main Soil Type 4			Main Soil Type 5
Sample ID	EB1	3(1)+3(2)	4(1)	4(2)	4(3)	5(1)
Location	Equipment Blank	Equipment Blank	Equipment Blank	Equipment Blank	Trip Blank	Equipment Blank
Landuse	QA/QC	QA/QC	QA/QC	QA/QC	QA/QC	QA/QC
Lab No	313773 / 1	314144/1	314571 / 1	314571 / 2	314571 / 3	314688 / 1
Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Date	6/9/03	6/12/03	6/21/03	6/21/03	6/21/03	6/23/03
Soluble Boron	0.012	Not reported	-	0.02	-	0.033
Total Recoverable As	< 0.001	< 0.001	-	< 0.001	-	< 0.001
Total Recoverable Cd	0.00006	0.00005	-	0.00007	-	0.0001
Total Recoverable Cr	< 0.0005	< 0.0005	-	< 0.0005	-	< 0.0005
Total Recoverable Cu	0.0492	0.0961	-	0.0301	-	0.0491
Total Recoverable Hg	< 0.00008	< 0.00008	-	< 0.00008	-	< 0.00008
Total Recoverable Ni	< 0.0005	0.0009	-	< 0.0005	-	< 0.0005
Total Recoverable Pb	0.0002	0.0021	-	0.0015	-	0.0021
Total Recoverable Zn	0.011	0.008	-	0.011	-	0.037
TPH (C7 - C44)	< 0.2	<0.2	<0.2	<0.2	<0.3	0.4

File Reference: RPD_QAQC-B.xls\Final RPD Table

3.4 General Observations

The following general observations were made during the results assessment:

- The background concentration ranges determined for the Wellington Region are at expected levels and fit within the ANZECC Guideline background concentration ranges.
- The majority of the sample sites comprised public and private bush reserves, with the remaining sites consisting of pastoral farmlands and recreational parklands.
- An assessment of the sample site soil profiles indicated that all the sample site soils were consistent with their Main Soil Type and could be included in the dataset. The soil profiles for each site are included in Appendix A.
- Of the 40 sample sites assessed in this investigation the following sites had analytical results that had an above average number of outlier or extreme values.
  - Paekakariki Domain in Main Soil Type 1.
  - Southern Walkway in Main Soil Type 2.
  - Masterton Reserve in Main Soil Type 4.

3.5 Summary of Background Concentration Ranges

This investigation has established a dataset of surface soil background concentration ranges for targeted analytes within five (5) Main Soil Types in the Wellington Region.

The analytes targeted were: arsenic (As), soluble boron (B), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), zinc (Zn), total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAH).

The background concentration ranges for each Main Soil type and analyte are summarised in Table 3-3.

Table 3 - 3: Target Analyte Background Soil Concentration Ranges for the Wellington Region

Element	Detection Level	Main Soil Type 1 (Sand)	Main Soil Type 2 (Greywacke)	Main Soil Type 3 (Hutt Alluvium)	Main Soil Type 4 (Wairarapa Alluvium)	Main Soil type 5 (Mudstone/Siltstone)
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Soluble Boron	3	0.3 - 2.1	0.9 - 2.2	0.3 - 1.6	0.7 - 2.7	1 - 2.6
Arsenic	2	<2 - 7	<2 - 7	2 - 7	2 - 7	<2 - 4
Cadmium	0.1	<0.1 - 0.1	<0.1 - 0.1	<0.1 - 0.2	<0.1 - 0.2	<0.1 - 0.2
Chromium	1	7 - 12	6 - 16	9 - 18	11- 21	8 - 15
Copper	1	4 - 10	3 - 25	5 - 19	7 - 19	6 - 19
Mercury	0.1	<0.1 - 0.10	<0.1 - 0.2	<0.1 - 2.6	<0.1 - 0.1	<0.1- 0.1
Nickel	1	4 - 9	4 - 13	5.0 - 14	6 - 21	5 - 13
Lead	1	4.5 - 180.0	5.9 – 78.6	16.7 - 73.3	9.4 - 34	10.8 - 38.1
Zinc	1	28 - 79	24 - 105	38 - 201	44 - 121	31 - 72
TPH (C_7 - C_{44})	8 - 60	<40 - 110	<30 - 190	<40 - 260	<30 - 820	<40 - 460
Anthracene	0.002 - 0.005	<0.002 - 0.01	<0.002 - 0.05	<0.002 - 0.04	<0.002 - 0.05	< 0.002 - 0.01
Benzo[a]pyrene	0.002 - 0.005	<0.002 - 0.08	<0.002 - 0.27	0.004 - 0.33	<0.002 - 0.31	<0.002 - 0.01
Fluoranthene	0.002 - 0.005	<0.002 - 0.14	<0.002 - 0.55	0.0071 - 0.39	<0.002 - 0.57	<0.002 - 0.02
Naphthalene	0.002 - 0.005	<0.002 - 0.01	<0.002 - 0.01	<0.002 - 0.01	<0.002 - 0.02	<0.004
Phenanthene	0.002 - 0.005	<0.002 - 0.07	<0.002 - 0.26	0.005 - 0.12	<0.002 - 0.35	<0.002 - 0.01
Pyrene	0.002 - 0.005	<0.002 - 0.12	<0.002 - 0.57	0.008 - 0.46	<0.002 - 0.60	<0.002 - 0.02

Appendix A
Sample Site Brief

1(A) Forest Lakes, Otaki

Soil Type	Rahui silt loam
GPS Coordinates	E2693316, N6050840 5.5 m accuracy (in bush, 3D GPS)
Site Sample Location	Approximately 15 m from driveway, on bank covered with mature trees, and native ferns. Sample location immediately before fenced of bush area, and not far from horse stable.
Site Location	Forest Lakes Camp Forest Lakes Rd OTAKI
Contact Name	Grant Crighton Manager (06) 364-8218
Classification	Mottled Orthic Brown Soil
Land Use	Private bush reserve
Present Vegetation	Large mature canopy, over a cover of dense native ferns, kawakawa
Land Use History	Loess derived from greywacke
Land Form	Terrace
Elevation (a msl)	26.9 m
Parent Material	Loess derived from greywacke
Date Sampled	9 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC 01-17

Description:	0 – 1 cm, dark brown (4/2) leaf litter and organic matter, distinct boundary. 1 – 11 cm, dark brown (10YR3/3) silt loam, slightly sticky, slightly plastic, weak soil strength, apedal earthy, common fine roots, very few medium roots, wavy boundary. 11 – 30 cm, light olive brown (2.5Y5/4) silty clay loam, few bright yellowish brown mottles, slightly sticky, slightly plastic, firm soil strength, weak pedality.
Oil Industry Guidelines:	Sandy Silt.

Pit to 30 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

1(B) Otaki Reserve, Otaki

Soil Type	Foxton sand
GPS Coordinates	E 2688193, N 6048996 4.4 m accuracy (3D GPS)
Site Sample Location	Within sand dunes
Site Location	Marine Parade OTAKI
Contact Name	Mike Cardiff Kapiti Coast District Council (04) 298-5139
Classification	Typic brown sandy soils
Land Use	Public bush reserve
Present Vegetation	Grasses, small woody scrub, some large pines
Land Use History	Reserve
Land Form	Inland dunes
Elevation	2.4 m asl
Parent Material	Coastal wind blown sand.
Date Sampled	9 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 50 cm, dark greyish fine sand.
Oil Industry Guidelines:	Sand

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

1(C) Private Reserve, Te Horo

Soil Type	Te Horo silt loam
GPS Coordinates	E 2690367, N 6041712 4.3 m accuracy (on exiting bush)
Site Sample Location	In fenced off bush on Richardson's property, Hautere Cross Rd, past Te Horo School, opposite dairy number 45850
Site Location	Hautere Cross Rd
Contact Name	Tom Richardson (06) 364-2100 027-488-8967
Classification	Mottled Orthic Brown Soil
Land Use	Private bush reserve
Present Vegetation	Indigenous forest
Land Use History	Private bush reserve
Land Form	Terrace
Elevation	36.9 m asl
Parent Material	Fine textured greywacke alluvium on deep alluvial gravels
Date Sampled	9 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, dark brown (10YR4/2) leaf litter, thick mat of roots, distinct boundary. 3 –8 cm, dark brown (10YR4/2) silt loam, many medium roots, strong pedality, indistinct boundary. 8 – 30 cm, yellowish brown (10YR5/4) clay loam, strong pedality, abundant fine – medium gravels (6 – 20 mm).
Oil Industry Guidelines:	Sandy silt/silty clay

Pit to 30 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

1(D) Nga Manu Nature Reserve, Waikanae

Soil Type	Waikanae sandy loam
GPS Coordinates	E 2683494, N 6035918 5.2 m accuracy (3D GPS)
Site Sample Location	Top clearing (#8), within native bush
Site Location	Nga Manu Nature Reserve Ngarara Rd WAIKANAE
Contact Name	Bruce Benseman Manager (06) 293-4131
Classification	Typic fluvial recent soil
Land Use	Private bush reserve
Present Vegetation	Indigenous forest
Land Use History	Indigenous forest, not regenerating, 400 year old forest
Land Form	Alluvial flats, flat to gently undulating
Elevation	11.4 m asl
Parent Material	Alluvium
Date Sampled	9 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 8 cm, olive brown (2.5YR4/3) fine loamy sand, common very fine - fine roots, wavy boundary. 8 – 50 cm, olive brown (2.5YR4/6) fine sand, common fine roots.
Oil Industry Guidelines:	Sand.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

1(E) Mazengarb Reserve, Paraparaumu

Soil Type	Foxton sand
GPS Coordinates	E 2678896, N 6032679 4.4 m accuracy
Site Sample Location	On raised hill, near the rear of the park
Site Location	Mazengarb Rd PARAPARAUMU
Contact Name	Mike Cardiff Kapiti Coast District Council (04) 298-5139
Classification	Typic sandy brown soil
Land Use	Public reserve
Present Vegetation	Grasses
Land Use History	No determined
Land Form	Inland rolling sand dunes
Elevation	8.8 m asl
Parent Material	Coastal wind blown sands
Date Sampled	10 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 2 cm, brownish black (2.5YR3/1) fine loamy sand, few very few roots, distinct boundary. 2 – 50 cm, yellowish brown (2.5YR3/1) fine loamy sand, few fine roots.
Oil Industry Guidelines:	Sand

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

1(F) Paekakariki Domain, Paekakariki

Soil Type	Foxton sand
GPS Coordinates	E 2673699, N 6021395 4.7 m accuracy
Site Sample Location	On seaward side of domain
Site Location	Paekakariki Domain Ames St PAEKAKARIKI
Contact Name	Mike Cardiff Kapiti Coast District Council (04) 298-5139
Classification	Typic sandy brown soil
Land Use	Public reserve
Present Vegetation	Grassed, few manuka, some toi-toi
Land Use History	Not determined
Land Form	Inland rolling sand dunes
Elevation	20.4 m asl
Parent Material	Coastal wind blown sands
Date Sampled	10 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 4 cm, dark brown (2.5YR3/1) fine loamy sandy, many fine roots, distinct boundary. 4 – 50 cm, yellowish brown (2.5YR5/3) fine loamy sand, very few shells.
Oil Industry Guidelines:	Sand

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(A) Raroa Reserve, Pukeura Bay

Soil Type	Terawhiti steepland soils
GPS Coordinates	E 2668419, N 6017581 7.3 m accuracy (in bush, 3D GPS)
Site Sample Location	Approximately 5 min walk into reserve
Site Location	Raroa Reserve Raroa Place PUKERUA BAY
Contact Name	Stuart Kilmister Porirua City Council (04) 237-5089
Classification	Typic immature pallic soils
Land Use	Public bush reserve
Present Vegetation	Kanuka, five-finger, seven-finger, some grass, pine, kawakawa, lancewood, coprosma
Land Use History	Not determined
Land Form	Steepland
Elevation	76.0 m asl
Parent Material	Greywacke and greywacke scree
Date Sampled	Carmen Sulzberger
Sampled By	3 June 2003
Previous WRC Sampling Location	No

Description:	0 – 4 cm, brownish black (7.5YR2/2) sandy loam, moderately sticky, moderately plastic, moderate pedality, very few medium roots. 4 – 50 cm, greyish yellow brown (10YR4/2) loamy silt, slightly sticky, slightly plastic, few fine – medium gravels, moderate pedality.
Oil Industry Guidelines:	Sandy silt/sand

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(B) Reserve, Plimmerton

Soil Type	Paramata hill soils
GPS Coordinates	E 2665924, N6013544 4.6 m accuracy (3D GPS)
Site Sample Location	Down steep bank, off driveway.
Site Location	Gordon Rd PLIMMERTON
Contact Name	Stuart Kilmister Porirua City Council (04) 237-5089
Classification	Mottled fragic pallic soils
Land Use	Public bush reserve
Present Vegetation	Kanuka, kawakawa, five finger, matai, silver beech, pine, mapou, mahoe, various native ferns
Land Use History	Not determined
Land Form	Hilly and steepland
Elevation	45.1 m asl
Parent Material	Loess and drift from weathered greywacke on greywacke
Date Sampled	3 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 50 cm, dull yellowish brown (10YR5/3) silt loam, moderately sticky, moderately plastic, moderate pedality, very few medium and course roots.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(C) Samwell Drive Reserve, Whitby

Soil Type	Korokoro hill soils
GPS Coordinates	E 2670141, N 6009156 5.1 m accuracy (3D GPS)
Site Sample Location	Down bank, off road
Site Location	Samwell Drive Reserve Samwell Drive WHITBY
Contact Name	Stuart Kilmister Porirua City Council (04) 237-5089
Classification	Typic firm brown soils
Land Use	Public bush reserve
Present Vegetation	Kanuka, pine, rimu, kawkawa, silver beech, kohekohe, mahoe, various native ferns
Land Use History	Not determined
Land Form	Moderately steep to steep slopes of ridges
Elevation	48.5 m asl
Parent Material	Greywacke drift on weathered greywacke
Date Sampled	3 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 10 cm, leaf litter and organic matter, moist, distinct boundary. 10 – 50 cm, dull yellowish brown (10YR5/3) silt loam, moderately sticky, very plastic, many soil fragments, moderate pedality, firm soil strength.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(D) Porirua Scenic Reserve, Porirua

Soil Type	Makara steepland soils
GPS Coordinates	E 2663318, N 6006173 10.7 m accuracy (in bush, 3D GPS)
Site Sample Location	Approximately 5 min walk into reserve
Site Location	Porirua Scenic Reserve Raiha St PORIRUA
Contact Name	Stuart Kilmister Porirua City Council (04) 237-5089
Classification	Typic Orthic brown soils
Land Use	Public bush reserve
Present Vegetation	Tawa, kohekohe, mahoe, mapou, lancewood, kawakawa, rangiora, kohuhu
Land Use History	Not determined
Land Form	Steep and very steep slopes
Elevation	77.4 m asl
Parent Material	Weathered greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, thick leaf litter and black (10YR2/1) organic matter, abundant roots, distinct boundary. 3 – 50 cm, greyish yellow (10YR5/2) silt loam, fine to medium roots, abundant fine to coarse gravels, apedal earthy, irregular boundary.
Oil Industry Guidelines:	Sandy silt.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(E) Wilf Mexted Scenic Reserve, Tawa

Soil Type	Korokoro hill soils
GPS Coordinates	E 2664613, N 6003158 9.5 m accuracy (in bush, 2D GPS)
Site Sample Location	Up bank, just inside the start of the walkway
Site Location	Wilf Mexted Scenic Reserve Collins Ave TAWA
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Typic firm brown soils
Land Use	Public bush reserve
Present Vegetation	Tawa, kohekohe, mahoe, mapou, lancewood, kawakawa, rangiora, kohuhu
Land Use History	Not determined
Land Form	Moderately steep to steep slopes of ridges
Elevation	69.3 m asl
Parent Material	Greywacke drift on weathered greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 10 cm, thick leaf litter and black (10YR2/1) organic matter, abundant roots, distinct boundary. 10 – 50 cm, dully yellowish brown (10YR5/4) silt loam, worm mixing, few roots, soil strength firm, moderately sticky, moderately plastic, moderately pedal.
Oil Industry Guidelines:	Sandy silt.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(F) Johnsonville Park, Johnsonville

Soil Type	Makara steepland soils
GPS Coordinates	E 2660090, N 5996083 13.0 m accuracy (in bush, 3D GP)
Site Sample Location	Up bank, just inside start of walkway
Site Location	Johnsonville Park
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Typic Orthic brown soils
Land Use	Public bush reserve
Present Vegetation	Tawa, kohekohe, mahoe, mapou, lancewood, kawakawa, rangiora, kohuhu
Land Use History	Not determined
Land Form	Steep and very steep slopes, sharp ridge crests
Elevation	208.3 m asl
Parent Material	Weathered greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 4 cm, leaf litter, common roots, few medium to large gravels, distinct boundary. 4 – 5.5 cm, black (10 YR2/1) organic matter, few fine roots, diffuse boundary. 5.5 – 25 cm, dull yellowish brown (10YR5/4) silt loam, many fine to medium roots, few fine to medium gravels, apedal earthy, moderately sticky, moderately plastic, diffuse boundary. 25 – 50 cm, dull yellow orange (10YR6/4) loamy silt, many fine gravels, very few medium gravels, moderately sticky, moderately plastic.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(G) Town Belt Northern Walkway, Wellington

Soil Type	Korokoro hill soils
GPS Coordinates	E 2657784, N 5990701 14.2 m accuracy (in bush, 3D GPS)
Site Sample Location	Down bank, just inside start of walkway
Site Location	Town Belt Northern Walkway Orangi Kaupapa St Northland WELLINGTON
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Typic firm brown soils
Land Use	Public bush reserve
Present Vegetation	Kawakawa, cabbage tree, flax, coprosma, various ferns
Land Use History	Not determined
Land Form	Rounded ridges and easy rolling valley sides
Elevation	221.2 m asl
Parent Material	Greywacke drift on weathered greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 1 cm, leaf litter, common roots, very few mosses, distinct boundary. 1 – 20 cm, dull yellow orange (10 YR6/3) loamy silt, few dark brown (10YR3/3) mottles, soil strength firm, moderately sticky, very plastic, apedal earthy. 20 – 50 cm, brown (10YR4/4) silt loam, soil strength firm, moderate pedality, slightly sticky, moderately plastic.
Oil Industry Guidelines:	Sandy silt

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(H) Town Belt Southern Walkway, Wellington

Soil Type	Paramata hill soils
GPS Coordinates	E 2659533, N 5985845 9.7 m accuracy (in bush, 3D GPS))
Site Sample Location	Up bank, just inside walkway entrance
Site Location	Town Belt Southern Walkway Manchester St Berhampore WELLINGTON
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Fragic pallic soils
Land Use	Public bush reserve
Present Vegetation	Kawakawa, beech, five-finger, various native ferns, pine
Land Use History	Not determined
Land Form	Rounded ridges and hill slopes
Elevation	69.7 m asl
Parent Material	Loess and drift from weathered greywacke on greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 6 cm, thick leaf litter and dark brown (10YR4/3) organic matter, distinct boundary. 6 – 23 cm, dark brown (10YR4/3) loamy silt, abundant fine to coarse gravel, few fine roots, slightly sticky, slightly plastic, apedal earthy, indistinct boundary. 23 – 50 cm, dark olive brown (2.5Y3/3) loamy silt, slightly sticky, slightly plastic, few large roots, many fine to coarse gravel, apedal earthy.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(I) Rangitatau Reserve, Wellington

Soil Type	Paramata hill soil
GPS Coordinates	E2662291, N 5983528 5.0 m accuracy (3D GPS)
Site Sample Location	Up bank, approximately 100 m from start of walkway
Site Location	Rangitatau Reserve Moa Point Rd Breaker Bay WELLINGTON
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Fragic pallic soils
Land Use	Public reserve
Present Vegetation	Coastal forest
Land Use History	Not determined
Land Form	Rounded ridges and hill slopes
Elevation	13.6 m asl
Parent Material	Loess and drift from weathered greywacke on greywacke
Date Sampled	4 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

No soil pit excavated. Soils are a firm silt loam.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(K) Town Belt Eastern Walkway, Wellington

Soil Type	Makara steepland soils
GPS Coordinates	E2663106, N5984955 10.9 m accuracy (in bush, 3D GPS)
Site Sample Location	Up hill, approximately 200 m from start of walkway
Site Location	Town Belt Eastern Walkway Beacon Hill Rd Seatoun WELLINGTON
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Typic orthic brown soils
Land Use	Public reserve
Present Vegetation	Pine and regenerating native bush (beech, five-finger, coprosma, various native ferns
Land Use History	Not determined
Land Form	Steep and very steep slopes below 300m
Elevation	113.2 m asl
Parent Material	Weathered greywacke
Date Sampled	5 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, leaf litter and black (10YR2/1) organic matter, distinct boundary. 3 – 18 cm, olive brown (2.5YR4/3) loamy silt, profuse fine gravels, many medium gravels, slightly sticky, slightly plastic, apedal earthy. 18 – 50 cm, dull yellow (2.5YR6/3) silt loam, moderately sticky, slightly plastic, moderate pedality, firm soil strength, abundant fine gravels, few coarse gravels.
Oil Industry Guidelines	Sandy silt.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(L) Karori Park, Wellington

Soil Type	Makara steepland soils
GPS Coordinates	E 2654329, N 5989932 12.2 m accuracy (in bush, 3D GPS)
Site Sample Location	Bush reserve at northern end
Site Location	Karori Park Karori Rd Karori WELLINGTON
Contact Name	Joanna Gillanders Wellington City Council (04) 499-4444
Classification	Typic orthic brown soils
Land Use	Public bush reserve
Present Vegetation	Indigenous forest
Land Use History	Not determined
Land Form	Steep and very steep slopes
Elevation	129.3 m asl
Parent Material	Weathered greywacke
Date Sampled	5 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, leaf litter and organic matter. 3 – 20 cm, brown (10YR4/4) silt loam, moderately plastic, slightly sticky, firm soil strength, moderately pedality, occluded boundary. 20 – 40 cm, dull yellowish brown (10YR5/4), moderately sticky, slightly plastic, apedal earthy.
Oil Industry Guidelines:	Sandy silt.

Pit to 40 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

2(M) Wainuiomata Scenic Reserve, Wainuiomata

Soil Type	Tawai steepland soils
GPS Coordinates	Lost satellite reception (in bush)
Site Sample Location	Approximately 300 m from start of walkway
Site Location	Wainuiomata Scenic Reserve Hair St WAINUIOMATA
Contact Name	Derrick Field Hutt City Council (04) 570-6666
Classification	Typic yellow ultic soils
Land Use	Public bush reserve
Present Vegetation	Tawa, kohekohe, mahoe, mapou, lancewood, kawakawa, rangiora, kohuhu, cabbage trees, various native ferns
Land Use History	Not determined
Land Form	Steep and very steep slopes east of the Hutt Valley
Elevation	Not determined
Parent Material	Colluvial debris from deeply weathered graywacke
Date Sampled	13 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 40 cm, dull yellowish brown (10YR4/3)silt loam slightly sticky, very plastic, apedal earthy.
Oil Industry Guidelines:	Sandy silt.

Pit to 40 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(A) Kaitoke Regional Park, Upper Hutt

Soil Type	Heretaunga stony silt loam
GPS Coordinates	E 2689853, N 6011332 4.6 m accuracy (on exiting bush, 3D GPS)
Site Sample Location	In fenced off bush reserve
Site Location	Main Road North Te Marua UPPER HUTT
Contact Name	
Classification	Typic firm brown soils
Land Use	Bush reserve
Present Vegetation	Kanuka, mapou, totara, koromiko, lemon wood, mahoe, various native ferns
Land Use History	Not determined
Land Form	Alluvial terraces above level of flooding
Elevation	116.4 m asl
Parent Material	Alluvium with stones and boulders
Date Sampled	12 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, leaf litter and abundant gross (>200 ml) gravels. 0 – 10 cm, dark brown (10YR3/3) silt loam, abundant fine roots and few medium roots, abundant fine to large gravels, slightly sticky and slightly plastic, apedal earthy.
Oil Industry Guidelines:	Sandy silt.

Pit to 10 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(B) Harcourt Park, Upper Hutt

Soil Type	Heretaunga stony silt loam
GPS Coordinates	E 2685745, N 6009343 4.7 m accuracy (3D GPS)
Site Sample Location	In middle of fenced of native bush, by club rooms and footbridge over Hutt River to Totara Park.
Site Location	Harcout Park Norbert St Brown Owl UPPER HUTT
Contact Name	Brett Latimer Upper Hutt City Council (04) 528-8769
Classification	Typic firm brown soils
Land Use	Fenced off bush reserve
Present Vegetation	Rimu, black beech, kanuka, cabbage trees, five-finger, kawakawa, maupou, karamu, koromiko, various native ferns
Land Use History	Not determined
Land Form	Alluvial terraces above the level of flooding
Elevation	83.0 m asl
Parent Material	Alluvium with stones and boulders
Date Sampled	12 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 10 cm, brown (7.5YR4/3) silt loam, slightly sticky, moderately plastic, many fine roots, moderate pedality, polyhedral to blocky fragments, firm soil strength, diffuse boundary. 10 – 45 cm, dull brown (7.5YR5/3) silt loam, moderately sticky, very plastic, moderate pedality, polyhedral to blocky fragments, very firm soil strength.
Oil Industry Guidelines:	Sandy silt

Pit to 45 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(C) Heretaunga Park, Upper Hutt

Soil Type	Waikanae silt loam
GPS Coordinates	E 2678958, N 6005304 4.5 m accuracy (3D GPS)
Site Sample Location	Along fence line between sports ground and St Patrick's College
Site Location	Heretaunga Park Kiwi St UPPER HUTT
Contact Name	Brett Latimer Upper Hutt City Council (04) 528-8769
Classification	Typic fluvial recent soils
Land Use	Recreation and sports ground
Present Vegetation	Grass
Land Use History	Not determined
Land Form	Alluvial floats, flat to gently undulating
Elevation	38.4 m asl
Parent Material	Alluvium
Date Sampled	12 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, dull brown (7.5YR5/4) silt loam, moderately sticky, very plastic, many fine roots, moderate pedality, crumb to polyhedral structure. 3 – 50 cm, brown(7.5YR4/3) silt loam, apeadal earthy, fine to large gravels, moderately sticky, moderately plastic.
Oil Industry Guidelines:	Sandy silt

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(D) Willow Park, Silverstream

Soil Type	Heretaunga stony silt loam
GPS Coordinates	E 2679050, N 6004151 5.2 m accuracy (3D GPS)
Site Sample Location	Within park area
Site Location	Willow Park Whitemans Rd Silverstream UPPER HUTT
Contact Name	Brett Latimer Upper Hutt City Council (04) 528-8769
Classification	Typic firm brown soils
Land Use	Public park
Present Vegetation	Willows, grass
Land Use History	Not determined
Land Form	Alluvial terrace above flooding level
Elevation	68.0 m asl
Parent Material	Alluvium with stones and boulders
Date Sampled	12 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 40 cm, brown (7.5YR4/3) loamy silt, crumb to blocky structure, moist, very few fine and medium roots, slightly sticky and slightly plastic. 40 –50 cm, dull brown (7.5YR5/4) silt loam, moderately sticky, moderately plastic, very few mottles.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(E) Delaney Park, Stokes Valley

Soil Type	Heretaunga mottled silt loam
GPS Coordinates	E 2676223, N 6001557 4.7 m accuracy (3D GPS)
Site Sample Location	Within park
Site Location	Stokes Valley Road Stokes Valley UPPER HUTT
Contact Name	Brett Latimer Upper Hutt City Council (04) 528-8769
Classification	Typic firm brown soils
Land Use	Public reserve
Present Vegetation	Mature trees, grasses
Land Use History	Not determined
Land Form	Alluvial terraces above level of flooding
Elevation	48.6 m asl
Parent Material	Alluvium
Date Sampled	13 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 35 cm, brown (7.5YR4/3) silt loam, few fine to medium roots, occluded boundary. 35 –50 cm, dull yellow orange (10YR6/3) clay loam, moderately sticky, moderately plastic, apedal earthy.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(F) Fraser Park, Lower Hutt

Soil Type	Waikanae silt loam
GPS Coordinates	E 2673688, N 6000997 5.6 m accuracy (3D GPS)
Site Sample Location	Within mature trees
Site Location	Fraser Park Cnr Reynolds Rd and Taita Drive LOWER HUTT
Contact Name	Bruce Hodgins Hutt City Council (04) 570-6666
Classification	Typic fluvial recent soils
Land Use	Public recreation park
Present Vegetation	Mature trees
Land Use History	Not determined
Land Form	Alluvial flats, flat to gently undulating
Elevation	20.8 m asl
Parent Material	Alluvium
Date Sampled	13 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 5 cm, dull brown (7.5YR5/3) silt loam, slightly sticky, moderately plastic, many fine and medium roots, apedal earthy. 5 – 30 cm, brown (7.5YR4/3) silt loam, abundant fine to large gravels.
Oil Industry Guidelines:	Sandy silt

Pit to 30 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(G) Hutt River Bank, Lower Hutt

Soil Type	Waikanae silt loam
GPS Coordinates	E 2672252, N 5999937 4.4 m accuracy (3D GPS)
Site Sample Location	Hutt River Bank walkway
Site Location	Harcourt Werry Drive Avalon UPPER HUTT
Contact Name	Bruce Hodgins Hutt City Council (04) 570-6666
Classification	Typic fluvial recent soils
Land Use	Public land reserve
Present Vegetation	Grasses, mature trees
Land Use History	Not determined
Land Form	Alluvial flats, flat to gently undulating
Elevation	8.8 m asl
Parent Material	Alluvium
Date Sampled	13 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 20 cm, brown (7.5YR4/3) loamy silt, abundant medium to coarse gravel, common fine roots, slightly sticky, slightly plastic, apedal earthy.
Oil Industry Guidelines:	Sandy silt

Pit to 20 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

3(H) Ewan Park, Lower Hutt

Soil Type	Waikanae silt loam
GPS Coordinates	E 2670209, N 5998668 4.1 m accuracy (3D GPS)
Site Sample Location	
Site Location	Melling Rd LOWER HUTT
Contact Name	Bruce Hodgins Hutt City Council (04) 570-6666
Classification	Typic fluvial recent soils
Land Use	Public reserve
Present Vegetation	Grasses, few mature trees
Land Use History	Not determined
Land Form	Alluvial flats, flat to gently undulating
Elevation	4.2 m asl
Parent Material	Alluvium
Date Sampled	15 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 18 cm, brown (7.5YR4/3) silt loam, slightly sticky, moderately plastic, abundant fine roots, apedal earthy. 18 – 30 cm, dull brown (7.5YR5/4) loamy silt, few fine roots, profuse fine to coarse gravels.
Oil Industry Guidelines:	Sandy silt.

Pit to 30 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Soils of Wellington, John Bruce and Interim report on soils of Wellington Region, New Zealand, NZ Soil Bureau Record 39, 1975.

4**(A) Featherston Reserve, Featherston**

Soil Type	Tauherenikau silt loam
GPS Coordinates	E 2705713, N 6008372 6.8 m accuracy (on exiting bush, 3D GPS)
Site Sample Location	Approximately 200 m from start of bushwalk.
Site Location	Underhill Rd FEATHERSTON
Contact Name	Raivi Manger South Wairararpa District Council (06) 306-9611
Classification	Not determined
Land Use	Public bush reserve
Present Vegetation	Native forest
Land Use History	Not determined
Land Form	River terraces and fans
Elevation	56.3 m asl
Parent Material	Alluvium
Date Sampled	17 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 2 cm, thick leaf litter. 2 – 12 cm, dark brown (10YR2/2) gravely silt loam, slightly sticky, slightly plastic, weak soil strength, friable, strong pedality, abundant roots, distinct boundary. 12 – 17 cm, light olive brown (2.5Y5/4) fine sandy gravels. 17 – 40 cm, greyish brown (2.5Y5/2) sandy silt loam, sticky, plastic, abundant small to medium gravels.
Oil Industry Guidelines:	Sandy silt

Photos attached.

Equipment blank and trip bank collected.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(B) Halford Farm, Martinborough

Soil Series	Martinborough silt loam
GPS Coordinates	E 2710858, N 5993856* 4.7 m accuracy (3D GPS)
Site Sample Location	End of drive, past house, sheep shed and cattle yard
Site Location	Halford Farm 2578B Mahaki Rd MARTINBOROUGH
Contact Name	Toby Sutherland (06) 306-9177
Classification	Mottled Immature Pallic Soil
Land Use	Pastoral beef and sheep, some spraying and cropping, long time pasture
Present Vegetation	Kawakawa, five-finger, various native ferns
Land Use History	Not determined
Land Form	Flood plain
Elevation	11.1 m asl
Parent Material	Alluvium, Loess
Date Sampled	18 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC01-2

Description:	0 – 20 cm, very dark greyish brown (10YR3/2) loamy silt, slightly sticky, non-plastic, weak soil strength, earthy, many fine and very fine roots, distinct smooth boundary. 20 – 50 cm, olive (5Y6/3) loamy silt, slightly sticky, slightly plastic, weak pedality, common fine and very fine roots.
Oil Industry Guidelines:	Sandy silt.

*GPS batteries low.
Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(C) DOC Reserve, Kahutara Rd, South Wairarapa

Soil Series	Ahikouka silt loam
GPS Coordinates	E 2700159, N 5987756 (on exiting bush, 3D GPS) 4.6 m accuracy
Site Sample Location	Just inside of bush due to density
Site Location	2337 Kahutara Rd SOUTH WAIRARAPA (20 km SSE of)
Contact Name	Derek Field Department of Conservation, Masterton (06) 377-0700
Classification	Typic Recent Gley Soil
Land Use	Native bush reserve
Present Vegetation	800 year old native bush
Land Use History	Not determined
Land Form	Low terrace
Elevation	4.0 m asl
Parent Material	Fine textured greywacke alluvium on deep alluvium
Date Sampled	18 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC 00_14

No pit dug. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(D) Spring Rock, Martinborough

Soil Series	Bideford silt loam*
GPS Coordinates	E 2725214, N 5995660 ** 12 m accuracy
Site Sample Location	Down road from homestead, enter property at Spring Rock vineyard, drive up gravel road to growing vines, around vines to fenced off bush reserve at back
Site Location	Spring Rock 2847 Martinborough - Longbush Rd MARTINBOROUGH
Contact Name	Rod Cameron (06) 372-7647
Classification	Typci Perch-gley Pallic Soil
Land Use	Private native bush reserve
Present Vegetation	Totara, cabbage trees, manuka, various native ferns.
Land Use History	Not determined
Land Form	Valley side
Elevation	60 m asl**
Parent Material	Colluvium for loess, sandstone and limestone
Date Sampled	18 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC01-1

Description:	0 – 14 cm, dark grey (10YR3/1) silt loam, slightly sticky, slightly plastic, weak soil strength, apedal earthy, many fine and very fine roots, indistinct boundary. 14 – 50 cm, dark greyish brown (2.5Y4/2) silt loam, slightly sticky, slightly plastic, weak soil strength, common medium roots.
Oil Industry Guidelines:	Sandy silt.

* The steep valley side is associated with Bideford soil set, which normally occurs on terraces.

** WRC waypoint as no reading taken by URS.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(F) Solider Memorial Park, Greytown

Soil Type	
GPS Coordinates	E 2716675, N 6011743 5.9 m accuracy (on exiting bush, 3D GPS)
Site Sample Location	At back of the park enter bush via gate beside tennis court
Site Location	Kuratawhiti St GREYTOWN
Contact Name	Allison Weirry Carterton District Council (06) 379-6626
Classification	Not determined
Land Use	Native bush reserve
Present Vegetation	Totara, kowhai, tikoki, mati, rimu, kahitkatea, kawakawa, various native ferns
Land Use History	Native bush reserve since 1928
Land Form	Terraces and fans
Elevation	54.6 m asl
Parent Material	Alluvium
Date Sampled	17 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 3 cm, thick leaf litter. 3 – 50 cm, dark brown silt loam, many medium roots and very few large roots. Very few fine roots, firm soil strength, moderate pedality, blocky structure.
Oil Industry Guidelines:	Sandy silt.

Photos attached.
Duplicate soil samples collected.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(G) 157 Park Rd, Caterton

Soil Series	Moroa silt loam
GPS Coordinates	E 2724256, N 6015573 6.3 m accuracy (3D GPS)
Site Sample Location	Approximately 100 m from house
Site Location	157 Park Rd CARTERTON
Contact Name	Greg Herrick (06) 379-7745
Classification	Mottled Immature Pallic Soil
Land Use	Dry stock (sheep)
Present Vegetation	Grasses
Land Use History	In dry stock for a very long time
Land Form	Terrace
Elevation	65.7 m asl
Parent Material	Loess
Date Sampled	18 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC01-12

Description:	0 – 32 cm, dark greyish brown (10YR4/2) silt loam, slightly sticky, slightly plastic, weak soil strength, abundant fine roots, few orange mottles increasing with depth, apedal earthy. 32 – 50 cm, olive brown (2.5Y4/4) clay loam, abundant orange mottles, sticky, plastic, firm soil strength, moderately pedal.
Oil Industry Guidelines.	Sandy silt/silty clay

Photos attached - note incorrect soil pit id shown in photograph.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(H) 34 Perry Rd, Carterton

Soil Series	Kokotau silt loam
GPS Coordinates	E 2730351, N 6020452 (on exit of bush, 3D GPS) 5.5 m accuracy
Site Sample Location	Approximately 100 m from entrance of bush
Site Location	34 Perry Rd CARTERON
Contact Name	Peter & Annette King (06) 370-8201
Classification	Argillic Perch-Gley Pallic Soil
Land Use	Private bush reserve
Present Vegetation	Totara, kowhai, tikoki, mati, rimu, kahitkatea, kawakawa, various native ferns, cabbage trees
Land Use History	Not determined
Land Form	Terrace
Elevation	112.0 m asl
Parent Material	Alluvium
Date Sampled	18 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WrC00-20

Description:	0 – 2 cm, leaf litter. 2 – 13 cm, dark brown (10YR3/3) silt loam, strong pedality, with common medium and fine polyhedral peds, common fine roots, diffuse boundary. 13 – 30 cm, yellowish brown (10YR5/4) silt loam, weak soil strength, strong pedality, with common medium and fine polyhedral peds, common fine roots.
Oil Industry Guidelines:	Sandy silt.

Pit to 30 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(I) Norfolk Rd, Masterton

Soil Series	Tauherenikau silt loam
GPS Coordinates	E 2726608, N 6025759 4.6 m accuracy (3D GPS)
Site Sample Location	Approximately 300 m from house
Site Location	131 Norkfolk Rd MASTERTON
Contact Name	Allan Williams (06) 377-5918
Classification	Typic Argillic Pallic Soil
Land Use	Dry stock (sheep)
Present Vegetation	Grasses
Land Use History	Pasture for 20 years or more
Land Form	Terrace
Elevation	146.4 m asl
Parent Material	Loess
Date Sampled	19 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	WRC01-9

Description:	0 – 11 cm, very dark brown (10YR2/2) gravely silt loam, slightly sticky, slightly plastic, many fine roots, abundant fine to very coarse gravels.
Oil Industry Guidelines:	Sandy silt.

Pit to 11 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(J) Reserve, Masterton

Soil Type	Greytown silt loam
GPS Coordinates	E 2733666, N 6024462 5.5 m accuracy (3D GPS)
Site Sample Location	Approximately 100 m into bush from road, across small stream
Site Location	Cnr McKenna & Hogg Sts MASTERTON
Contact Name	Roseanne Haynes Masterton District Council (06) 378-9666
Classification	Not determined.
Land Use	Public bush reserve
Present Vegetation	Totara, various native ferns, monkey puzzle, five-finger, cabbage trees
Land Use History	Not determined
Land Form	Terrace
Elevation	101.6 m asl
Parent Material	Loess
Date Sampled	19 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 2 cm, thick leaf litter. 2 – 50 cm, dark greyish silt loam.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

4(K) Mel Parkinson Reserve, Opaki

Soil Type	Greytown silt loam
GPS Coordinates	E 2734392, N 6033652 5.0 m accuracy (3D GPS)
Site Sample Location	Within bush reserve
Site Location	Cnr Opaki - Kaiparoro & Bluff Rancitumau Rd OPAKI
Contact Name	Roseanne Haynes Masterton District Council (06) 378-9666
Classification	
Land Use	Public bush reserve
Present Vegetation	Cabbage trees, manuka, kowhai, five-finger, totara, pine
Land Use History	Bush reserve since 1970
Land Form	Terrace
Elevation	159.2 m asl
Parent Material	Loess
Date Sampled	20 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 2 cm, black silt loam, few fine roots, abundant medium gravels, distinct boundary. 2 – 20 cm, dull brown silt loam abundant fine to large gravels, few medium roots.
Oil Industry Guidelines:	Sandy silt.

Pit to 20 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

5(A) Ngaumu Forest, Stronvar

Soil Type	Not determined
GPS Coordinates	E 2753130, N 6014667 6.0 m accuracy (on exiting forest, 3D GPS)
Site Sample Location	In bush, approximately 50 m from forest boundary and 500m past forest headquarters
Site Location	Juken Nissho Ltd Ngaumu Forest Masterton – Stronvar Rd
Contact Name	Kushler Forestry Group Juken Nissho Ltd MASTERTON (06) 377-4944
Classification	Not determined
Land Use	Mature forest
Present Vegetation	Pine, undergrowth consists of manuka and kawakawa
Land Use History	Not determined
Land Form	Undulating, rolling and hilly land
Elevation	265.6 m asl
Parent Material	Sandstone and siltstone
Date Sampled	20 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Pit to 11 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

5(B) Clarke Memorial, Mauriceville

Soil Type	Not determined
GPS Coordinates	E 2737749, N 6043343 5.9 m accuracy (3D GPS)
Site Sample Location	Just before rail over-bridge into Mauriceville and approximately 200 m into reserve down bank
Site Location	Clarke Memorial Opaki – Kaiparoro Rd MAURICEVILLE
Contact Name	Roseanne Haynes Masterton District Council (06) 378-9666
Classification	Not determined
Land Use	Public recreation reserve
Present Vegetation	Grasses, various mature trees
Land Use History	Public reserve since 1955
Land Form	Undulating, rolling and hilly land
Elevation	210.2 m asl
Parent Material	Mudstone and siltstone
Date Sampled	20 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Description:	0 – 25 cm, brown silt loam, soft, some fine roots very few gravels. 05 – 50 cm, yellow brown silt loam, very few gravels, some yellow mottles.
Oil Industry Guidelines:	Sandy silt.

Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

5(C) Public Reserve, Tinui

Soil Type	Not determined
GPS Coordinates	E 2768611, N 6032684 6.8 m accuracy (3D GPS)
Site Sample Location	Playground area behind grass tennis courts
Site Location	Manawa Rd off Masterton – Castlepoint Rd TINUI
Contact Name	Roseanne Haynes Masterton District Council (06) 378-9666
Classification	Not determined
Land Use	Public Reserve and grass tennis courts
Present Vegetation	Not determined
Land Use History	Not determined
Land Form	Undulating, rolling and hilly land
Elevation	39.1 m asl
Parent Material	Mudstone and siltstone
Date Sampled	20 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

No pit excavated. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

5(D) Thistle Top Bush Reserve, Masterton

Soil Type	Not determined
GPS Coordinates	E 2749406, N 6032133 5.9 m accuracy (on exiting bush, 3D GPS)
Site Sample Location	Very large beef farm, native bush reserve is approximately 2.5 km up the road from Thistle Top homestead, bush is directly opposite property No. 1650 and before Canaga Park No. 1665, park vehicle on road at about No. 1650 and cross 3 paddocks in order to access bush
Site Location	Thistle Top 1423 & 1427 Te Ore Ore – Biddeford Rd MASTERTON
Contact Name	Thistle Top 1423 & 1427 Rd MASTERTON
Classification	Not determined
Land Use	Private native bush reserve
Present Vegetation	Indigenous forest
Land Use History	Not determined
Land Form	Undulating, rolling and hilly land
Elevation	153.0 m asl
Parent Material	Mudstone and siltstone
Date Sampled	20 June 2003
Sampled By	Carmen Sulzberger
Previous WRC Sampling Location	No

Pit to 11 cm bgl - pit could not be advanced. Photos attached.

Soils classified in conjunction with Interim report on soils of Wairarapa Valley, New Zealand, NZ Soil Bureau Record 40, 1975.

Appendix B
Soil Sample Plans

Soil Sampling Plan

Main Soil Type 1 (Wellington)

Greater Wellington Regional Council Background Soil Survey

6 June 2003

Project No:	48253-002.
Client Contact:	Bruce Croucher, Contaminated Sites Officer, Resource Investigations, Greater Wellington Regional Council.
Sampling Objectives:	To determine background concentrations of selected metals and petroleum hydrocarbons in 5 main soil types identified within the Wellington region, from areas reasonably unaffected by recent human activity. This includes statistical evaluation of the data to produce a representative set of background concentrations in which Greater Wellington Regional Council can utilise as generic screening concentrations for potential contamination.
Sampling Sites:	Sampling locations identified in the Main Soil Type 1 (Coastal and Terrace Soils North of Paekakariki, which mostly comprise Brown Soils associated with the Holocene dune sand and flood plain, estuarine and beach deposits of the Kapiti Coast): - 1A: Forest Lake Camp, Otaki south side entrance (WRC sample site, approval granted). - 1B: Otaki Recreation Reserve, Marine Parade (KCDC approval granted). - 1C: Tom Richardson property, Hautere Cross Rd (WRC sample site, approval granted). - 1D: Nga Manu Sanctuary, Ngarara Rd, Waikanae, (approval granted). - 1E: Mazengarb Reserve, Mazengarb Rd, Paraparaumu/Mati Rd Reserve, Matai Rd, Paraparaumu (KCDC approval granted). - 1F: Paekakariki Reserve, Ames St, Paekakariki (KCDC approval granted). All six (6) of the above sample sites will be sampled. Note these locations are distributed throughout the subject area and two (2) locations represent sites previously sampled by Greater Wellington Regional Council/Landcare Research for other soil quality programmes. The land use types targeted are primarily reserves, private indigenous reserves and regional parks.
	Anthropogenic effects on soils are to be avoided such as, landfilling, incineration fallout, vehicle particulates, and fill material.

<table>
<tr><td></td><td colspan="2">The sampling locations at each site will target an area that is not subject to heavy land use. Should suitable sampling locations not be located at the above chosen sites, additional sample locations will be selected from additional sites at the time for the applicable area.

Main Soil Types 1 and 3 will be forwarded later when all the data requested is received.

Following sample location agreement with GW, site owners are to be contacted to seek permission to enter their properties. This will involve an explanation of the purpose behind the sampling and requesting access.</td></tr>
<tr><td>Determinants & LOD (mg/kg):</td><td>Arsenic - <2

Boron (soluble) - 3

Cadmium - <0.1

Chromium - <1

Copper - <1

Lead - <1

Mercury - <0.1

Nickel - <1

Zinc - <1

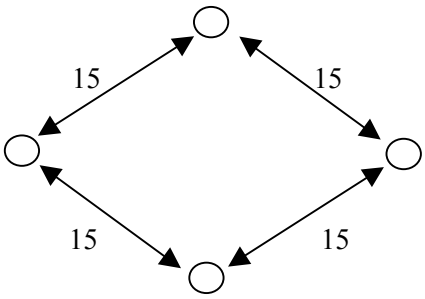
TPH (C7 to C44) – <8 - <60 mg/kg

PAH – 0.002 – 0.005 mg/kg</td><td>Laboratory supplied glass sample containers, with Teflon sealing lids.

Collected samples will be stored in chilly bins with slicker pads in order to keep the soil samples chilled.</td></tr>
<tr><td>Sampling Method:</td><td colspan="2">Sites identified will be walked into and all field gear carried in. Note the required fieldgear comprised handauger (with 3.5 cm dia pushtube) and spade.

Four soils samples will be collected at each sampling point using a stainless steel push tube from 0-10 cm or 15 cm depth. First, surface vegetation and extending roots will be removed.

A cardinal sampling layout will be used, with sampling locations spaced approximately 15 m apart.

 
</td></tr>
</table>

	The four samples will be composited in the laboratory prior to analysis. For QA/QC purposes 1 duplicate set of samples will be collected and analysed i.e. 10%.
	A hole to 500 mm depth will also be excavated by spade to confirm the soil profile at the sampling location. The soil profile will be logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System. The test pit will be reinstated with absolute care.
	All samples will be obtained, handled and transported to the laboratory in accordance with URS Field Procedures. The Procedures include: ▪ The use of laboratory supplied containers fit for purpose (see above); ▪ Storage and transport of samples in dedicated chilly bins in a chilled state; ▪ Samples will be labelled with unique numbers and labels. ▪ Cleaning of field equipment between each sample site using bottlebrushes to scrub equipment and three (3) buckets for water wash, decon and a final water rinse. A plastic groundsheet will also be utilised. One (1) equipment blank will be taken off the corer from each main Soil Type area and held cold at lab until further notice; ▪ The use of standard URS Chain of Custody documentation to provide an auditable trail of sample transport history.
Laboratory:	Hill Laboratories, 1 Clyde St, Hamilton, (07) 858-2000.
Proposed Sampling Date:	Starting 9 June 2003.
Health & Safety Plan:	To be prepared by field staff and reviewed prior to undertaking site works.
Prepared by:	Carmen Sulzberger, URS New Zealand Limited.
Reviewed by:	David Whitty, URS New Zealand Limited.

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Soil Sampling Plan

Main Soil Type 2 (Wellington)

Greater Wellington Regional Council Background Soil Survey

29 May 2003

Project No:	48253-002.
Client Contact:	Bruce Croucher, Contaminated Sites Officer, Resource Investigations, Greater Wellington Regional Council.
Sampling Objectives:	To determine background concentrations of selected metals and petroleum hydrocarbons in 5 main soil types identified within the Wellington region, from areas reasonably unaffected by recent human activity. This includes statistical evaluation of the data to produce a representative set of background concentrations in which Greater Wellington Regional Council can utilise as generic screening concentrations for potential contamination.
Sampling Sites:	Sampling locations identified in the Main Soil Type 2 (Rugged Axis Soils, mainly to the west of the Wairarapa Fault, which comprise mainly Brown Soils associated with the Greywacke bedrock) are (see attached sample plan): - 2A: Pukerua Bay, Raroa Reserve (Spring 2003 soil sample location for GWRC indicator programme). - 2B: Karehana Bay, Plimmerton, Recreation Reserve. - 2C: Saline Recent Gley Soil, south side of Pauatahanui-Plimmerton Highway, 150 yards from junction with old main highway (Landcare Research soil sample location). - 2D: Whitby Forest, Whitby. - 2E: Porirua Scenic Reserve, Prosser St, Porirua or Belmont Regional Park, accessed via eastern Porirua. - 2F: Wilf Mexted Scenic Reserve, Collins Ave, Greenacres. - 2G: Johnsonville Park, Trustcott Rd, Johnsonville. - 2H: Town Belt, Wilton/Northland, Wellington. - 2I: Makara Forest, off Makara Rd, Karori, Wellington. - 2J: Ataturk Park, Breaker Bay, Wellington. - 2K: Small lookout, Newport Rd, Seatoun Heights, Wellington. Eleven (11) of the above sample sites will be sampled. Note these locations are distributed throughout the subject area and two (2) locations represent sites previously sampled by Greater Wellington Regional Council/Landcare Research for other soil quality programmes. The land use types targeted are primarily reserves and regional parks. Anthropogenic effects on soils are to be avoided such as, landfilling, incineration fallout, vehicle particulates, and fill material.

<table>
<tr><td></td><td colspan="2">The sampling locations at each site will target an area that is not subject to heavy land use. Should suitable sampling locations not be located at the above chosen sites, additional sample locations will be selected from additional sites at the time for the applicable area.

Main Soil Types 1 and 3 will be forwarded later when all the data requested is received.

Following sample location agreement with GW, site owners are to be contacted to seek permission to enter their properties. This will involve an explanation of the purpose behind the sampling and requesting access.</td></tr>
<tr><td>Determinants & LOD (mg/kg):</td><td>Arsenic - <2

Boron (soluble) - 3

Cadmium - <0.1

Chromium - <1

Copper - <1

Lead - <1

Mercury - <0.1

Nickel - <1

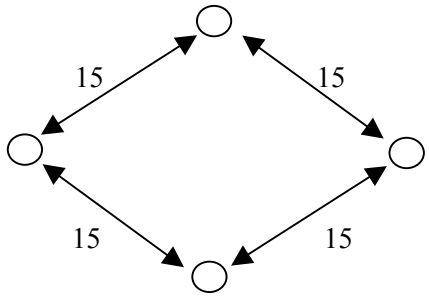
Zinc - <1

TPH (C7 to C44) – <8 - <60 mg/kg

PAH – 0.002 – 0.005 mg/kg</td><td>Laboratory supplied glass sample containers, with Teflon sealing lids.

Collected samples will be stored in chilly bins with slicker pads in order to keep the soil samples chilled.</td></tr>
<tr><td>Sampling Method:</td><td colspan="2">Four soils samples will be collected at each sampling point using a stainless steel push tube from 0-10 cm or 15 cm depth. First, surface vegetation and extending roots will be removed.

A cardinal sampling layout will be used, with sampling locations spaced approximately 15 m apart.

 
</td></tr>
</table>

	The four samples will be composited in the laboratory prior to analysis. For QA/QC purposes 1 duplicate set of samples will be collected and analysed i.e. 10%. A hole to 500 mm depth will also be excavated by spade to confirm the soil profile at the sampling location. The soil profile will be logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System. All samples will be obtained, handled and transported to the laboratory in accordance with URS Field Procedures. The Procedures include: ▪ The use of laboratory supplied containers fit for purpose (see above); ▪ Storage and transport of samples in dedicated chilly bins in a chilled state; ▪ Samples will be labelled with unique numbers and labels. ▪ Cleaning of field equipment between each sample site using bottlebrushes to scrub equipment and three (3) buckets for water wash, decon and a final water rinse. A plastic groundsheet will also be utilised. One (1) equipment blank will be taken off the corer from each main Soil Type area and held cold at lab until further notice; ▪ The use of standard URS Chain of Custody documentation to provide an auditable trail of sample transport history.
Laboratory:	Hill Laboratories, 1 Clyde St, Hamilton, (07) 858-2000.
Proposed Sampling Date:	3Starting 30 May 2003.
Health & Safety Plan:	To be prepared by field staff and reviewed prior to undertaking site works.
Prepared by:	Carmen Sulzberger, URS New Zealand Limited.
Reviewed by:	David Whitty, URS New Zealand Limited.

Soil Sampling Plan

Main Soil Type 3 (Hutt Valley)

Greater Wellington Regional Council Background Soil Survey

11 June 2003

Project No:	48253-002.
Client Contact:	Bruce Croucher, Contaminated Sites Officer, Resource Investigations, Greater Wellington Regional Council.
Sampling Objectives:	To determine background concentrations of selected metals and petroleum hydrocarbons in 5 main soil types identified within the Wellington region, from areas reasonably unaffected by recent human activity. This includes statistical evaluation of the data to produce a representative set of background concentrations in which Greater Wellington Regional Council can utilise as generic screening concentrations for potential contamination.
Sampling Sites: **Upper Hutt City Council = Permission Granted** **HCC Sites = Awaiting Permission**	Sampling locations identified in the Main Soil Type 3 (Ultic soils associated with the Holocene flood plain deposits of the Hutt Valley). - 3A: Recreation Reserve, Main Rd, North, Te Marua, Upper Hutt or Mangaroa Hill Scenic Reserve, Main Rd, North, Te Marua, Upper Hutt. - 3B: Te Haukaretu Park, Norbert St, Brown Owl, Upper Hutt. - 3C: Heretaunga Park, Perry St, Heretaunga, Upper Hutt - 3D: Willow Park, Whitemans Rd, Silver Stream, Upper Hutt. - 3E: Delany Park, off Stokes Valley Rd, Stokes Valley, Lower Hutt. - 3F: Fraser Park, off Harcourt Werry Drive, Taita, Lower Hutt. - 3G: Naenae Park, Gibson St, Naenae, Lower Hutt. - 3H: Te Whiti Park, off Whites Line East, Waiwhetu, Lower Hutt (western side only). - 3I: Hutt Central river terrace, off Rutherford St, Lower Hutt. - 3J: Petone Rec Ground, off Kensington Ave, Petone. - 2M: Wainuomata Scenic Reserve, off Hair St, Wainuiomata (Greywacke, Main Soil Type 2). Eleven (11) sample sites will be sampled. Note these locations are distributed throughout the subject area. The land use types targeted are primarily reserves and regional parks.
	Anthropogenic effects on soils are to be avoided such as, landfilling, incineration fallout, vehicle particulates, and fill material.

<table>
<tr><td></td><td colspan="2">The sampling locations at each site will target an area that is not subject to heavy land use. Should suitable sampling locations not be located at the above chosen sites, additional sample locations will be selected from additional sites at the time for the applicable area.

Main Soil Types 1 and 3 will be forwarded later when all the data requested is received.

Following sample location agreement with GW, site owners are to be contacted to seek permission to enter their properties. This will involve an explanation of the purpose behind the sampling and requesting access.</td></tr>
<tr><td>Determinants & LOD (mg/kg):</td><td>Arsenic - <2

Boron (soluble) - 3

Cadmium - <0.1

Chromium - <1

Copper - <1

Lead - <1

Mercury - <0.1

Nickel - <1

Zinc - <1

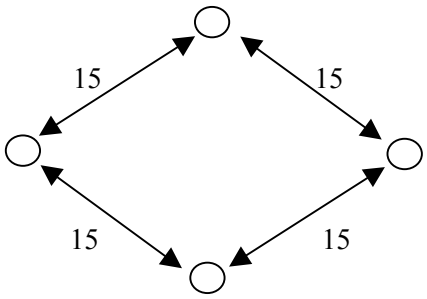
TPH (C7 to C44) – <8 - <60 mg/kg

PAH – 0.002 – 0.005 mg/kg</td><td>Laboratory supplied glass sample containers, with Teflon sealing lids.

Collected samples will be stored in chilly bins with slicker pads in order to keep the soil samples chilled.</td></tr>
<tr><td>Sampling Method:</td><td colspan="2">Sites identified will be walked into and all field gear carried in. Note the required fieldgear comprises handauger (with 3.5 cm dia pushtube) and spade.

Four (4) soil samples will be collected at each sampling point using a stainless steel push tube from 0-10 cm or 15 cm depth. First, surface vegetation and extending roots will be removed.

A cardinal sampling layout will be used, with sampling locations spaced approximately 15 m apart.

 
</td></tr>
</table>

	The four samples will be composited in the laboratory prior to analysis. For QA/QC purposes 1 duplicate set of samples will be collected and analysed i.e. 10%.
	A hole to 500 mm depth will also be excavated by spade to confirm the soil profile at the sampling location. The soil profile will be logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System. The test pit will be reinstated with absolute care and in the order of removal ensure like soils are returned in correct sequence.
	All samples will be obtained, handled and transported to the laboratory in accordance with URS Field Procedures. The Procedures include: ▪ The use of laboratory supplied containers fit for purpose (see above); ▪ Storage and transport of samples in dedicated chilly bins in a chilled state; ▪ Samples will be labelled with unique numbers and labels. ▪ Cleaning of field equipment between each sample site using bottlebrushes to scrub equipment and three (3) buckets for water wash, decon and a final water rinse. A plastic groundsheet will also be utilised. One (1) equipment blank will be taken off the corer from each main Soil Type area and held cold at lab until further notice; ▪ The use of standard URS Chain of Custody documentation to provide an auditable trail of sample transport history.
Laboratory:	Hill Laboratories, 1 Clyde St, Hamilton, (07) 858-2000.
Proposed Sampling Date:	Starting 11 June 2003 (in this instance the Upper Hutt sites will be sampled first).
Health & Safety Plan:	To be prepared by field staff and reviewed prior to undertaking site works.
Prepared by:	Carmen Sulzberger, URS New Zealand Limited.
Reviewed by:	David Whitty, URS New Zealand Limited.

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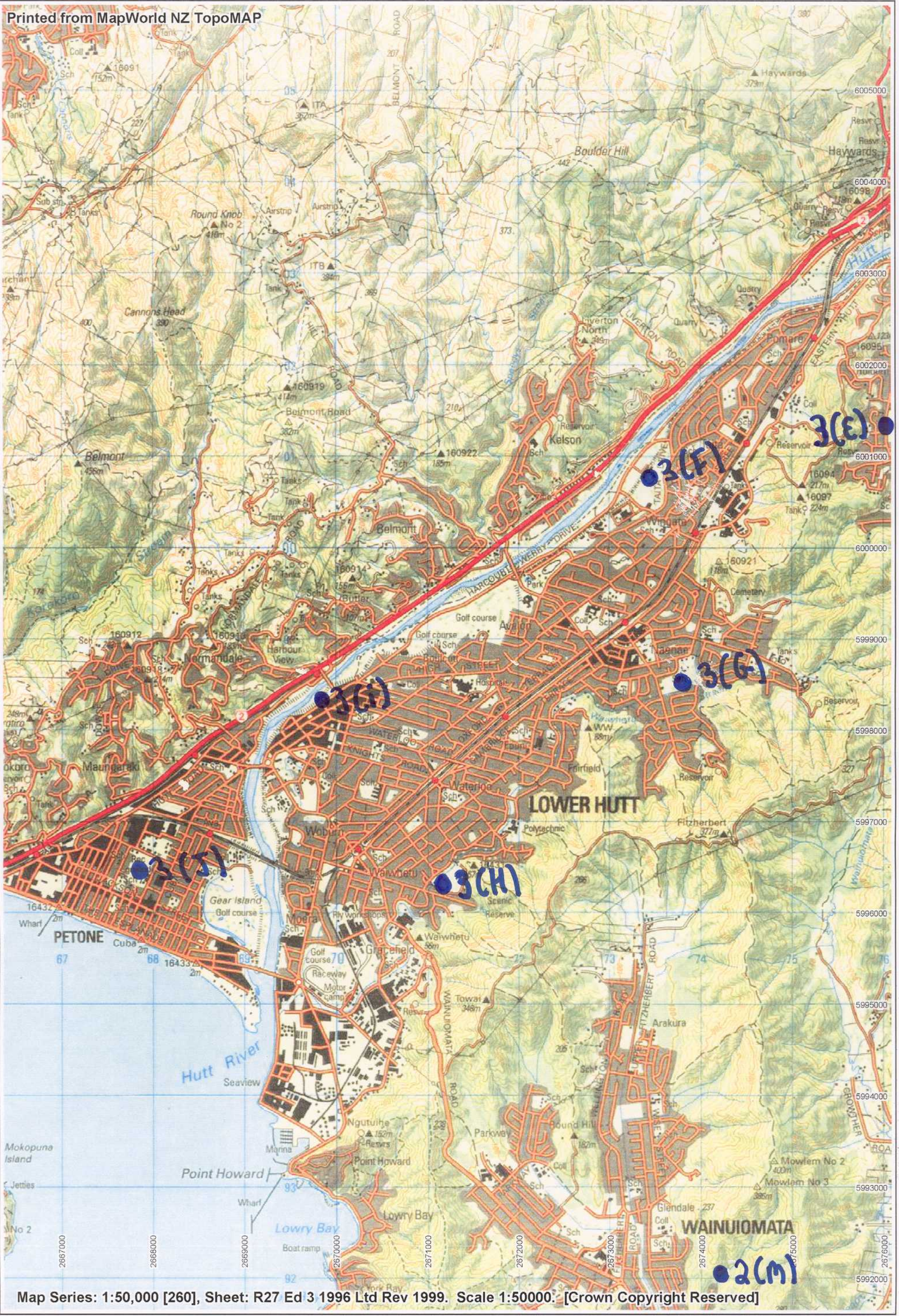

Boulder Hill
Haywards
Round Knob No 2
Cannons Head
Belmont
Belmont Road
Kelson
Liverton North
Pomare
Wingate
Taita
Avalon
Naenae
Normandale
Harbour View
Maungaraki
LOWER HUTT
Fairfield
Waterloo
Woburn
Waiwhetu
Polytechnic
Fitzherbert
Moera
Gracefield
Gear Island
Golf course
Hutt River
Seaview
PETONE
Cuba
Wharf
Ngutuihe
Point Howard
Mokopuna Island
Lowry Bay
Boat ramp
Towai
Arakura
Parkway
Sound Hill
Glendale
WAINUIOMATA
Mowlem No 2
Mowlem No 3
HARCOURT WERRY DRIVE
WATERLOO ROAD
KNIGHTS ROAD
HIGH STREET
WAINUIOMATA ROAD
FITZHERBERT ROAD
THE ESPLANADE
3(E)
3(F)
3(G)
3(I)
3(J)
3(H)
2(M)

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Akatarawa River
Kakariki
Karaitoo Stream
Hutt River
Pakuratahi Forks
Weir
Water works
Pipe bridge
Filtration plant
Aqueduct tunnel
Puffer
Tank
Youth hostel
Pakuratahi
Kaitoke
Research farm
Water treatment plant
Reservoirs
Stockcar track
Golf course
Te Marua
Sch
The Plateau
Cemetery
Go kart track
Airstrip
Rifle range
Gate (locked)
Gates (locked)
Goat Rock
Tunnel
Plateau
Rimutaka Incline Walk
Kaumatua Ridge
Ford
Tunnel ventilation shaft
Rimutaka Railway Tunnel
Maymorn
Maymorn Road
Settling ponds
Wairarapa Line
Mangaroa
Parkes Line
Collets Road
Training stables
Valley Road
North Climie
Climie No 2
Summit
Range
3(A)

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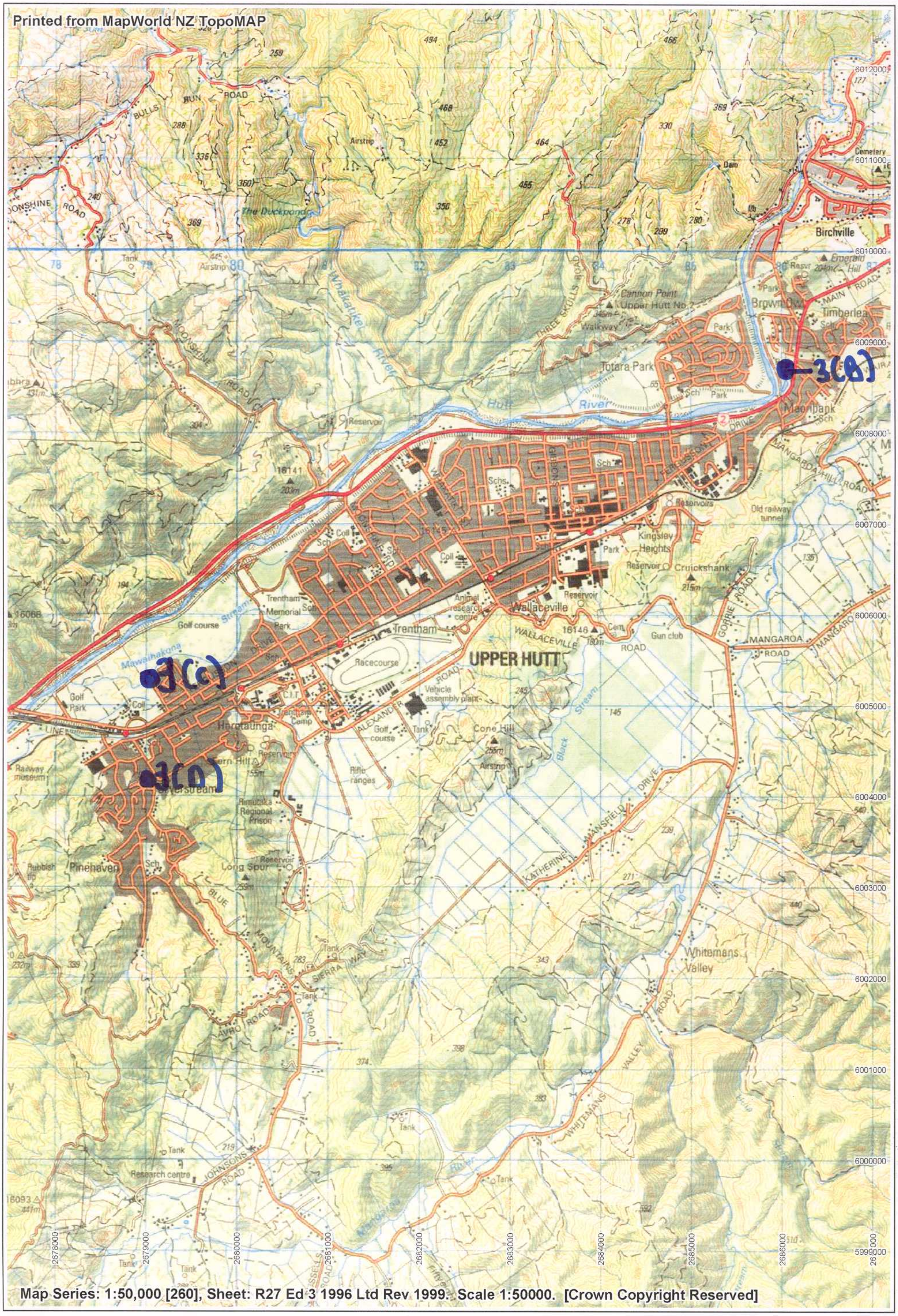

UPPER HUTT
Birchville
Brown Owl
Timberlea
Maoribank
Totara Park
Kingsley Heights
Cruickshank
Wallaceville
Trentham
Heretaunga
Silverstream
Pinehaven
Whitemans Valley
The Duckpond
Hutt River
Whakatiki River
Mangaroa River
Racecourse
Golf course
Vehicle assembly plant
Rimutaka Regional Prison
Cone Hill
Long Spur
Emerald Hill
Cannon Point
Upper Hutt No.2
Gun club
Rifle ranges
Railway museum
Research centre
Old railway tunnel
BULLS RUN ROAD
MOONSHINE ROAD
THREE SKULLS ROAD
MAIN ROAD
FERGUSSON DRIVE
MANGAROA HILL ROAD
GORRIE ROAD
MANGAROA ROAD
WALLACEVILLE ROAD
ALEXANDER ROAD
KATHERINE MANSFIELD DRIVE
BLUE MOUNTAINS ROAD
SIERRA WAY
AKATARAWA ROAD
JOHNSONS ROAD
WHITEMANS VALLEY ROAD
3(B)
3(C)
3(D)

Map Series: 1:50,000 [260], Sheet: R27 Ed 3 1996 Ltd Rev 1999. Scale 1:50000.

Soil Sampling Plan

Main Soil Type 4 (Wairarapa)

Greater Wellington Regional Council Background Soil Survey

29 May 2003

Project No:	48253-002.
Client Contact:	Bruce Croucher, Contaminated Sites Officer, Resource Investigations, Greater Wellington Regional Council.
Sampling Objectives:	To determine background concentrations of selected metals and petroleum hydrocarbons in 5 main soil types identified within the Wellington region, from areas reasonably unaffected by recent human activity. This includes statistical evaluation of the data to produce a representative set of background concentrations in which Greater Wellington Regional Council can utilise as generic screening concentrations for potential contamination.
Sampling Sites:	Sampling locations identified in the Main Soil Type 4 (alluvial soils of the Wairarapa) are (see attached sample plan): - 4A: Bideford silt loam, Gladstone, Martinborough Rd, Longbush, not used reserve, WRC01-1. - 4B: Martinborough loam, Martinborough, Pirnoa Rd, long term pasture, WRC01-2. - 4C: Tauherenikau silt loam, Norfolk Rd, West of Wangawa River, pasture for 20 yrs, WRC01-9. - 4D: Rangitikei loamy silt, end of Taumata Island Rd, on Rumahanga River flats, unused, fenced off, WRC01-11. - 4E: Moroa silt loam, Park Rd, southeast of Caterton, drystock, WRC01-12. - 4F: Ahikouka silt loam, DOC, indigenous forest, reserve, WRC00-14. - 4G: Kokotau silt loam, PeterKings bush, Perry Rd, reserve, WRC00-20. - 4H: Greytown silt loam, Brain Farley's property, Woodside Rd, Southwest of Greytown, WRC00-23. - 4I: Greytown silt loam, David Bulmains property, Akura Rd, 2 km west of Masterton, grazing, WRC00-26. - 4J: Featherston, to be determined. Note these locations are distributed throughout the subject area and target locations previously sampled by Greater Wellington Regional Council and Landcare Research for the indicators programme. The land use types vary between reserve, dairy, drystock and indigenous forest. Anthropogenic effects on soils are to be avoided such as, landfilling, incineration fallout, vehicle particulates, and fill material. The sampling locations at each site will target an area that is not subject to heavy land use. Should suitable sampling locations not be located at the above chosen sites, additional sample locations will be selected from additional sites listed on the attached Table 1 for the applicable area.

<table>
<tr><td></td><td colspan="2">Main Soil Types 1,2, 3 and 5 will be forwarded later when all the data requested is received.

Following sample location agreement with GW, site owners are to be contacted to seek permission to enter their properties. This will involve an explanation of the purpose behind the sampling and requesting access.</td></tr>
<tr><td>Determinants & LOD (mg/kg):</td><td>Arsenic - <2

Boron (soluble) - 3

Cadmium - <0.1

Chromium - <1

Copper - <1

Lead - <1

Mercury - <0.1

Nickel - <1

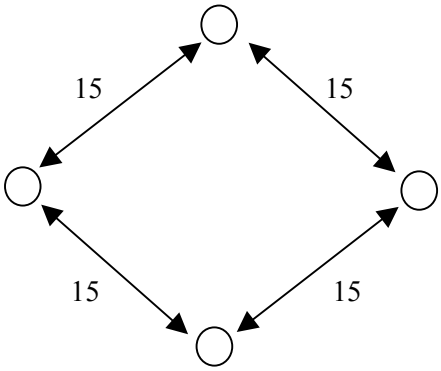
Zinc - <1

TPH (C7 to C44) – <8 - <60 mg/kg

PAH – 0.002 – 0.005 mg/kg</td><td>Laboratory supplied glass sample containers, with Teflon sealing lids.

Collected samples will be stored in chilly bins with slicker pads in order to keep the soil samples chilled.</td></tr>
<tr><td>Sampling Method:</td><td colspan="2">Four soils samples will be collected at each sampling point using a stainless steel push tube from 0-10 cm or 15 cm depth. First, surface vegetation and extending roots will be removed.

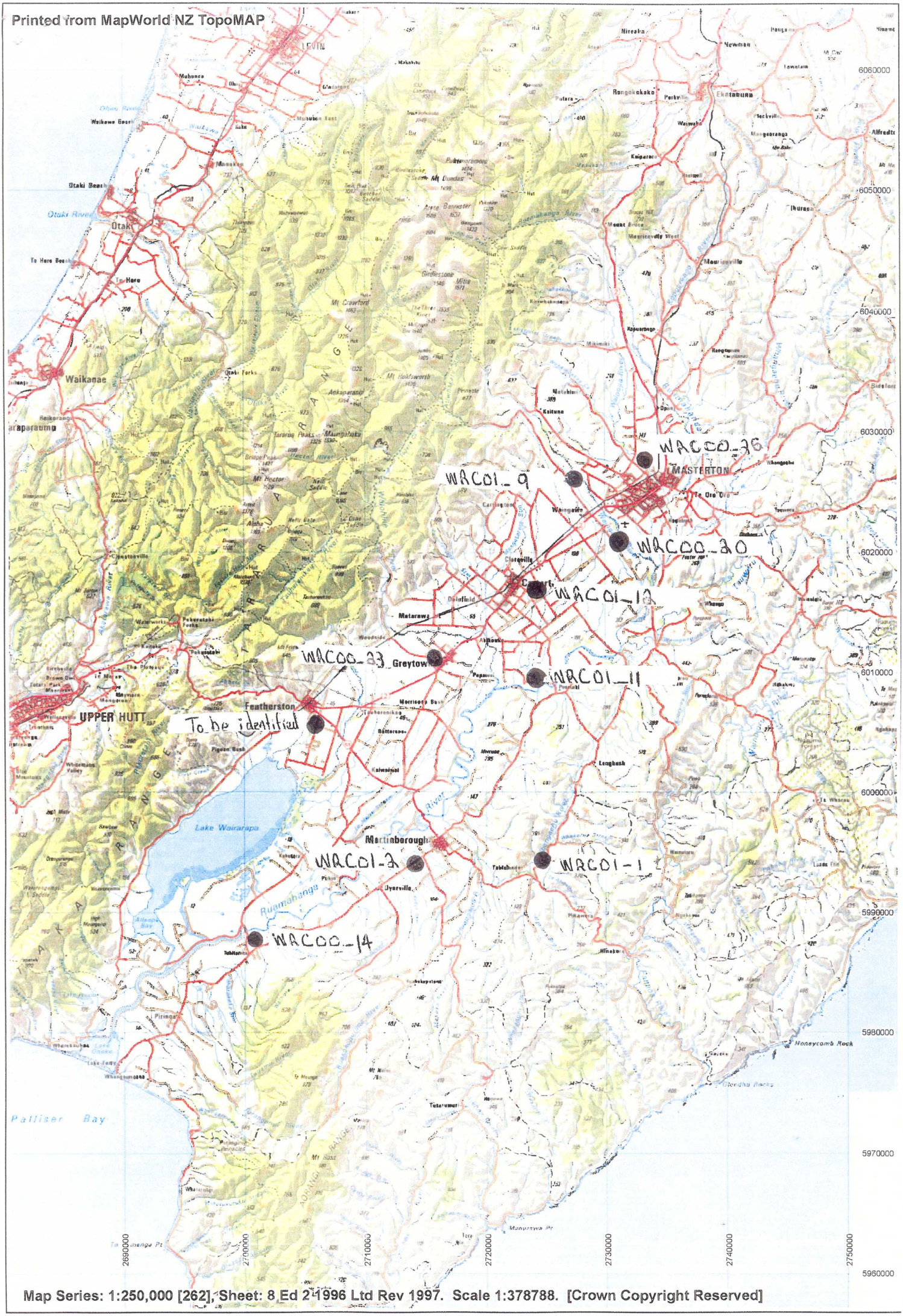
A cardinal sampling layout will be used, with sampling locations spaced approximately 15 m apart.

The four samples will be composited in the laboratory prior to analysis.

For QA/QC purposes 1 duplicate set of samples will be collected and analysed i.e. 10%.</td></tr>
</table>

	A hole to 500 mm depth will also be excavated by spade to confirm the soil profile at the sampling location. The soil profile will be logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System. All samples will be obtained, handled and transported to the laboratory in accordance with URS Field Procedures. The Procedures include: ▪ The use of laboratory supplied containers fit for purpose (see above); ▪ Storage and transport of samples in dedicated chilly bins in a chilled state; ▪ Samples will be labelled with unique numbers and labels. ▪ Cleaning of field equipment between each sample site using bottlebrushes to scrub equipment and three (3) buckets for water wash, decon and a final water rinse. A plastic groundsheet will also be utilised. One (1) equipment blank will be taken off the corer from each main Soil Type area and held cold at lab until further notice; ▪ The use of standard URS Chain of Custody documentation to provide an auditable trail of sample transport history.
Laboratory:	Hill Laboratories, 1 Clyde St, Hamilton, (07) 858-2000.
Proposed Sampling Date:	3 and 4 May 2003.
Health & Safety Plan:	To be prepared by field staff and reviewed prior to undertaking site works.
Prepared by:	Carmen Sulzberger, URS New Zealand Limited.
Reviewed by:	David Whitty, URS New Zealand Limited.



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Soil Sampling Plan

Main Soil Type 5 (Wairarapa)

Greater Wellington Regional Council Background Soil Survey

29 May 2003

Project No:	48253-002.
Client Contact:	Bruce Croucher, Contaminated Sites Officer, Resource Investigations, Greater Wellington Regional Council.
Sampling Objectives:	To determine background concentrations of selected metals and petroleum hydrocarbons in 5 main soil types identified within the Wellington region, from areas reasonably unaffected by recent human activity. This includes statistical evaluation of the data to produce a representative set of background concentrations in which Greater Wellington Regional Council can utilise as generic screening concentrations for potential contamination.
Sampling Sites:	Sampling locations identified in the Main Soil Type 5 (Pallic soils associated with the Tertiary mudstones and siltstones of the Wairarapa) are (see attached sample plan): - 5A: Mottled Fluvial Recent Soil, heavy metal data collected, Landcare Research agricultural based study. - 5B: Mottles Orthic Brown Soil, Whangaehu Valley Rd, Wairarapa, 16 miles north by road from Masterton, on slip face above creek, Landcare Research agricultural based study - 5C: Acidic Orthic Brown Soil, North of Masterton Castlepoint Rd, headwaters of Pukeatua Stream, Landcare Research agricultural based study. - 5D: Bideford area, Te Ore Ore Bideford Rd, URS yet to determine. - 5E: Fairlie area, Hinakura Rd, URS yet to determine. - 5F: Tauwera area, Masterton Castlepoint Rd, URS yet to determine. Five (5) of the above sample sites will be chosen for collecting soil samples, one additional sample site has been added for contingency purposes. The sample sites have been distributed throughout the subject area. Three (3) of these soil sample sites were previously sampled by Landcare Research for an agricultural based study, while three (3) sample sites are additional and selected by URS. Grossly anthropogenic affected soils are to be avoided and this includes those such as, landfilling, incineration fallout, heavy vehicle particulate fallout, and fill material. The sampling locations at each site will target an area that is not subject to heavy landuse (See attached Table 1). Should suitable sampling locations not be located at the above chosen sites, additional sample locations will be selected from the applicable area.

<table>
<tr><td></td><td colspan="2">Main Soil Types 1,2, and 3 will be forwarded shortly when all the data requested is received.

Following sample location agreement with GW, site owners are to be contacted to seek permission to enter their properties. This will involve an explanation of the purpose behind the sampling and requesting access. Note some sample sites selected by URS are located in general areas and at the time of sampling a suitable location will be located at the time and permission sort.</td></tr>
<tr><td>Determinants & LOD (mg/kg):</td><td>Arsenic - <2

Boron (soluble) - 3

Cadmium - <0.1

Chromium - <1

Copper - <1

Lead - <1

Mercury - <0.1

Nickel - <1

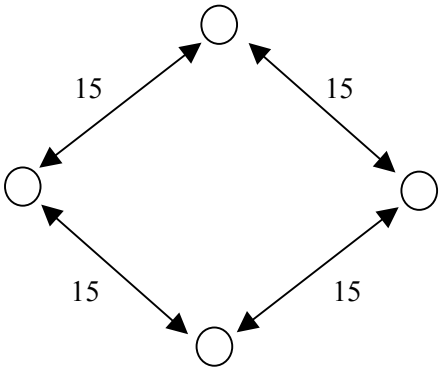
Zinc - <1

TPH (C7 to C44) – <8 - <60 mg/kg

PAH – 0.002 – 0.005 mg/kg</td><td>Laboratory supplied glass sample containers, with Teflon sealing lids.

Collected samples will be stored in chilly bins with slicker pads in order to keep the soil samples chilled and packed ready for transportation.</td></tr>
<tr><td>Sampling Method:</td><td colspan="2">Four soils samples will be collected at each sampling point using a stainless steel push tube from 0 - 10 cm or 15 cm depth. First, surface vegetation and extending roots will be removed.

A cardinal sampling layout will be used, with sampling locations spaced approximately 15 m apart.

The four (4) samples will be composited in the laboratory prior to analysis.

For QA/QC purposes one (1) duplicate set of samples will be collected and analysed i.e. 10%.</td></tr>
</table>

	A hole to 500 mm depth will also be excavated by spade to confirm the soil profile at the sampling location. The soil profile will be logged in accordance with the New Zealand Soil Classification System, cross-referenced to the New Zealand Geomechanics Society Soil Classification System. All samples will be obtained, handled and transported to the laboratory in accordance with URS Field Procedures. The Procedures include: ▪ The use of laboratory supplied containers fit for purpose (see above); ▪ Storage and transport of samples in dedicated chilly bins in a chilled state; ▪ Samples will be labelled with unique numbers and labels. ▪ Cleaning of field equipment between each sample site using bottlebrushes to scrub equipment and three (3) buckets for water wash, decon and a final water rinse. A plastic groundsheet will also be utilised. One (1) equipment blank will be taken off the corer from each main Soil Type area and held cold at lab until further notice; ▪ The use of standard URS Chain of Custody documentation to provide an auditable trail of sample transport history.
Laboratory:	Hill Laboratories, 1 Clyde St, Hamilton, (07) 858-2000.
Proposed Sampling Date:	6 and 7 June 2003.
Health & Safety Plan:	To be prepared by field staff and reviewed prior to undertaking site works.
Prepared by:	Carmen Sulzberger, URS New Zealand Limited.
Reviewed by:	David Whitty, URS New Zealand Limited.

Map Series: 1:250,000 [262], Sheet: 8 Ed 2 1996 Ltd Rev 1997. Scale 1:378788. [Crown Copyright Reserved]

Appendix C
Raw Data and Laboratory Reports

Reported Analytical Results for Main Soil Type 1

	Metals and TPH							
Sample ID	1(A)	1(A2)	1(B)	1(C)	1(D)	1(E)	1(F)	EB1
Location	Forest Lakes	Duplicate	Otaki Reserve	Private Reserve, Te Horo	Nga Manu Nature Reserve, Waikanae	Mazengarb Reserve, Paraparaumu	Paekakariki Domain	Equipment Blank
Landuse	Private Bush	Private Bush	Public Reserve	Private Bush	Private Bush	Public Reserve	Public Reserve	QA/QC
Lab No	313773 / 30	313773 / 34	313773 / 31	313773 / 32	313773 / 33	313773 / 35	313773 / 36	313773 / 1
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	9/06/03	9/06/03	9/06/03	9/06/2003	9/06/03	9/06/03	9/06/03	9/06/2003
Soluble Boron	2.1	1.9	0.5	1.7	0.3	0.4	0.6	0.012
Total Recoverable As	< 2	< 2	5	2	3	4	7	< 0.001
Total Recoverable Cd	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	0.00006
Total Recoverable Cr	7	7	9	12	8	7	8	< 0.0005
Total Recoverable Cu	6	6	6	10	4	7	9	0.0492
Total Recoverable Hg	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.00008
Total Recoverable Ni	4	4	9	9	6	5	6	< 0.0005
Total Recoverable Pb	5.7	5.3	8.5	13.5	4.5	5.3	180	0.0002
Total Recoverable Zn	38	31	55	69	30	28	79	0.011
TPH (C_7 - C_{44})	<40	60	80	110	80	100	70	< 0.2

Notes:

EB - Equipment blank: wash water from hand auger

	PAH						
Sample ID	1(A)	1(A2)	1(B)	1(C)	1(D)	1(E)	1(F)
Location	Forest Lakes	Duplicate	Otaki Reserve	Private Reserve, Te Horo	Nga Manu Nature Reserve, Waikanae	Mazengarb Reserve, Paraparaumu	Paekakariki Domain
Landuse	Private Bush	Private Bush	Public Reserve	Private Bush	Private Bush	Public Reserve	Public Reserve
Lab No	313773 / 30	313773 / 34	313773 / 31	313773 / 32	313773 / 33	313773 / 35	313773 / 36
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003
Acenaphthene	0.0010	< 0.0008	0.0008	< 0.0009	< 0.0008	< 0.0008	0.0011
Acenaphthylene	< 0.0008	< 0.0008	0.0009	< 0.0009	< 0.0008	< 0.0008	0.0170
Anthracene	< 0.0008	< 0.0008	< 0.0007	< 0.0009	< 0.0008	0.0010	0.0130
Benzo[a]anthracene	0.0017	0.0009	0.0008	< 0.0009	< 0.0008	< 0.0008	0.0545
Benzo[a]pyrene (BAP)	0.0027	0.0018	0.0013	0.0011	< 0.0008	< 0.0008	0.0779
Benzo[b]fluoranthene	0.0042	0.0030	0.0032	0.0030	< 0.0008	0.0022	0.118
Benzo[g,h,i]perylene	0.0016	0.0013	0.0012	< 0.0009	< 0.0008	< 0.0008	0.0500
Benzo[k]fluoranthene	0.0015	0.0009	0.0008	< 0.0009	< 0.0008	< 0.0008	0.0378
Chrysene	0.0055	0.0042	0.0044	< 0.0009	< 0.0008	0.0034	0.0703
Dibenzo[a,h]anthracene	< 0.0008	< 0.0008	< 0.0007	< 0.0009	< 0.0008	0.0041	0.0410
Fluoranthene	0.0047	0.0022	0.0028	0.0014	< 0.0008	0.0027	0.136
Fluorene	0.0011	< 0.0008	0.0009	< 0.0009	< 0.0008	< 0.0008	0.0034
Indeno(1,2,3-c,d)pyrene	0.0024	0.0017	0.0018	0.0010	< 0.0008	0.0051	0.120
Naphthalene	< 0.004	< 0.004	0.010	0.010	< 0.004	0.007	0.005
Phenanthrene	< 0.0008	< 0.0008	< 0.0007	< 0.0009	< 0.0008	< 0.0008	0.0660
Pyrene	0.0044	0.0021	0.0028	0.0012	< 0.0008	0.0013	0.122

Notes:

EB - Equipment blank: wash water from hand auger

1A2 - Duplicate

Reported Analytical Results for Main Soil Type 2

	Metals and TPH											
Sample ID	2(A)	2(B)	2(C)	2(D)	2(E)	2(F)	2(G)	2(H)	2(I)	2(K)	2(L)	2(M)
Location	Raroa Reserve, Pukerua Bay	Small Reserve, Plimmerton	Samwell Drive Reserve, Whitby	Porirua Scenic Reserve	Wilf Mexted Scenic Reserve, Tawa	Johnsonville Park	Northern Walkway	Southern Walkway	Rangitatau Reserve, Wellington	Eastern Walkway	Karori park	Wainuiomata Scenic Reserve
Landuse	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve
Lab No	313417 / 45	313417 / 46	313417 / 47	313417 / 48	313417 / 49	313417 / 50	313417 / 51	313417 / 52	313417 / 53	313417 / 54	313417 / 55	314144 / 49
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	03/06/03	03/06/03	03/06/03	03/06/03	04/06/03	04/06/03	04/06/03	04/06/03	04/06/03	05/06/03	05/06/03	13/06/2003
Soluble Boron	1.2	1.3	1.8	1.2	1.3	1.1	1.1	1.7	1.3	1.8	2.2	0.9
Total Recoverable As	< 2	6	3	7	6	5	3	7	5	5	4	3
Total Recoverable Cd	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1	0.1
Total Recoverable Cr	6	11	10	13	14	16	15	14	14	15	13	9
Total Recoverable Cu	3	7	6	18	10	11	11	25	6	15	8	8
Total Recoverable Hg	< 0.1	< 0.1	0.1	0.1	0.1	< 0.1	0.1	0.2	< 0.1	< 0.1	0.1	< 0.1
Total Recoverable Ni	4	7	6	12	7	9	9	13	6	12	6	9
Total Recoverable Pb	5.9	13.1	9.3	21.2	14.5	22.1	31.2	78.6	20.7	29.9	24.5	14.4
Total Recoverable Zn	24	39	33	74	36	57	53	105	52	80	32	53
TPH	<30	70	50	40	50	40	140	80	<40	160	190	<70

	PAH											
Sample ID	2(A)	2(B)	2(C)	2(D)	2(E)	2(F)	2(G)	2(H)	2(I)	2(K)	2(L)	2(M)
Location	Raroa Reserve, Pukerua Bay	Small Reserve, Plimmerton	Samwell Drive Reserve, Whitby	Porirua Scenic Reserve	Wilf Mexted Scenic Reserve, Tawa	Johnsonville Park	Northern Walkway	Southern Walkway	Rangitatau Reserve, Wellington	Eastern Walkway	Karori park	Wainuiomata Scenic Reserve
Landuse	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve
Lab No	313417 / 45	313417 / 46	313417 / 47	313417 / 48	313417 / 49	313417 / 50	313417 / 51	313417 / 52	313417 / 53	313417 / 54	313417 / 55	314144 / 49
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	03/06/03	03/06/03	03/06/03	03/06/03	04/06/03	04/06/03	04/06/03	04/06/03	04/06/03	05/06/03	05/06/03	13/06/2003
Acenaphthene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009	< 0.0008	< 0.0008	0.0063	< 0.0008	0.0029	< 0.0008	< 0.001
Acenaphthylene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009	0.0022	< 0.0008	0.0469	0.0073	0.0086	< 0.0008	< 0.001
Anthracene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009	0.0025	0.0027	0.0481	0.0041	0.0099	0.0008	< 0.001
Benzo[a]anthracene	0.0029	0.0018	< 0.0008	0.0013	< 0.0009	0.0079	0.0083	0.206	0.0188	0.0445	0.0060	0.001
Benzo[a]pyrene (BAP)	0.0033	0.0017	< 0.0008	0.0015	0.0013	0.0092	0.0106	0.270	0.0326	0.0477	0.0070	0.002
Benzo[b]fluoranthene	0.0061	0.0032	< 0.0008	0.0027	0.0024	0.0142	0.0173	0.407	0.0512	0.0712	0.0152	0.004
Benzo[g,h,i]perylene	0.0024	0.0013	< 0.0008	0.0012	0.0012	0.0071	0.0096	0.229	0.0323	0.0349	0.0061	0.002
Benzo[k]fluoranthene	0.0022	0.0012	< 0.0008	< 0.0008	0.0009	0.005	0.0057	0.131	0.0202	0.0275	0.0049	0.001
Chrysene	0.0074	0.0061	< 0.0008	0.0049	< 0.0009	0.0139	0.0129	0.260	0.0254	0.0565	0.0110	0.004
Dibenzo[a,h]anthracene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009	0.0021	0.0029	0.0718	0.0103	0.0115	0.0018	< 0.001
Fluoranthene	0.0068	0.0050	0.0013	0.0034	0.0025	0.0218	0.0206	0.547	0.0317	0.126	0.0154	0.004
Fluorene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009	0.0009	< 0.0008	0.0108	< 0.0008	0.0056	< 0.0008	< 0.001
Indeno(1,2,3-c,d)pyrene	0.0035	0.0015	< 0.0008	0.0016	0.0014	0.0082	0.0119	0.315	0.0440	0.0461	0.0090	0.002
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.012	< 0.004	< 0.004	< 0.004	< 0.005
Phenanthrene	0.0016	0.0025	< 0.0008	0.0016	0.0009	0.0125	0.0087	0.257	0.0085	0.0934	0.0033	0.001
Pyrene	0.0068	0.0050	0.0012	0.0034	0.0025	0.0201	0.0209	0.574	0.0316	0.124	0.0148	0.003

Reported Analytical Results for Main Soil Type 3

	Metals and TPH									
Sample ID	3(A)	3(B)	3(C)	3(D)	3(E)	3(F)	3(F2)	3(G)	3(H)	3(1)+3(2)
Location	Kaitoke Regional Park	Harcourt Park Reserve, Upper Hutt	Heretaunga Park, Upper Hutt	Willow Park, Silverstream	Delaney Park, Stokes Valley	Fraser Park, Lower Hutt	Duplicate	Hutt River Terrace, Lower Hutt	Ewan Park, Lower Hutt	Equipment Blank
Landuse	Public Bush Reserve	Public Bush Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	QA/QC
Lab No.	314144 / 42	314144 / 43	314144 / 44	314144 / 45	314144 / 46	314144 / 47	314144 / 48	314144 / 50	314144 / 51	314144/1
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	12/06/2003	12/06/2003	12/06/2003	12/06/2003	13/06/2003	13/06/2003	13/06/2003	15/06/2003	15/06/2003	12/06/2003
Soluble Boron	0.9	1.6	0.6	0.9	1.0	0.4	0.3	0.3	0.4	Not reported
Total Recoverable As	2	3	7	5	5	5	5	4	7	< 0.001
Total Recoverable Cd	< 0.1	< 0.1	0.1	0.1	0.2	< 0.1	< 0.1	< 0.1	0.1	0.00005
Total Recoverable Cr	9	15	18	12	14	16	17	17	17	< 0.0005
Total Recoverable Cu	6	5	13	13	18	13	13	11	19	0.0961
Total Recoverable Hg	2.6	0.1	< 0.1	0.1	0.2	0.1	0.1	< 0.1	0.1	< 0.00008
Total Recoverable Ni	5	7	14	9	7	13	13	14	14	0.0009
Total Recoverable Pb	16.7	17.9	31.1	53.9	73.3	33.1	31.6	32.7	51.9	0.0021
Total Recoverable Zn	38	42	86	109	201	73	72	76	97	0.008
TPH (C_7-C_{44})	260	200	<100	<40	<40	100	120	<50	<60	<0.2

Notes:

3(1) +3(2) - Equipment blank: wash water from hand auger

3(F2) - Duplicate

	PAH								
Sample ID	3(A)	3(B)	3(C)	3(D)	3(E)	3(F)	3(F2)	3(G)	3(H)
Location	Kaitoke Regional Park	Harcourt Park Reserve, Upper Hutt	Heretaunga Park, Upper Hutt	Willow Park, Silverstream	Delaney Park, Stokes Valley	Fraser Park, Lower Hutt	Duplicate	Hutt River Terrace, Lower Hutt	Ewan Park, Lower Hutt
Landuse	Public Bush Reserve	Public Bush Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve
Lab No	314144 / 42	314144 / 43	314144 / 44	314144 / 45	314144 / 46	314144 / 47	314144 / 48	314144 / 50	314144 / 51
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	12/06/2003	12/06/2003	12/06/2003	12/06/2003	13/06/2003	13/06/2003	13/06/2003	15/06/2003	15/06/2003
Acenaphthene	0.001	< 0.0008	< 0.0008	0.0089	< 0.0009	< 0.0007	< 0.0008	< 0.0008	0.0019
Acenaphthylene	0.009	0.0011	0.0021	0.0080	0.0076	0.0020	0.0018	0.0036	0.0590
Anthracene	0.006	0.0010	0.0010	0.0250	0.0063	0.0009	< 0.0008	0.0021	0.0362
Benzo[a]anthracene	0.013	0.0051	0.0060	0.126	0.0450	0.0032	0.0024	0.0093	0.196
Benzo[a]pyrene (BAP)	0.014	0.0048	0.0095	0.136	0.0660	0.0049	0.0039	0.0155	0.328
Benzo[b]fluoranthene	0.021	0.0076	0.0153	0.192	0.0828	0.0082	0.0065	0.0222	0.369
Benzo[g,h,i]perylene	0.010	0.0035	0.0083	0.0847	0.0525	0.0052	0.0046	0.0152	0.255
Benzo[k]fluoranthene	0.007	0.0027	0.0047	0.0560	0.0261	0.0027	0.0021	0.0073	0.132
Chrysene	0.017	0.0072	0.0100	0.122	0.0555	0.0056	0.0064	0.0125	0.197
Dibenzo[a,h]anthracene	0.004	< 0.0008	0.0024	0.0396	0.0166	0.0016	0.0011	0.0043	0.0898
Fluoranthene	0.031	0.0126	0.0127	0.259	0.103	0.0071	0.0062	0.0199	0.386
Fluorene	0.004	< 0.0008	0.0009	0.0069	0.0014	< 0.0007	< 0.0008	0.0015	0.0079
Indeno(1,2,3-c,d)pyrene	0.01	0.0049	0.0098	0.126	0.0603	0.0053	0.0043	0.0141	0.323
Naphthalene	0.006	0.008	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.012
Phenanthrene	0.038	0.0063	0.0069	0.112	0.0348	0.0049	0.0048	0.0131	0.118
Pyrene	0.033	0.0144	0.0145	0.238	0.124	0.0083	0.0072	0.0247	0.461

Notes:

3(F2) - Duplicate

The Wairarapa Soils, located to the east of the Wairarapa Fault, which comprise Gley and Immature Pallic Soils associated with Holocene flood plain and terrace deposits

Reported Analytical Results for Main Soil Type 4

	Metals and TPH													
Sample ID	4(A)	4(B)	4(C)	4(D)	4(F)	4(F2)	4(G)	4(H)	4(I)	4(J)	4(K)	4(1)	4(2)	4(3)
Location	Featherston Reserve	Halford Farm, Martinborough	DOC Reserve, South Wairarapa	Spring Rock Farm, Martinborough	Solider Memorial Park, Greytown	Duplicate	Farm, Carterton	Private Reserve, Carterton	Farm, Masterton	Bush Reserve, Masterton	Mel Parkinson Reserve, Opaki	Equipment Blank	Equipment Blank	Trip Blank
Landuse	Public Bush Reserve	Pastoral Beef & Sheep	Private Bush Reserve	Private Bush Reserve	Public Bush Reserve	Public Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Public Bush Reserve	QA/QC	QA/QC	QA/QC
Lab No.	314571 / 48	314571 / 49	314571 / 50	314571 / 51	314571 / 52	314571 / 53	314571 / 54	314571 / 55	314571 / 56	314571 / 57	314688/27	314571 / 1	314571 / 2	314571 / 3
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/L	mg/L
Date	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003
Soluble Boron	2.0	1.2	1.6	1.8	2.7	2.8	0.9	2.2	1.7	2.7	0.7	-	0.020	-
Total Recoverable As	4	5	2	3	7	7	4	3	4	7	3	-	< 0.001	-
Total Recoverable Cd	< 0.1	0.2	< 0.1	< 0.1	0.1	0.1	0.2	< 0.1	0.2	0.1	<0.1	-	0.00007	-
Total Recoverable Cr	13	21	14	14	20	20	16	14	11	19	18	-	< 0.0005	-
Total Recoverable Cu	15	18	9	7	18	18	8	11	11	19	13	-	0.0301	-
Total Recoverable Hg	< 0.1	< 0.1	0.1	< 0.1	0.1	0.1	< 0.1	< 0.1	< 0.1	< 0.1	<0.1	-	< 0.00008	-
Total Recoverable Ni	13.0	21	11	10	20	20	10	10	6	21	16	-	< 0.0005	-
Total Recoverable Pb	21.6	18.1	18.3	9.4	32.0	31.3	21.4	15.2	16.3	34.0	17.9	-	0.0015	-
Total Recoverable Zn	87	90	67	44	121	125	70	61	63	118	62	-	0.011	-
TPH (C_7-C_{44})	<40	<40	<50	90	60	<40	<40	80	820	130	<30	<0.2	-	<0.2

Notes:

4(1) +4(2) - Equipment blank: wash water from hand auger

4(F2) - Duplicate

4(3) - Trip Blank

	PAH										
Sample ID	4(A)	4(B)	4 (C)	4(D)	4(F)	4(F2)	4(G)	4(H)	4(I)	4(J)	4(K)
Location	Featherston Reserve	Halford Farm, Martinborough	DOC Reserve, South Wairarapa	Spring Rock Farm, Martinborough	Soldier Memorial Park, Greytown	Duplicate	Farm, Carterton	Private Reserve, Carterton	Farm, Masterton	Bush Reserve, Masterton	Mel Parkinson Reserve, Opaki
Landuse	Public Bush Reserve	Pastoral Beef & Sheep	Private Bush Reserve	Private Bush Reserve	Public Bush Reserve	Public Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Public Bush Reserve
Lab No	314571 / 48	314571 / 49	314571 / 50	314571 / 51	314571 / 52	314571 / 53	314571 / 54	314571 / 55	314571 / 56	314571 / 57	314688/27
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003
Acenaphthene	< 0.0008	0.0009	< 0.001	< 0.0008	0.001	< 0.0009	< 0.0009	< 0.0008	0.0065	0.013	0.0017
Acenaphthylene	< 0.0008	< 0.0008	< 0.001	0.0008	0.0023	0.0009	< 0.0009	< 0.0008	< 0.0009	0.0287	0.0591
Anthracene	< 0.0008	0.001	< 0.001	< 0.0008	0.003	0.0024	0.0009	< 0.0008	0.0019	0.0402	0.0456
Benzo[a]anthracene	0.0015	0.0026	< 0.001	< 0.0008	0.0071	0.0092	0.0043	0.0018	0.0059	0.188	0.129
Benzo[a]pyrene (BAP)	0.0017	0.0026	< 0.001	< 0.0008	0.007	0.0132	0.0049	0.0015	0.0051	0.313	0.225
Benzo[b]fluoranthene	0.0051	0.013	0.004	< 0.0008	0.0205	0.0342	0.0105	0.0063	0.0124	0.423	0.347
Benzo[g,h,i]perylene	0.0032	0.0071	0.002	< 0.0008	0.0067	0.0146	0.0061	0.0031	0.0049	0.268	0.181
Benzo[k]fluoranthene	0.0011	0.0032	< 0.001	< 0.0008	0.0052	0.01	0.0028	0.0014	0.0033	0.123	0.114
Chrysene	0.0019	0.0069	< 0.001	< 0.0008	0.0153	0.0183	0.0043	0.0024	0.0079	0.232	0.136
Dibenzo[a,h]anthracene	< 0.0008	0.0013	< 0.001	< 0.0008	0.0018	0.0038	0.0009	< 0.0008	< 0.0009	0.0519	0.0482
Fluoranthene	0.0036	0.0089	0.001	< 0.0008	0.0277	0.0236	0.0117	0.0061	0.0182	0.568	0.213
Fluorene	< 0.0008	0.0031	< 0.001	< 0.0008	0.0036	0.0044	< 0.0009	< 0.0008	< 0.0009	0.0188	0.004
Indeno(1,2,3-c,d)pyrene	0.0022	0.0027	< 0.001	< 0.0008	0.005	0.0117	0.0053	0.0028	0.005	0.233	0.194
Naphthalene	< 0.004	< 0.004	< 0.005	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.005	0.019	< 0.004
Phenanthrene	0.0014	0.0192	0.002	< 0.0008	0.032	0.034	0.0051	0.0026	0.0116	0.35	0.0651
Pyrene	0.0048	0.0124	0.002	< 0.0008	0.0217	0.0287	0.0126	0.0064	0.0208	0.595	0.223

Notes:

4(F2) - Duplicate

Reported Analytical Results for Main Soil Type 5

	Metals and TPH					
Sample ID	5(A)	5(B)	5(B2)	5(C)	5(D)	5(1)+5(2)
Location	Ngaumu Forest, Stronvar	Clarke Memorial, Mauriceville	Duplicate	Public Reserve, Tinui	Private Reserve, Masterton	Equipment Blank
Landuse	Exotic Forest	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Private Bush Reserve	QA/QC
Lab No.	314688/28	314688/29	314688/30	314688/31	314688/32	314688 / 1&2
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	20/06/2003	20/06/2003	20/06/2003	20/06/2003	20/06/2003	23/06/2003
Soluble Boron	1.7	1.0	1.1	2.5	2.6	0.033
Total Recoverable As	4	4	3	4	< 2	< 0.001
Total Recoverable Cd	< 0.1	0.1	0.1	< 0.1	0.2	0.00010
Total Recoverable Cr	8	15	15	10	10	< 0.0005
Total Recoverable Cu	7	11	9	19	6	0.0491
Total Recoverable Hg	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.00008
Total Recoverable Ni	5	13	12	7	8	< 0.0005
Total Recoverable Pb	12.2	20.5	20.2	38.1	10.8	0.0021
Total Recoverable Zn	31	52	52	72	57	0.037
TPH (C_7-C_{44})	460	50	<40	50	<40	0.4

Notes:

5(1) - Equipment blank: wash water from hand auger

5(F2) - Duplicate

	PAH				
Sample ID	5(A)	5(B)	5(B2)	5(C)	5(D)
Location	Ngaumu Forest, Stronvar	Clarke Memorial, Mauriceville	Duplicate	Public Reserve, Tinui	Private Bush Reserve, Masterton
Landuse	Exotic Forest	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Private Bush Reserve
Lab No	314688/28	314688/29	314688/30	314688/31	314688/32
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	20/06/2003	20/06/2003	20/06/2003	20/06/2003	20/06/2003
Acenaphthene	< 0.0008	< 0.0009	< 0.0009	< 0.0008	< 0.0009
Acenaphthylene	< 0.0008	< 0.0009	< 0.0009	< 0.0008	< 0.0009
Anthracene	< 0.0008	< 0.0009	0.0010	0.0009	< 0.0009
Benzo[a]anthracene	< 0.0008	0.0024	0.0051	0.0049	< 0.0009
Benzo[a]pyrene (BAP)	< 0.0008	0.0022	0.0041	0.0054	< 0.0009
Benzo[b]fluoranthene	0.0022	0.0074	0.0094	0.0104	< 0.0009
Benzo[g,h,i]perylene	0.0012	0.0041	0.0048	0.0062	< 0.0009
Benzo[k]fluoranthene	< 0.0008	0.0029	0.0029	0.0031	< 0.0009
Chrysene	< 0.0008	0.0030	0.0040	0.0054	< 0.0009
Dibenzo[a,h]anthracene	< 0.0008	< 0.0009	0.0009	0.0009	< 0.0009
Fluoranthene	0.0021	0.0061	0.0088	0.0147	< 0.0009
Fluorene	< 0.0008	< 0.0009	< 0.0009	< 0.0008	< 0.0009
Indeno(1,2,3-c,d)pyrene	0.0011	0.0031	0.0040	0.0048	< 0.0009
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	< 0.0008	0.0016	0.0024	0.0073	< 0.0009
Pyrene	0.0084	0.0068	0.0101	0.0146	< 0.0009

Notes:

5(B2) - Duplicate

Hill Laboratories

- 2 JUL 2003

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Amended Report: *This is an amended report, which replaces a report issued on the 17/06/2003. The TPH results have been corrected to TPHGC, with C7-C44 reported. For full details of this refer to QOWQ5586.*

Client: URS New Zealand Limited
Address: P O Box 3367,
WELLINGTON
Contact: Carmen Sulzberger

Laboratory No: 313773
Date Registered: 11/06/2003
Date Completed: 27/06/2003
Page Number: 1 of 7

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
1A = 1(A) 1 09/06/03 + 1(A)2 09/06/03 + 1(A) 3 09/06/03 + 1(A) 4 09/06/03 (Composite)	313773/30	2.1	< 2	< 0.1	7	6
1B = 1(B) 1 09/06/03 + 1(B)2 09/06/03 + 1(B) 3 09/06/03 + 1(B) 4 09/06/03 (Composite)	313773/31	0.5	5	< 0.1	9	6
1C = 1(C) 1 09/06/03 + 1(C)2 09/06/03 + 1(C) 3 09/06/03 + 1(C) 4 09/06/03 (Composite)	313773/32	1.7	2	< 0.1	12	10
1D = 1(D) 1 09/06/03 + 1(D)2 09/06/03 + 1(D) 3 09/06/03 + 1(D) 4 09/06/03 (Composite)	313773/33	0.3	3	< 0.1	8	4
1A2 = 1(A2) 1 09/06/03 + 1(A2)2 09/06/03 + 1(A2) 3 09/06/03 + 1(A2) 4 09/06/03 (Composite)	313773/34	1.9	< 2	< 0.1	7	6
1E = 1(E) 1 09/06/03 + 1(E)2 09/06/03 + 1(E) 3 09/06/03 + 1(E) 4 09/06/03 (Composite)	313773/35	0.4	4	< 0.1	7	7
1F = 1(F) 1 09/06/03 + 1(F)2 09/06/03 + 1(F) 3 09/06/03 + 1(F) 4 09/06/03 (Composite)	313773/36	0.6	7	0.1	8	9

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
1A = 1(A) 1 09/06/03 + 1(A)2 09/06/03 + 1(A) 3 09/06/03 + 1(A) 4 09/06/03 (Composite)	313773/30	< 0.1	4	5.7	38	80.6
1B = 1(B) 1 09/06/03 + 1(B)2 09/06/03 + 1(B) 3 09/06/03 + 1(B) 4 09/06/03 (Composite)	313773/31	< 0.1	9	8.5	55	92.4
1C = 1(C) 1 09/06/03 + 1(C)2 09/06/03 + 1(C) 3 09/06/03 + 1(C) 4 09/06/03 (Composite)	313773/32	0.1	9	13.5	69	76.5
1D = 1(D) 1 09/06/03 + 1(D)2 09/06/03 + 1(D) 3 09/06/03 + 1(D) 4 09/06/03 (Composite)	313773/33	< 0.1	6	4.5	30	84.5
1A2 = 1(A2) 1 09/06/03 + 1(A2)2 09/06/03 + 1(A2) 3 09/06/03 + 1(A2) 4 09/06/03 (Composite)	313773/34	< 0.1	4	5.3	31	80.6
1E = 1(E) 1 09/06/03 + 1(E)2 09/06/03 + 1(E) 3 09/06/03 + 1(E) 4 09/06/03 (Composite)	313773/35	< 0.1	5	5.3	28	85.9
1F = 1(F) 1 09/06/03 + 1(F)2 09/06/03 + 1(F) 3 09/06/03 + 1(F) 4 09/06/03 (Composite)	313773/36	< 0.1	6	180	79	90.2

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	1A = 1(A) 1 09/06/03 + 1(A)2 09/06/03 + 1(A) 3 09/06/03 + 1(A) 4 09/06/03 (Composite)	1B = 1(B) 1 09/06/03 + 1(B)2 09/06/03 + 1(B) 3 09/06/03 + 1(B) 4 09/06/03 (Composite)	1C = 1(C) 1 09/06/03 + 1(C)2 09/06/03 + 1(C) 3 09/06/03 + 1(C) 4 09/06/03 (Composite)	1D = 1(D) 1 09/06/03 + 1(D)2 09/06/03 + 1(D) 3 09/06/03 + 1(D) 4 09/06/03 (Composite)	1A2 = 1(A2) 1 09/06/03 + 1(A2)2 09/06/03 + 1(A2) 3 09/06/03 + 1(A2) 4 09/06/03 (Composite)
Lab No	313773/30	313773/31	313773/32	313773/33	313773/34
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	0.0010	0.0008	< 0.0009	< 0.0008	< 0.0008
Acenaphthylene	< 0.0008	0.0009	< 0.0009	< 0.0008	< 0.0008
Anthracene	< 0.0008	< 0.0007	< 0.0009	< 0.0008	< 0.0008
Benzo[a]anthracene	0.0017	0.0008	< 0.0009	< 0.0008	0.0009
Benzo[a]pyrene (BAP)	0.0027	0.0013	0.0011	< 0.0008	0.0018
Benzo[b]fluoranthene	0.0042	0.0032	0.0030	< 0.0008	0.0030
Benzo[g,h,i]perylene	0.0016	0.0012	< 0.0009	< 0.0008	0.0013
Benzo[k]fluoranthene	0.0015	0.0008	< 0.0009	< 0.0008	0.0009
Chrysene	0.0055	0.0044	< 0.0009	< 0.0008	0.0042
Dibenzo[a,h]anthracene	< 0.0008	< 0.0007	< 0.0009	< 0.0008	< 0.0008
Fluoranthene	0.0047	0.0028	0.0014	< 0.0008	0.0022
Fluorene	0.0011	0.0009	< 0.0009	< 0.0008	< 0.0008
Indeno(1,2,3-c,d)pyrene	0.0024	0.0018	0.0010	< 0.0008	0.0017
Naphthalene	< 0.004	0.010	0.010	< 0.004	< 0.004
Phenanthrene	< 0.0008	< 0.0007	< 0.0009	< 0.0008	< 0.0008
Pyrene	0.0044	0.0028	0.0012	< 0.0008	0.0021

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	1E = 1(E) 1 09/06/03 + 1(E)2 09/06/03 + 1(E) 3 09/06/03 + 1(E) 4 09/06/03 (Composite)	1F = 1(F) 1 09/06/03 + 1(F)2 09/06/03 + 1(F) 3 09/06/03 + 1(F) 4 09/06/03 (Composite)
Lab No	313773/35	313773/36
Units	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0008	0.0011
Acenaphthylene	< 0.0008	0.0170
Anthracene	0.0010	0.0130
Benzo[a]anthracene	< 0.0008	0.0545
Benzo[a]pyrene (BAP)	< 0.0008	0.0779
Benzo[b]fluoranthene	0.0022	0.118
Benzo[g,h,i]perylene	< 0.0008	0.0500
Benzo[k]fluoranthene	< 0.0008	0.0378
Chrysene	0.0034	0.0703
Dibenzo[a,h]anthracene	0.0041	0.0410
Fluoranthene	0.0027	0.136
Fluorene	< 0.0008	0.0034
Indeno(1,2,3-c,d)pyrene	0.0051	0.120
Naphthalene	0.007	0.005
Phenanthrene	< 0.0008	0.0660
Pyrene	0.0013	0.122

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	1A = 1(A) 1 09/06/03 + 1(A)2 09/06/03 + 1(A) 3 09/06/03 + 1(A) 4 09/06/03 (Composite)	1B = 1(B) 1 09/06/03 + 1(B)2 09/06/03 + 1(B) 3 09/06/03 + 1(B) 4 09/06/03 (Composite)	1C = 1(C) 1 09/06/03 + 1(C)2 09/06/03 + 1(C) 3 09/06/03 + 1(C) 4 09/06/03 (Composite)	1D = 1(D) 1 09/06/03 + 1(D)2 09/06/03 + 1(D) 3 09/06/03 + 1(D) 4 09/06/03 (Composite)	1A2 = 1(A2) 1 09/06/03 + 1(A2)2 09/06/03 + 1(A2) 3 09/06/03 + 1(A2) 4 09/06/03 (Composite)
Lab No	313773/30	313773/31	313773/32	313773/33	313773/34
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 4	< 5	< 5	< 5
C10 - C11	< 5	< 4	< 5	< 5	< 5
C12 -C14	< 5	< 4	7	< 5	< 5
C15 - C20	< 5	< 4	8	< 5	< 5
C21 - C25	< 5	5	< 5	< 5	< 5
C26 - C29	8	6	18	< 5	5
C30 - C44	31	69	77	80	51
Total hydrocarbons (C7 - C44) mg/kg	< 40	80	110	80	60

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	1E = 1(E) 1 09/06/03 + 1(E)2 09/06/03 + 1(E) 3 09/06/03 + 1(E) 4 09/06/03 (Composite)	1F = 1(F) 1 09/06/03 + 1(F)2 09/06/03 + 1(F) 3 09/06/03 + 1(F) 4 09/06/03 (Composite)
Lab No	313773/35	313773/36
Units	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 4
C10 - C11	< 5	< 4
C12 -C14	< 5	< 4
C15 - C20	< 5	< 4
C21 - C25	< 5	< 4
C26 - C29	15	5
C30 - C44	85	61
Total hydrocarbons (C7 - C44) mg/kg	100	70

Sample Type: Water,

Sample Name		EB1 09/06/03
Lab No		313773/1
Total Boron	(g.m-3)	0.012
Total Arsenic	(g.m-3)	< 0.001
Total Cadmium	(g.m-3)	0.00006
Total Chromium	(g.m-3)	< 0.0005
Total Copper	(g.m-3)	0.0492
Total Mercury	(g.m-3)	< 0.00008
Total Nickel	(g.m-3)	< 0.0005
Total Lead	(g.m-3)	0.0002
Total Zinc	(g.m-3)	0.011

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	EB1 09/06/03
Lab No	313773/1
Units	(g.m-3)
C7 - C9	< 0.03
C10 - C11	< 0.03
C12 - C14	< 0.03
C15 - C20	< 0.03
C21 - C25	< 0.03
C26 - C29	< 0.03
C30 - C44	< 0.05
Total hydrocarbons (C7 - C44) g.m-3	< 0.2

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass for TPH (250 or 500 mL)	250	1
Nitric Preserved (100 mL)	100	1
Glass Jar (Soils)	500	28

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

* This test is not accredited.

Substance Type: Water

Parameter	Method Used	Detection Limit
Total (nitric) acid digest for low level metals	Boiling nitric acid digestion. APHA 3030 E 20th ed. 1998	N/A
Total Boron	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.005 g.m-3
Total Arsenic	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Total Cadmium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.00005 g.m-3
Total Chromium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Copper	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Mercury	Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2	0.00008 g.m-3
Total Nickel	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Lead	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0001 g.m-3
Total Zinc	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Petroleum hydrocarbons by GC-FID, carbon banding	Solvent extraction (hexane), GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

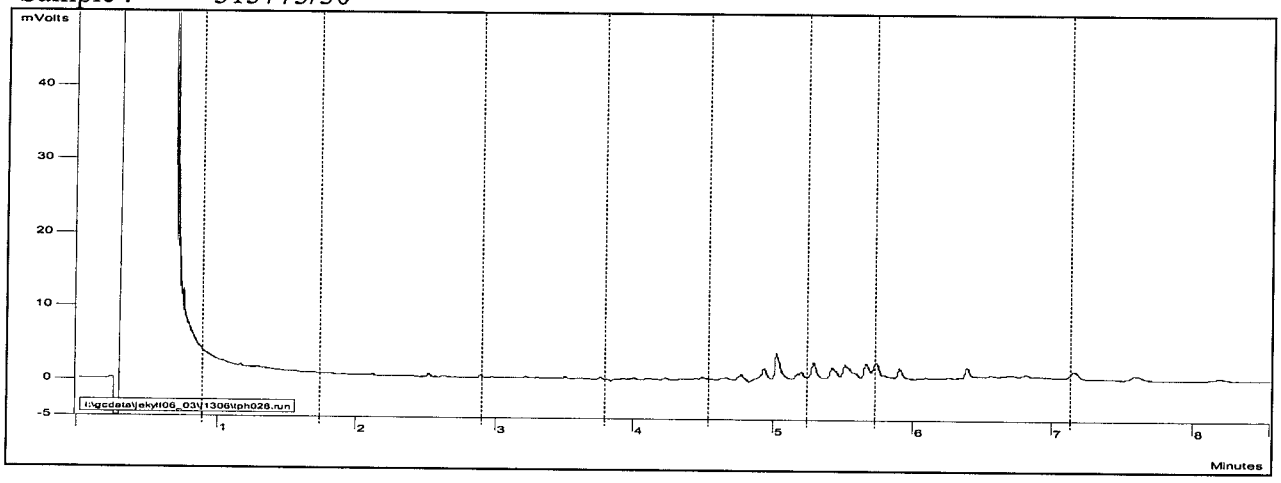
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

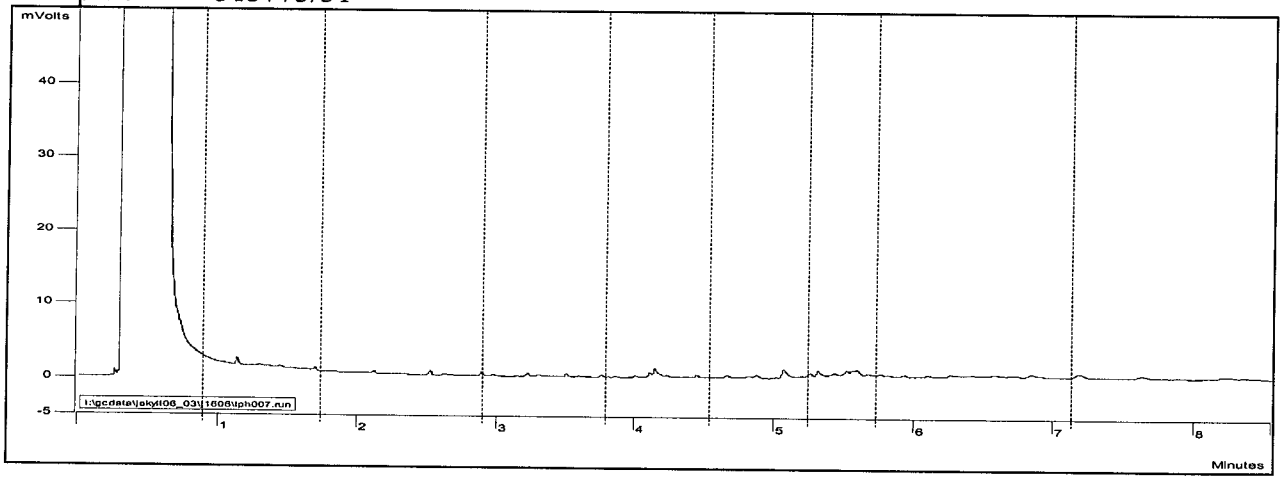
Total Petroleum Hydrocarbon Chromatograms

Appendix

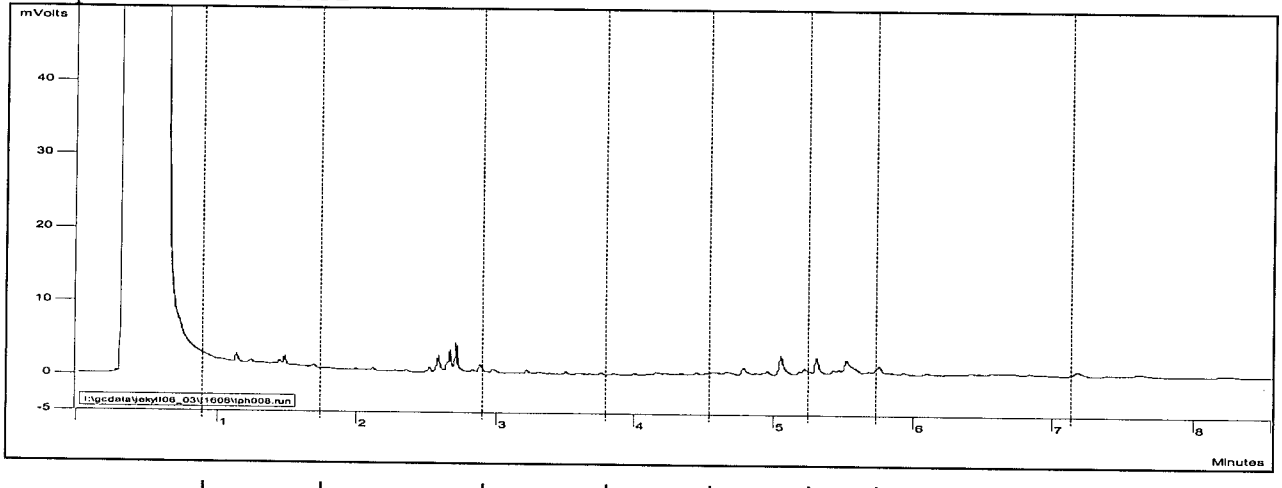
Sample : 313773/30



Sample : 313773/31



Sample : 313773/32



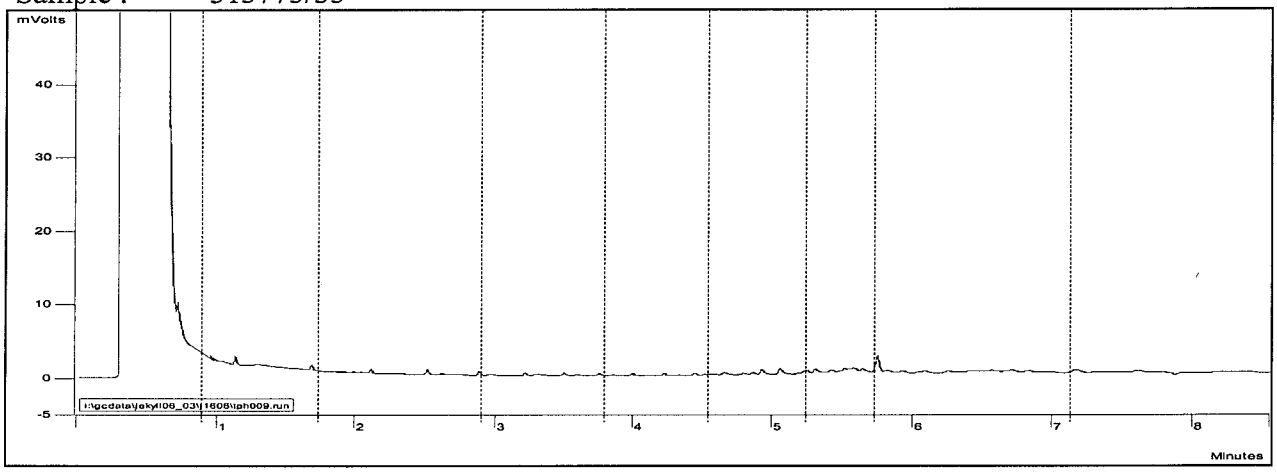
C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories, Hamilton, NZ

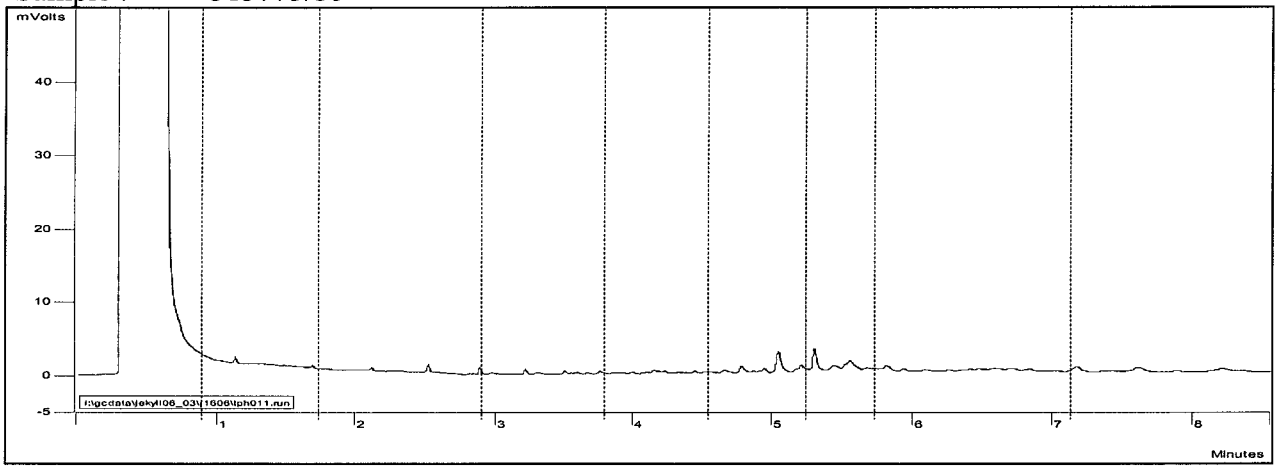
Total Petroleum Hydrocarbon Chromatograms

Appendix

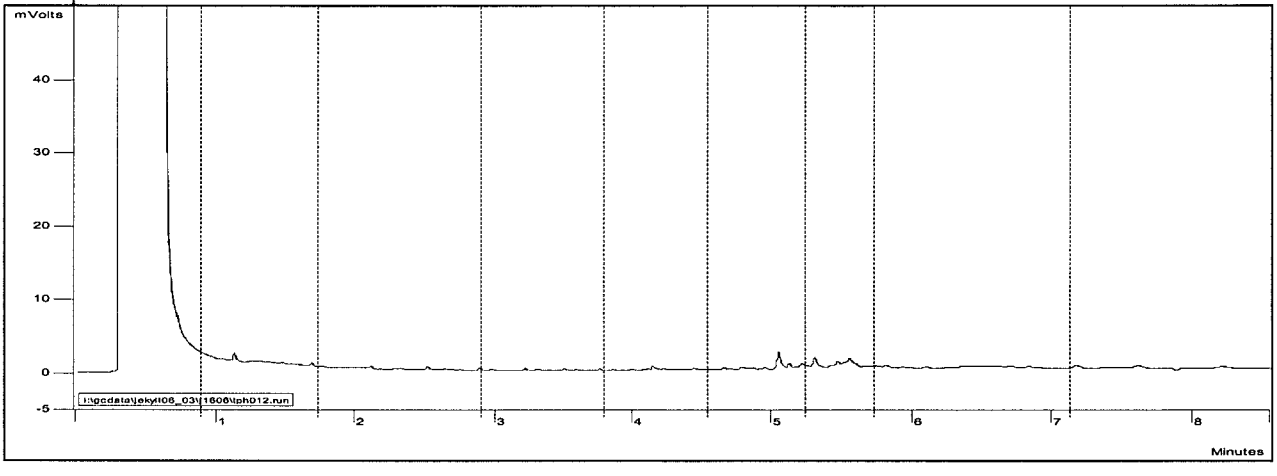
Sample : 313773/33



Sample : 313773/35



Sample : 313773/36



C7 C10 C15 C20 C25 C30 C34 C44

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- 2 JUL 2003

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Amended Report: *This is an amended report which replaces a report issued on the 23/06/2003. The TPH results have been corrected to TPHGC, with C7-C44 reported. For full details of this refer to QOWQ5586.*

Client: *URS New Zealand Limited*
Address: *P O Box 3367, WELLINGTON*
Contact: *Carmen Sulzberger*

Laboratory No: *313417*
Date Registered: *6/06/2003*
Date Completed: *27/06/2003*
Page Number: *1 of 8*

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
2A = 2(A)1 + 2(A)2 + 2(A)3 + 2(A)4 03/06/03 (Composite)	313417/45	1.2	< 2	< 0.1	6	3
2B = 2(B)1 + 2(B)2 + 2(B)3 + 2(B)4 03/06/03 (Compsite)	313417/46	1.3	6	< 0.1	11	7
2C = 2(C)1 + 2(C)2 + 2(C)3 + 2(C)4 03/06/03 (Composite)	313417/47	1.8	3	< 0.1	10	6
2D = 2(D)1 + 2(D)2 + 2(D)3 + 2(D)4 03/06/03 (Composite)	313417/48	1.2	7	< 0.1	13	18
2E = 2(E)1 + 2(E)2 + 2(E)3 + 2(E)4 04/06/03 (Composite)	313417/49	1.3	6	< 0.1	14	10
2F = 2(F)1 + 2(F)2 + 2(F)3 + 2(F)4 04/06/03 (Composite)	313417/50	1.1	5	< 0.1	16	11
2G = 2(G)1 + 2(G)2 + 2(G)3 + 2(G)4 04/06/03 (Composite)	313417/51	1.1	3	< 0.1	15	11
2H = 2(H)1 + 2(H)2 + 2(H)3 + 2(H)4 04/06/03 (Composite)	313417/52	1.7	7	0.1	14	25
2I = 2(I)1 + 2(I)2 + 2(I)3 + 2(I)4 04/06/03 (Composite)	313417/53	1.3	5	< 0.1	14	6
2K = 2(K)1 + 2(K)2 + 2(K)3 + 2(K)4 05/06/03 (Composite)	313417/54	1.8	5	< 0.1	15	15
2L = 2(L)1 + 2(L)2 + 2(L)3 + 2(L)4 05/06/03 (Composite)	313417/55	2.2	4	< 0.1	13	8

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
2A = 2(A)1 + 2(A)2 + 2(A)3 + 2(A)4 03/06/03 (Composite)	313417/45	< 0.1	4	5.9	24	89.8
2B = 2(B)1 + 2(B)2 + 2(B)3 + 2(B)4 03/06/03 (Compsite)	313417/46	< 0.1	7	13.1	39	88.5
2C = 2(C)1 + 2(C)2 + 2(C)3 + 2(C)4 03/06/03 (Composite)	313417/47	0.1	6	9.3	33	88.2
2D = 2(D)1 + 2(D)2 + 2(D)3 + 2(D)4 03/06/03 (Composite)	313417/48	0.1	12	21.2	74	81.8
2E = 2(E)1 + 2(E)2 + 2(E)3 + 2(E)4 04/06/03 (Composite)	313417/49	0.1	7	14.5	36	77.9
2F = 2(F)1 + 2(F)2 + 2(F)3 + 2(F)4 04/06/03 (Composite)	313417/50	< 0.1	9	22.1	57	79.8
2G = 2(G)1 + 2(G)2 + 2(G)3 + 2(G)4 04/06/03 (Composite)	313417/51	0.1	9	31.2	53	83.9
2H = 2(H)1 + 2(H)2 + 2(H)3 + 2(H)4 04/06/03 (Composite)	313417/52	0.2	13	78.6	105	83.1
2I = 2(I)1 + 2(I)2 + 2(I)3 + 2(I)4 04/06/03 (Composite)	313417/53	< 0.1	6	20.7	52	85.6
2K = 2(K)1 + 2(K)2 + 2(K)3 + 2(K)4 05/06/03 (Composite)	313417/54	< 0.1	12	29.9	80	89.8
2L = 2(L)1 + 2(L)2 + 2(L)3 + 2(L)4 05/06/03 (Composite)	313417/55	0.1	6	24.5	32	80.8

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	2A = 2(A)1 + 2(A)2 + 2(A)3 + 2(A)4 03/06/03 (Composite)	2B = 2(B)1 + 2(B)2 + 2(B)3 + 2(B)4 03/06/03 (Compsite)	2C = 2(C)1 + 2(C)2 + 2(C)3 + 2(C)4 03/06/03 (Composite)	2D = 2(D)1 + 2(D)2 + 2(D)3 + 2(D)4 03/06/03 (Composite)	2E = 2(E)1 + 2(E)2 + 2(E)3 + 2(E)4 04/06/03 (Composite)
Lab No	313417/45	313417/46	313417/47	313417/48	313417/49
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009
Acenaphthylene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009
Anthracene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009
Benzo[a]anthracene	0.0029	0.0018	< 0.0008	0.0013	< 0.0009
Benzo[a]pyrene (BAP)	0.0033	0.0017	< 0.0008	0.0015	0.0013
Benzo[b]fluoranthene	0.0061	0.0032	< 0.0008	0.0027	0.0024
Benzo[g,h,i]perylene	0.0024	0.0013	< 0.0008	0.0012	0.0012
Benzo[k]fluoranthene	0.0022	0.0012	< 0.0008	< 0.0008	0.0009
Chrysene	0.0074	0.0061	< 0.0008	0.0049	< 0.0009
Dibenzo[a,h]anthracene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009
Fluoranthene	0.0068	0.0050	0.0013	0.0034	0.0025
Fluorene	< 0.0007	< 0.0008	< 0.0008	< 0.0008	< 0.0009

Sample Name	2A = 2(A)1 + 2(A)2 + 2(A)3 + 2(A)4 03/06/03 (Composite)	2B = 2(B)1 + 2(B)2 + 2(B)3 + 2(B)4 03/06/03 (Compsite)	2C = 2(C)1 + 2(C)2 + 2(C)3 + 2(C)4 03/06/03 (Composite)	2D = 2(D)1 + 2(D)2 + 2(D)3 + 2(D)4 03/06/03 (Composite)	2E = 2(E)1 + 2(E)2 + 2(E)3 + 2(E)4 04/06/03 (Composite)
Lab No	313417/45	313417/46	313417/47	313417/48	313417/49
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Indeno(1,2,3-c,d)pyrene	0.0035	0.0015	< 0.0008	0.0016	0.0014
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	0.0016	0.0025	< 0.0008	0.0016	0.0009
Pyrene	0.0068	0.0050	0.0012	0.0034	0.0025

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	2F = 2(F)1 + 2(F)2 + 2(F)3 + 2(F)4 04/06/03 (Composite)	2G = 2(G)1 + 2(G)2 + 2(G)3 + 2(G)4 04/06/03 (Composite)	2H = 2(H)1 + 2(H)2 + 2(H)3 + 2(H)4 04/06/03 (Composite)	2I = 2(I)1 + 2(I)2 + 2(I)3 + 2(I)4 04/06/03 (Composite)	2K = 2(K)1 + 2(K)2 + 2(K)3 + 2(K)4 05/06/03 (Composite)
Lab No	313417/50	313417/51	313417/52	313417/53	313417/54
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0008	< 0.0008	0.0063	< 0.0008	0.0029
Acenaphthylene	0.0022	< 0.0008	0.0469	0.0073	0.0086
Anthracene	0.0025	0.0027	0.0481	0.0041	0.0099
Benzo[a]anthracene	0.0079	0.0083	0.206	0.0188	0.0445
Benzo[a]pyrene (BAP)	0.0092	0.0106	0.270	0.0326	0.0477
Benzo[b]fluoranthene	0.0142	0.0173	0.407	0.0512	0.0712
Benzo[g,h,i]perylene	0.0071	0.0096	0.229	0.0323	0.0349
Benzo[k]fluoranthene	0.0050	0.0057	0.131	0.0202	0.0275
Chrysene	0.0139	0.0129	0.260	0.0254	0.0565
Dibenzo[a,h]anthracene	0.0021	0.0029	0.0718	0.0103	0.0115
Fluoranthene	0.0218	0.0206	0.547	0.0317	0.126
Fluorene	0.0009	< 0.0008	0.0108	< 0.0008	0.0056
Indeno(1,2,3-c,d)pyrene	0.0082	0.0119	0.315	0.0440	0.0461
Naphthalene	< 0.004	< 0.004	0.012	< 0.004	< 0.004
Phenanthrene	0.0125	0.0087	0.257	0.0085	0.0934
Pyrene	0.0201	0.0209	0.574	0.0316	0.124

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	2L = 2(L)1 + 2(L)2 + 2(L)3 + 2(L)4 05/06/03 (Composite)
Lab No	313417/55
Units	(mg/kg dry wt)
Acenaphthene	< 0.0008
Acenaphthylene	< 0.0008
Anthracene	0.0008
Benzo[a]anthracene	0.0060
Benzo[a]pyrene (BAP)	0.0070
Benzo[b]fluoranthene	0.0152
Benzo[g,h,i]perylene	0.0061
Benzo[k]fluoranthene	0.0049
Chrysene	0.0110
Dibenzo[a,h]anthracene	0.0018
Fluoranthene	0.0154

Sample Name	2L = 2(L)1 + 2(L)2 + 2(L)3 + 2(L)4 05/06/03 (Composite)
Lab No	313417/55
Units	(mg/kg dry wt)
Fluorene	< 0.0008
Indeno(1,2,3-c,d)pyrene	0.0090
Naphthalene	< 0.004
Phenanthrene	0.0033
Pyrene	0.0148

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	2A = 2(A)1 + 2(A)2 + 2(A)3 + 2(A)4 03/06/03 (Composite)	2B = 2(B)1 + 2(B)2 + 2(B)3 + 2(B)4 03/06/03 (Compsite)	2C = 2(C)1 + 2(C)2 + 2(C)3 + 2(C)4 03/06/03 (Composite)	2D = 2(D)1 + 2(D)2 + 2(D)3 + 2(D)4 03/06/03 (Composite)	2E = 2(E)1 + 2(E)2 + 2(E)3 + 2(E)4 04/06/03 (Composite)
Lab No	313417/45	313417/46	313417/47	313417/48	313417/49
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 4	5	< 5	< 5	< 5
C10 - C11	< 4	< 4	< 5	< 5	< 5
C12 -C14	< 4	< 4	< 5	< 5	< 5
C15 - C20	< 4	6	< 5	< 5	< 5
C21 - C25	< 4	< 4	8	5	16
C26 - C29	6	10	8	8	< 5
C30 - C44	22	46	37	25	14
Total hydrocarbons (C7 - C44) mg/kg	< 30	70	50	40	50

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	2F = 2(F)1 + 2(F)2 + 2(F)3 + 2(F)4 04/06/03 (Composite)	2G = 2(G)1 + 2(G)2 + 2(G)3 + 2(G)4 04/06/03 (Composite)	2H = 2(H)1 + 2(H)2 + 2(H)3 + 2(H)4 04/06/03 (Composite)	2I = 2(I)1 + 2(I)2 + 2(I)3 + 2(I)4 04/06/03 (Composite)	2K = 2(K)1 + 2(K)2 + 2(K)3 + 2(K)4 05/06/03 (Composite)
Lab No	313417/50	313417/51	313417/52	313417/53	313417/54
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 5	< 5	< 5	< 4
C10 - C11	< 5	< 5	< 5	< 5	< 4
C12 -C14	< 5	< 5	< 5	< 5	< 4
C15 - C20	9	41	6	< 5	19
C21 - C25	8	23	14	< 5	80
C26 - C29	7	19	13	< 5	6
C30 - C44	15	52	44	< 9	50
Total hydrocarbons (C7 - C44) mg/kg	40	140	80	< 40	160

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	2L = 2(L)1 + 2(L)2 + 2(L)3 + 2(L)4 05/06/03 (Composite)
Lab No	313417/55
Units	(mg/kg dry wt)
C7 - C9	< 5
C10 - C11	< 5
C12 -C14	< 5
C15 - C20	< 5
C21 - C25	15
C26 - C29	36
C30 - C44	138
Total hydrocarbons (C7 - C44) mg/kg	190

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass Jar (Soils)	500	44

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

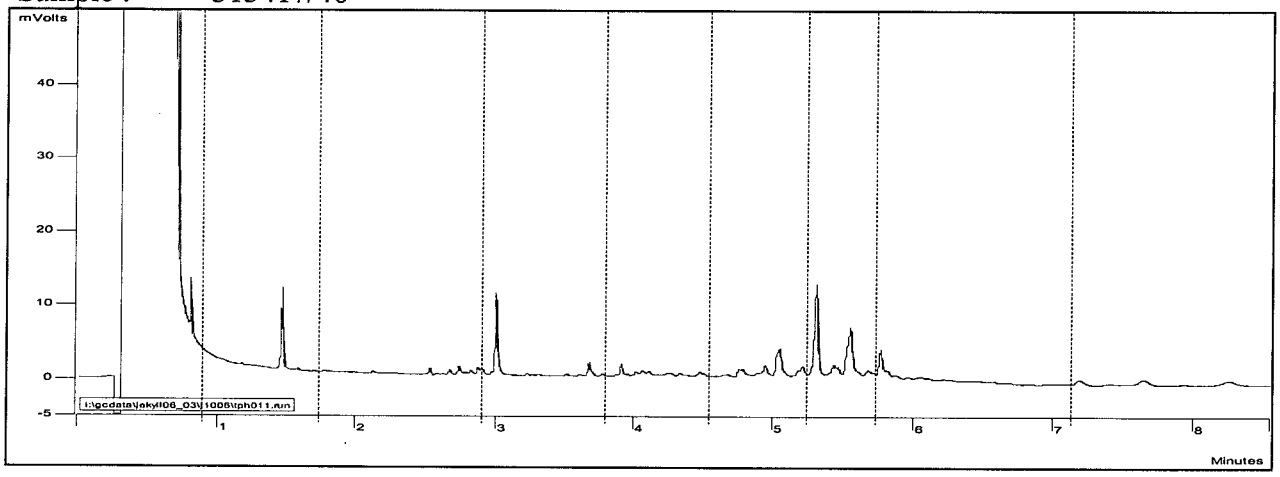
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

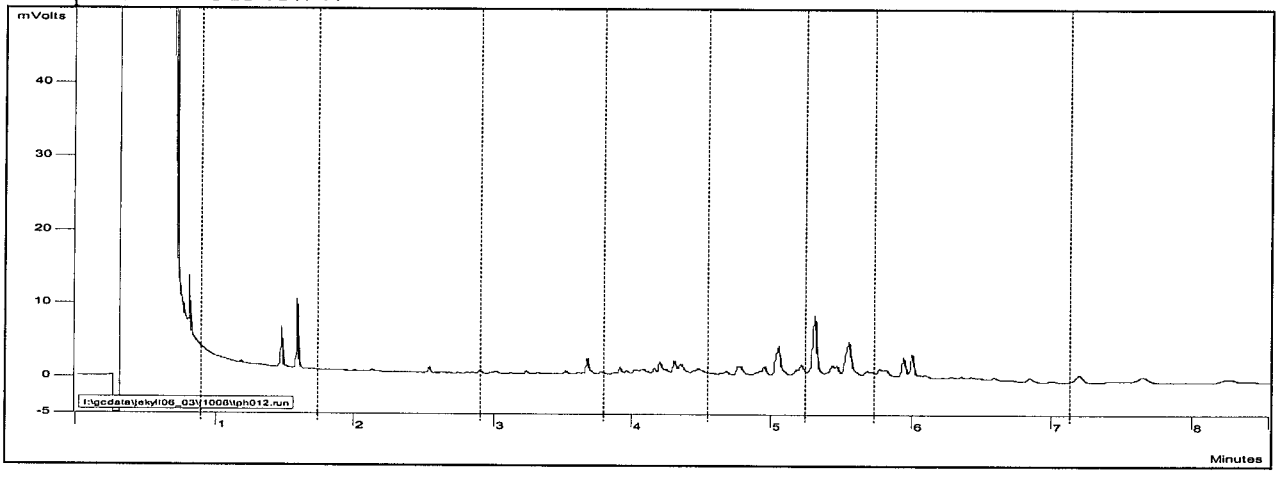
Total Petroleum Hydrocarbon Chromatograms

Appendix

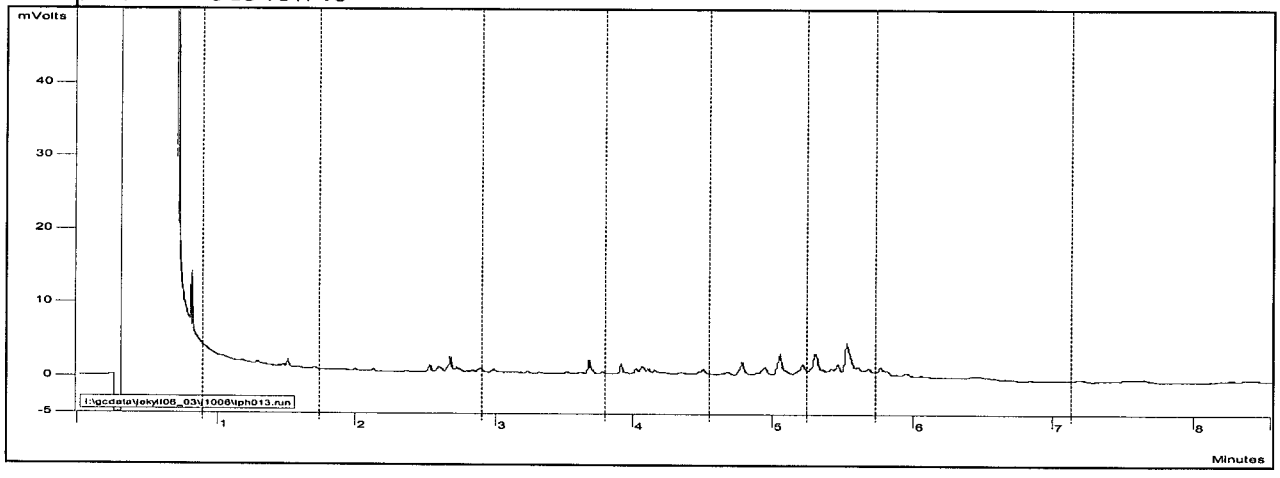
Sample : 313417/46



Sample : 313417/47



Sample : 313417/48



C7 C10 C15 C20 C25 C30 C34 C44

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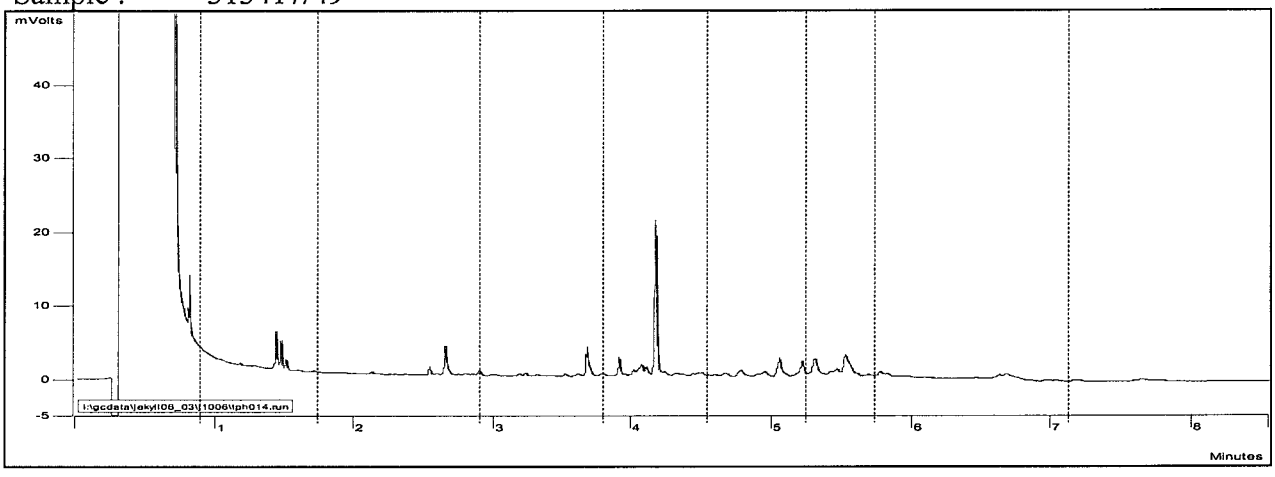
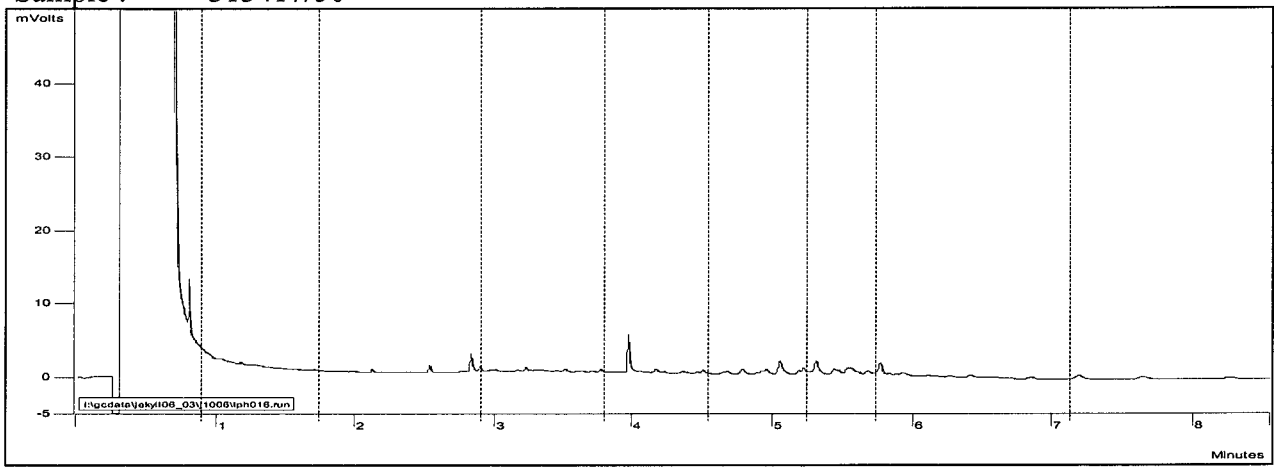
Total Petroleum Hydrocarbon Chromatograms

Appendix

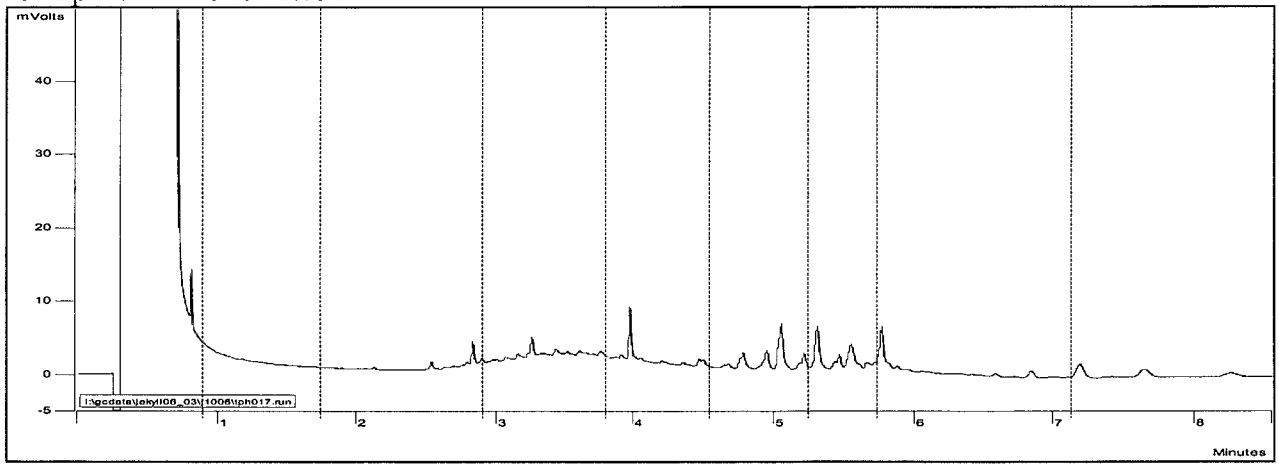
Sample : 313417/49



Sample : 313417/50



Sample : 313417/51



C7 C10 C15 C20 C25 C30 C34 C44

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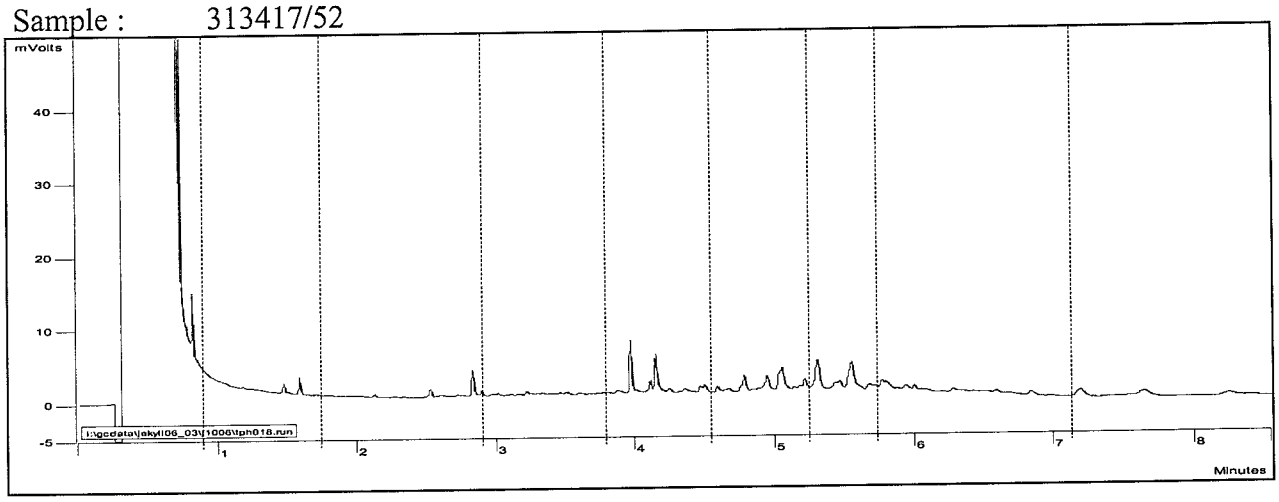
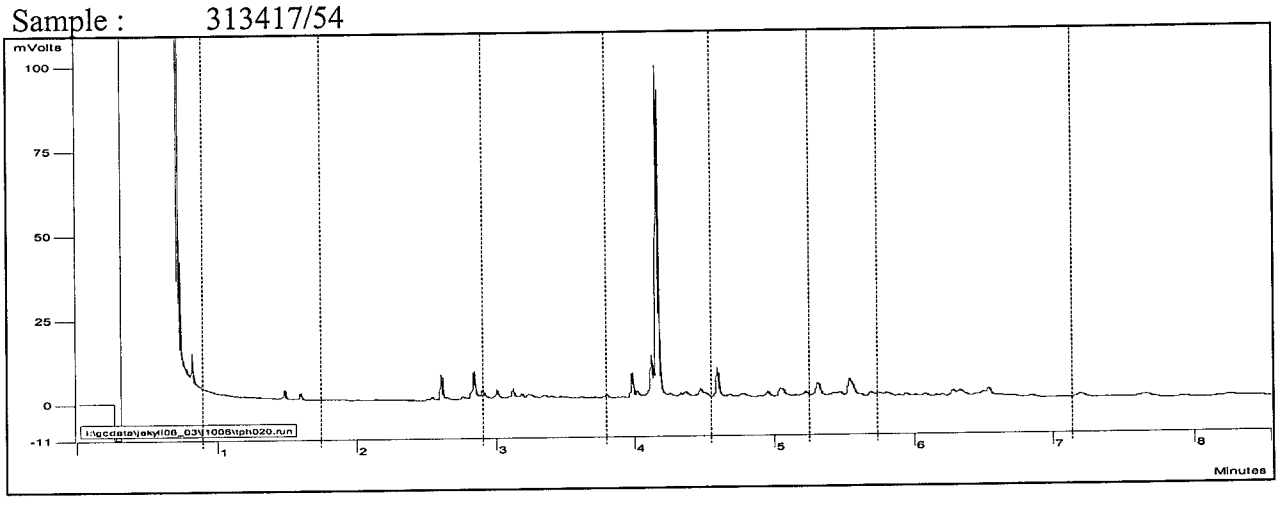
Total Petroleum Hydrocarbon Chromatograms

Appendix

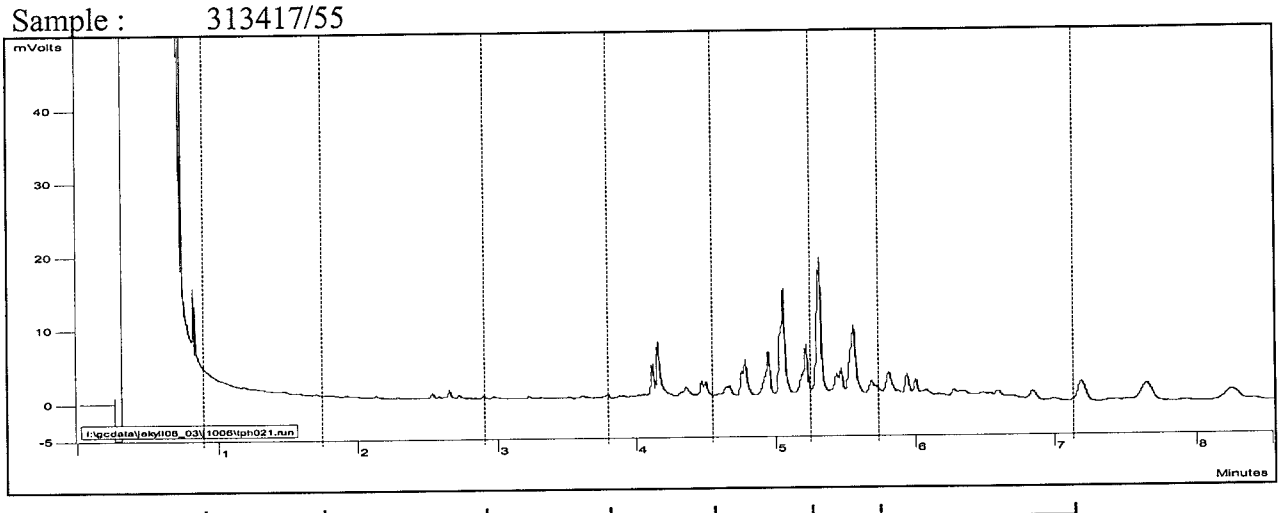
Sample : 313417/52



Sample : 313417/54



Sample : 313417/55



C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories

- 3 JUL 2003

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Amended Report: *This is an amended report which replaces a report issued on the 23/06/2003. The TPH results have been corrected to TPHGC, with C7-C44 reported. For full details of this refer to QOWQ5586.*

Client: *URS New Zealand Limited*
Address: *P O Box 3367, WELLINGTON*
Contact: *Carmen Sulzberger*

Laboratory No: *314144*
Date Registered: *17/06/2003*
Date Completed: *27/06/2003*
Page Number: *1 of 7*

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
3(A)1 + 3(A)2 + 3(A)3 + 3(A)4 12/6/03 (Composite)	314144/42	0.9	2	< 0.1	9	6
3(B)1 + 3(B)2 + 3(B)3 + 3(B)4 12/6/03 (Composite)	314144/43	1.6	3	< 0.1	15	5
3(C)1 + 3(C)2 + 3(C)3 + 3(C)4 12/6/03 (Composite)	314144/44	0.6	7	0.1	18	13
3(D)1 + 3(D)2 + 3(D)3 + 3(D)4 12/6/03 (Composite)	314144/45	0.9	5	0.1	12	13
3(E)1 + 3(E)2 + 3(E)3 + 3(E)4 13/6/03 (Composite)	314144/46	1.0	5	0.2	14	18
3(F)1 + 3(F)2 + 3(F)3 + 3(F)4 13/6/03 (Composite)	314144/47	0.4	5	< 0.1	16	13
3(F2)1 + 3(F2)2 + 3(F2)3 + 3(F2)4 13/6/03 (Composite)	314144/48	0.3	5	< 0.1	17	13
2(M)1 + 2(M)2 + 2(M)3 + 2(M)4 13/6/03 (Composite)	314144/49	0.9	3	0.1	9	8
3(G)1 + 3(G)2 + 3(G)3 + 3(G)4 15/6/03 (Composite)	314144/50	0.3	4	< 0.1	17	11
3(H)1 + 3(H)2 + 3(H)3 + 3(H)4 15/6/03 (Composite)	314144/51	0.4	7	0.1	17	19

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
3(A)1 + 3(A)2 + 3(A)3 + 3(A)4 12/6/03 (Composite)	314144/42	2.6	5	16.7	38	68.3
3(B)1 + 3(B)2 + 3(B)3 + 3(B)4 12/6/03 (Composite)	314144/43	0.1	7	17.9	42	77.1
3(C)1 + 3(C)2 + 3(C)3 + 3(C)4 12/6/03 (Composite)	314144/44	< 0.1	14	31.1	86	75.7
3(D)1 + 3(D)2 + 3(D)3 + 3(D)4 12/6/03 (Composite)	314144/45	0.1	9	53.9	109	74.2
3(E)1 + 3(E)2 + 3(E)3 + 3(E)4 13/6/03 (Composite)	314144/46	0.2	7	73.3	201	74.6
3(F)1 + 3(F)2 + 3(F)3 + 3(F)4 13/6/03 (Composite)	314144/47	0.1	13	33.1	73	86.7
3(F2)1 + 3(F2)2 + 3(F2)3 + 3(F2)4 13/6/03 (Composite)	314144/48	0.1	13	31.6	72	86.1
2(M)1 + 2(M)2 + 2(M)3 + 2(M)4 13/6/03 (Composite)	314144/49	< 0.1	9	14.4	53	67.8
3(G)1 + 3(G)2 + 3(G)3 + 3(G)4 15/6/03 (Composite)	314144/50	< 0.1	14	32.7	76	83.3
3(H)1 + 3(H)2 + 3(H)3 + 3(H)4 15/6/03 (Composite)	314144/51	0.1	14	51.9	97	79.7

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	3(A)1 + 3(A)2 + 3(A)3 + 3(A)4 12/6/03 (Composite)	3(B)1 + 3(B)2 + 3(B)3 + 3(B)4 12/6/03 (Composite)	3(C)1 + 3(C)2 + 3(C)3 + 3(C)4 12/6/03 (Composite)	3(D)1 + 3(D)2 + 3(D)3 + 3(D)4 12/6/03 (Composite)	3(E)1 + 3(E)2 + 3(E)3 + 3(E)4 13/6/03 (Composite)
Lab No	314144/42	314144/43	314144/44	314144/45	314144/46
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	0.001	< 0.0008	< 0.0008	0.0089	< 0.0009
Acenaphthylene	0.009	0.0011	0.0021	0.0080	0.0076
Anthracene	0.006	0.0010	0.0010	0.0250	0.0063
Benzo[a]anthracene	0.013	0.0051	0.0060	0.126	0.0450
Benzo[a]pyrene (BAP)	0.014	0.0048	0.0095	0.136	0.0660
Benzo[b]fluoranthene	0.021	0.0076	0.0153	0.192	0.0828
Benzo[g,h,i]perylene	0.010	0.0035	0.0083	0.0847	0.0525
Benzo[k]fluoranthene	0.007	0.0027	0.0047	0.0560	0.0261
Chrysene	0.017	0.0072	0.0100	0.122	0.0555
Dibenzo[a,h]anthracene	0.004	< 0.0008	0.0024	0.0396	0.0166
Fluoranthene	0.031	0.0126	0.0127	0.259	0.103
Fluorene	0.004	< 0.0008	0.0009	0.0069	0.0014
Indeno(1,2,3-c,d)pyrene	0.010	0.0049	0.0098	0.126	0.0603
Naphthalene	0.006	0.008	< 0.004	< 0.004	< 0.004
Phenanthrene	0.038	0.0063	0.0069	0.112	0.0348
Pyrene	0.033	0.0144	0.0145	0.238	0.124

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	3(F)1 + 3(F)2 + 3(F)3 + 3(F)4 13/6/03 (Composite)	3(F2)1 + 3(F2)2 + 3(F2)3 + 3(F2)4 13/6/03 (Composite)	2(M)1 + 2(M)2 + 2(M)3 + 2(M)4 13/6/03 (Composite)	3(G)1 + 3(G)2 + 3(G)3 + 3(G)4 15/6/03 (Composite)	3(H)1 + 3(H)2 + 3(H)3 + 3(H)4 15/6/03 (Composite)
Lab No	314144/47	314144/48	314144/49	314144/50	314144/51
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0007	< 0.0008	< 0.001	< 0.0008	0.0019
Acenaphthylene	0.0020	0.0018	< 0.001	0.0036	0.0590
Anthracene	0.0009	< 0.0008	< 0.001	0.0021	0.0362
Benzo[a]anthracene	0.0032	0.0024	0.001	0.0093	0.196
Benzo[a]pyrene (BAP)	0.0049	0.0039	0.002	0.0155	0.328
Benzo[b]fluoranthene	0.0082	0.0065	0.004	0.0222	0.369
Benzo[g,h,i]perylene	0.0052	0.0046	0.002	0.0152	0.255
Benzo[k]fluoranthene	0.0027	0.0021	0.001	0.0073	0.132
Chrysene	0.0056	0.0064	0.004	0.0125	0.197
Dibenzo[a,h]anthracene	0.0016	0.0011	< 0.001	0.0043	0.0898
Fluoranthene	0.0071	0.0062	0.004	0.0199	0.386
Fluorene	< 0.0007	< 0.0008	< 0.001	0.0015	0.0079
Indeno(1,2,3-c,d)pyrene	0.0053	0.0043	0.002	0.0141	0.323
Naphthalene	< 0.004	< 0.004	< 0.005	< 0.004	0.012
Phenanthrene	0.0049	0.0048	0.001	0.0131	0.118
Pyrene	0.0083	0.0072	0.003	0.0247	0.461

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	3(A)1 + 3(A)2 + 3(A)3 + 3(A)4 12/6/03 (Composite)	3(B)1 + 3(B)2 + 3(B)3 + 3(B)4 12/6/03 (Composite)	3(C)1 + 3(C)2 + 3(C)3 + 3(C)4 12/6/03 (Composite)	3(D)1 + 3(D)2 + 3(D)3 + 3(D)4 12/6/03 (Composite)	3(E)1 + 3(E)2 + 3(E)3 + 3(E)4 13/6/03 (Composite)
Lab No	314144/42	314144/43	314144/44	314144/45	314144/46
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 20	< 5	< 10	< 5	< 5
C10 - C11	< 20	< 5	< 10	< 5	< 5
C12 -C14	< 20	< 5	< 10	< 5	< 5
C15 - C20	< 20	< 5	< 10	< 5	< 5
C21 - C25	< 20	9	< 10	< 5	< 5
C26 - C29	50	47	23	< 5	9
C30 - C44	211	139	53	< 10	21
Total hydrocarbons (C7 - C44) mg/kg	260	200	< 100	< 40	< 40

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	3(F)1 + 3(F)2 + 3(F)3 + 3(F)4 13/6/03 (Composite)	3(F2)1 + 3(F2)2 + 3(F2)3 + 3(F2)4 13/6/03 (Composite)	2(M)1 + 2(M)2 + 2(M)3 + 2(M)4 13/6/03 (Composite)	3(G)1 + 3(G)2 + 3(G)3 + 3(G)4 15/6/03 (Composite)	3(H)1 + 3(H)2 + 3(H)3 + 3(H)4 15/6/03 (Composite)
Lab No	314144/47	314144/48	314144/49	314144/50	314144/51
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 5	< 8	< 7	< 7
C10 - C11	< 5	< 5	< 8	< 7	< 7
C12 -C14	< 5	< 5	< 8	< 7	< 7
C15 - C20	10	13	< 8	< 7	< 7
C21 - C25	< 5	5	< 8	< 7	< 7
C26 - C29	20	23	< 8	8	11
C30 - C44	69	76	59	24	22
Total hydrocarbons (C7 - C44) mg/kg	100	120	< 70	< 50	< 60

Sample Type: Water,

Sample Name		3(1) + 3(2) 13/6/03
Lab No		314144/1
Total Arsenic	(g.m-3)	< 0.001
Total Cadmium	(g.m-3)	0.00005
Total Chromium	(g.m-3)	< 0.0005
Total Copper	(g.m-3)	0.0961
Total Mercury	(g.m-3)	< 0.00008
Total Nickel	(g.m-3)	0.0009
Total Lead	(g.m-3)	0.0021
Total Zinc	(g.m-3)	0.008

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	3(1) + 3(2) 13/6/03
Lab No	314144/1
Units	(g.m-3)
C7 - C9	< 0.03
C10 - C11	< 0.03
C12 - C14	< 0.03
C15 - C20	< 0.03
C21 - C25	< 0.03
C26 - C29	< 0.03
C30 - C44	< 0.05
Total hydrocarbons (C7 - C44) g.m-3	< 0.2

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass for TPH (250 or 500 mL)	250	1
Nitric Preserved (100 mL)	100	1
Glass Jar (Soils)	500	40

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

* This test is not accredited.

Substance Type: Water

Parameter	Method Used	Detection Limit
Total (nitric) acid digest for low level metals	Boiling nitric acid digestion. APHA 3030 E 20th ed. 1998	N/A
Total Arsenic	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Total Cadmium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.00005 g.m-3
Total Chromium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Copper	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Mercury	Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2	0.00008 g.m-3
Total Nickel	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Lead	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0001 g.m-3
Total Zinc	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Petroleum hydrocarbons by GC-FID, carbon banding	Solvent extraction (hexane), GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

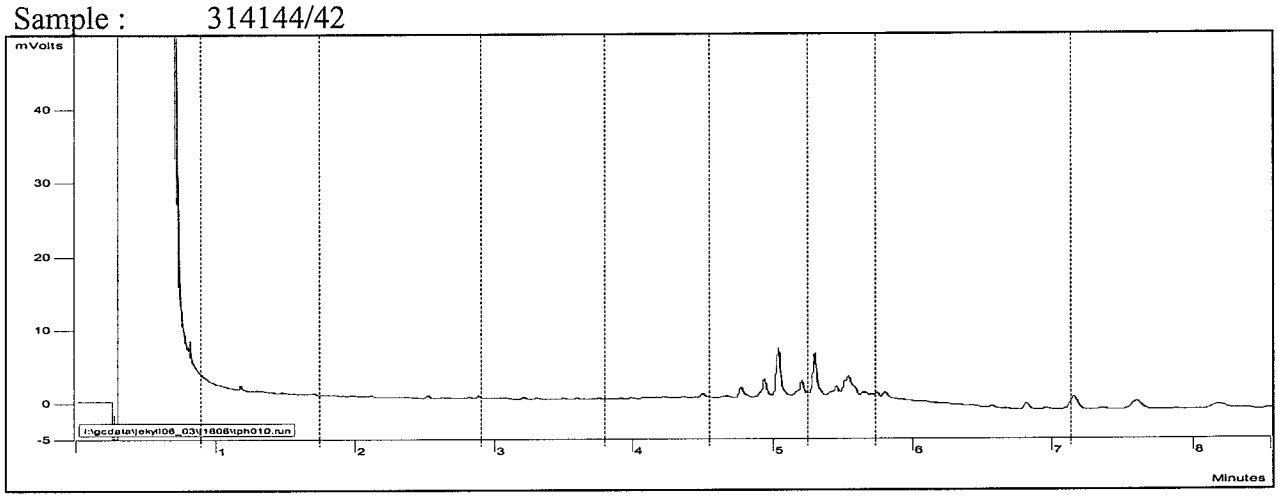
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314144/42



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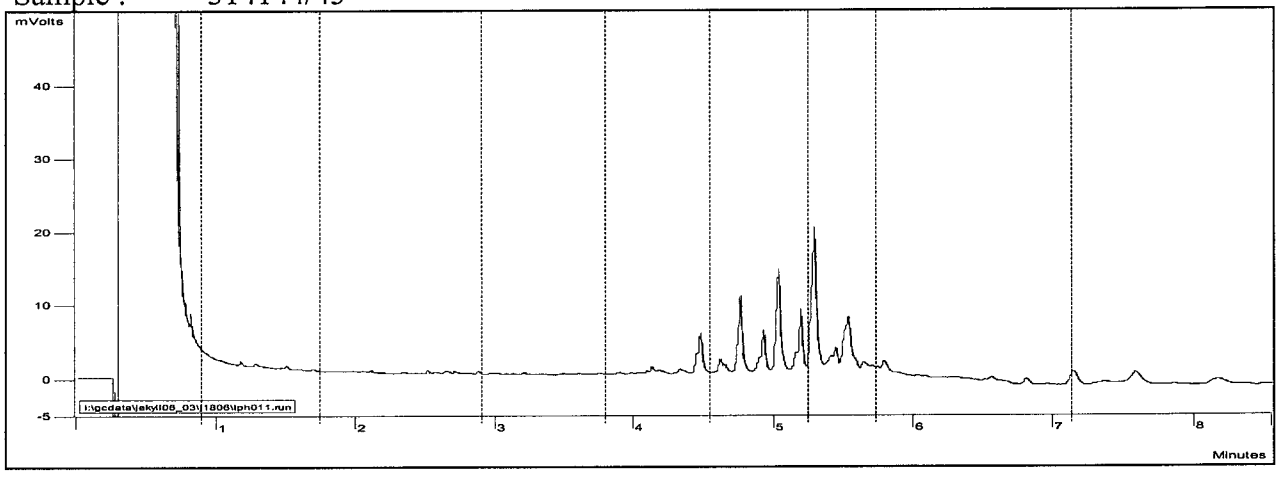
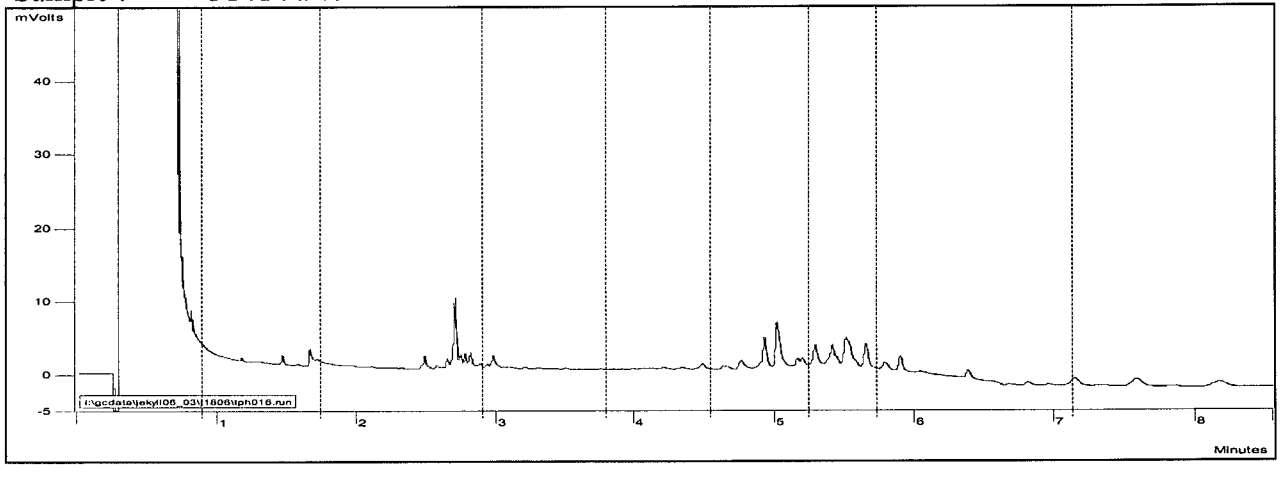


Sample : 314144/47



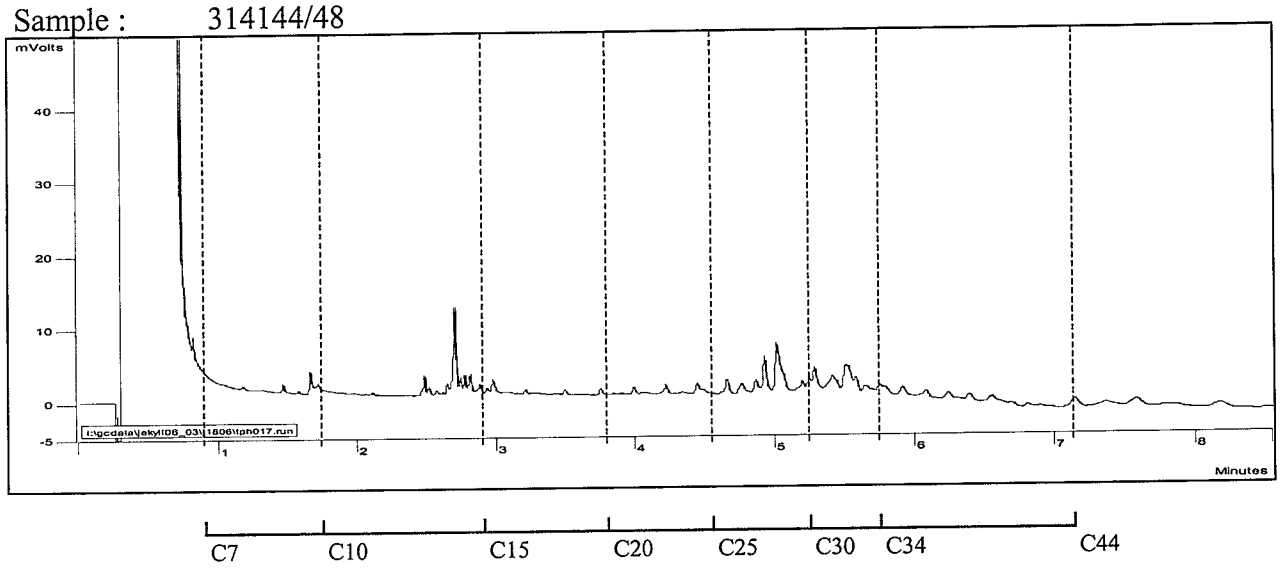
C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories, Hamilton, NZ

Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314144/48



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- 3 JUL 2003

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Laboratory No: 314571
Date Registered: 21/06/2003
Date Completed: 30/06/2003
Page Number: 1 of 7

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
4(A)1+2+3+4 (Composite)	314571/48	2.0	4	< 0.1	13	15
4(B)1+2+3+4 (Composite)	314571/49	1.2	5	0.2	21	18
4(C)1+2+3+4 (Composite)	314571/50	1.6	2	< 0.1	14	9
4(D)1+2+3+4 (Composite)	314571/51	1.8	3	< 0.1	14	7
4(F)1+2+3+4 (Composite)	314571/52	2.7	7	0.1	20	18
4(F2)1+2+3+4 (Composite)	314571/53	2.8	7	0.1	20	18
4(G)1+2+3+4 (Composite)	314571/54	0.9	4	0.2	16	8
4(H)1+2+3+4 (Composite)	314571/55	2.2	3	< 0.1	14	11
4(I)1+2+3+4 (Composite)	314571/56	1.7	4	0.2	11	11
4(J)1+2+3+4 (Composite)	314571/57	2.7	7	0.1	19	19

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
4(A)1+2+3+4 (Composite)	314571/48	< 0.1	13	21.6	87	83.2
4(B)1+2+3+4 (Composite)	314571/49	< 0.1	21	18.1	90	77.2
4(C)1+2+3+4 (Composite)	314571/50	0.1	11	18.3	67	66.5
4(D)1+2+3+4 (Composite)	314571/51	< 0.1	10	9.4	44	86.3
4(F)1+2+3+4 (Composite)	314571/52	0.1	20	32.0	121	77.5
4(F2)1+2+3+4 (Composite)	314571/53	0.1	20	31.3	125	76.5
4(G)1+2+3+4 (Composite)	314571/54	< 0.1	10	21.4	70	76.4
4(H)1+2+3+4 (Composite)	314571/55	< 0.1	10	15.2	61	80.4
4(I)1+2+3+4 (Composite)	314571/56	< 0.1	6	16.3	63	71.7
4(J)1+2+3+4 (Composite)	314571/57	< 0.1	21	34.0	118	80.0

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	4(A)1+2+3+4 (Composite)	4(B)1+2+3+4 (Composite)	4(C)1+2+3+4 (Composite)	4(D)1+2+3+4 (Composite)	4(F)1+2+3+4 (Composite)
Lab No	314571/48	314571/49	314571/50	314571/51	314571/52
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0008	0.0009	< 0.001	< 0.0008	0.0010
Acenaphthylene	< 0.0008	< 0.0008	< 0.001	0.0008	0.0023
Anthracene	< 0.0008	0.0010	< 0.001	< 0.0008	0.0030
Benzo[a]anthracene	0.0015	0.0026	< 0.001	< 0.0008	0.0071
Benzo[a]pyrene (BAP)	0.0017	0.0026	< 0.001	< 0.0008	0.0070
Benzo[b]fluoranthene	0.0051	0.0130	0.004	< 0.0008	0.0205
Benzo[g,h,i]perylene	0.0032	0.0071	0.002	< 0.0008	0.0067
Benzo[k]fluoranthene	0.0011	0.0032	< 0.001	< 0.0008	0.0052
Chrysene	0.0019	0.0069	< 0.001	< 0.0008	0.0153
Dibenzo[a,h]anthracene	< 0.0008	0.0013	< 0.001	< 0.0008	0.0018
Fluoranthene	0.0036	0.0089	0.001	< 0.0008	0.0277
Fluorene	< 0.0008	0.0031	< 0.001	< 0.0008	0.0036
Indeno(1,2,3-c,d)pyrene	0.0022	0.0027	< 0.001	< 0.0008	0.0050
Naphthalene	< 0.004	< 0.004	< 0.005	< 0.004	< 0.004
Phenanthrene	0.0014	0.0192	0.002	< 0.0008	0.0320
Pyrene	0.0048	0.0124	0.002	< 0.0008	0.0217

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	4(F2)1+2+3+4 (Composite)	4(G)1+2+3+4 (Composite)	4(H)1+2+3+4 (Composite)	4(I)1+2+3+4 (Composite)	4(J)1+2+3+4 (Composite)
Lab No	314571/53	314571/54	314571/55	314571/56	314571/57
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	< 0.0009	< 0.0009	< 0.0008	0.0065	0.0130
Acenaphthylene	0.0009	< 0.0009	< 0.0008	< 0.0009	0.0287
Anthracene	0.0024	0.0009	< 0.0008	0.0019	0.0402
Benzo[a]anthracene	0.0092	0.0043	0.0018	0.0059	0.188
Benzo[a]pyrene (BAP)	0.0132	0.0049	0.0015	0.0051	0.313
Benzo[b]fluoranthene	0.0342	0.0105	0.0063	0.0124	0.423
Benzo[g,h,i]perylene	0.0146	0.0061	0.0031	0.0049	0.268
Benzo[k]fluoranthene	0.0100	0.0028	0.0014	0.0033	0.123
Chrysene	0.0183	0.0043	0.0024	0.0079	0.232
Dibenzo[a,h]anthracene	0.0038	0.0009	< 0.0008	< 0.0009	0.0519
Fluoranthene	0.0236	0.0117	0.0061	0.0182	0.568
Fluorene	0.0044	< 0.0009	< 0.0008	< 0.0009	0.0188
Indeno(1,2,3-c,d)pyrene	0.0117	0.0053	0.0028	0.0050	0.233
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.005	0.019
Phenanthrene	0.0340	0.0051	0.0026	0.0116	0.350
Pyrene	0.0287	0.0126	0.0064	0.0208	0.595

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	4(A)1+2+3+4 (Composite)	4(B)1+2+3+4 (Composite)	4(C)1+2+3+4 (Composite)	4(D)1+2+3+4 (Composite)	4(F)1+2+3+4 (Composite)
Lab No	314571/48	314571/49	314571/50	314571/51	314571/52
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 5	< 6	< 4	< 5
C10 - C11	< 5	< 5	< 6	< 4	< 5
C12 -C14	< 5	< 5	< 6	< 4	< 5
C15 - C20	< 5	< 5	< 6	< 4	< 5
C21 - C25	< 5	< 5	< 6	8	7
C26 - C29	5	22	9	21	14
C30 - C44	< 9	24	< 10	65	36
Total hydrocarbons (C7 - C44) mg/kg	< 40	< 40	< 50	90	60

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	4(F2)1+2+3+4 (Composite)	4(G)1+2+3+4 (Composite)	4(H)1+2+3+4 (Composite)	4(I)1+2+3+4 (Composite)	4(J)1+2+3+4 (Composite)
Lab No	314571/53	314571/54	314571/55	314571/56	314571/57
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 5	< 5	< 5	< 6	< 5
C10 - C11	< 5	< 5	< 5	< 6	< 5
C12 -C14	< 5	< 5	< 5	< 6	< 5
C15 - C20	11	< 5	< 5	80	5
C21 - C25	< 5	< 5	< 5	82	10
C26 - C29	10	11	14	190	15
C30 - C44	< 10	< 10	64	472	95
Total hydrocarbons (C7 - C44) mg/kg	< 40	< 40	80	820	130

Sample Type: Water,

Sample Name		4(2) 17/6/03
Lab No		314571/2
Total Boron	(g.m-3)	0.020
Total Arsenic	(g.m-3)	< 0.001
Total Cadmium	(g.m-3)	0.00007
Total Chromium	(g.m-3)	< 0.0005
Total Copper	(g.m-3)	0.0301
Total Mercury	(g.m-3)	< 0.00008
Total Nickel	(g.m-3)	< 0.0005
Total Lead	(g.m-3)	0.0015
Total Zinc	(g.m-3)	0.011

Sample Type: Water,

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	4(1) 17/6/03	4(3) 17/6/03
Lab No	314571/1	314571/3
Units	(g.m-3)	(g.m-3)
C7 - C9	< 0.03	< 0.03
C10 - C11	< 0.03	< 0.03
C12 - C14	< 0.03	< 0.03
C15 - C20	< 0.03	< 0.03
C21 - C25	< 0.03	< 0.03
C26 - C29	< 0.03	< 0.03
C30 - C44	< 0.05	< 0.05
Total hydrocarbons (C7 - C44) g.m-3	< 0.2	< 0.2

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass for TPH (250 or 500 mL)	250	2
Nitric Preserved (100 mL)	100	1
Glass Jar (Soils)	500	44

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

* This test is not accredited.

Substance Type: Water

Parameter	Method Used	Detection Limit
Total (nitric) acid digest for low level metals	Boiling nitric acid digestion. APHA 3030 E 20th ed. 1998	N/A
Total Boron	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.005 g.m-3
Total Arsenic	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Total Cadmium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.00005 g.m-3
Total Chromium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Copper	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Mercury	Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2	0.00008 g.m-3
Total Nickel	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Lead	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0001 g.m-3
Total Zinc	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Petroleum hydrocarbons by GC-FID, carbon banding	Solvent extraction (hexane), GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

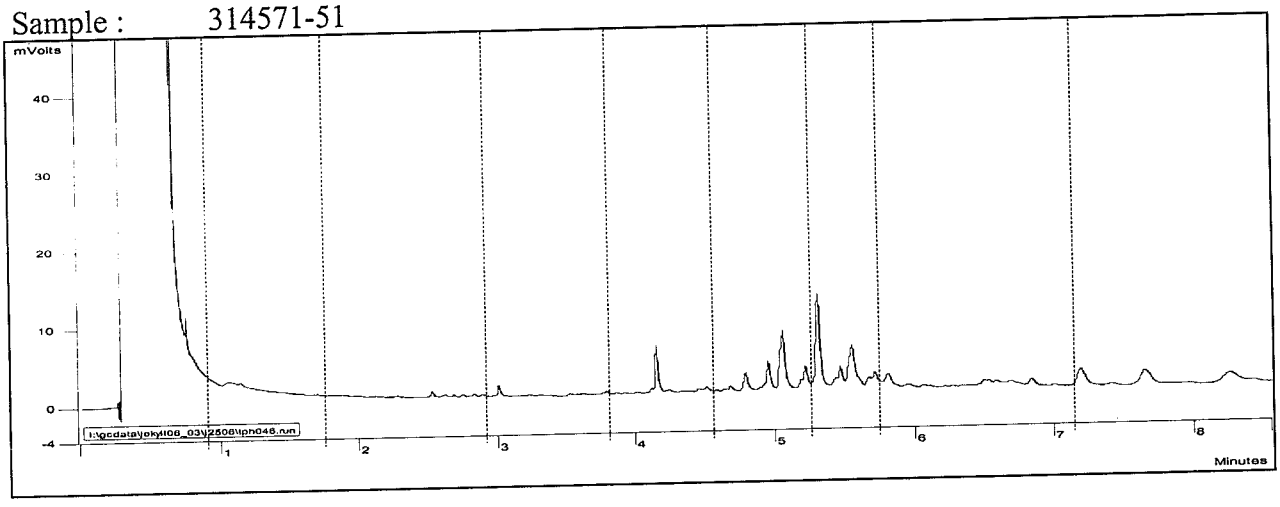
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

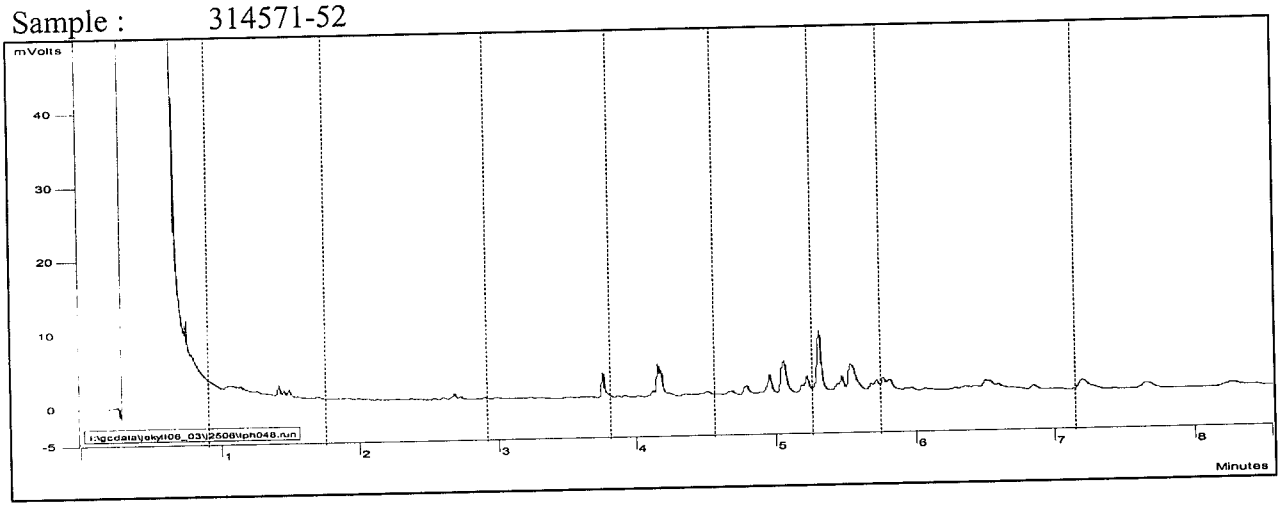
Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314571-51



Sample : 314571-52



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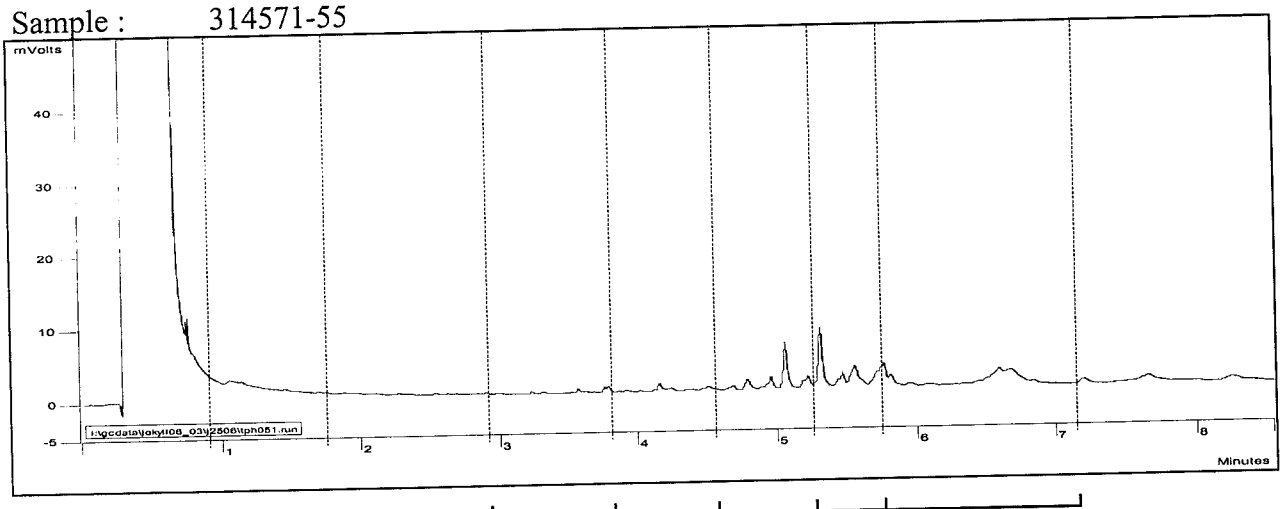


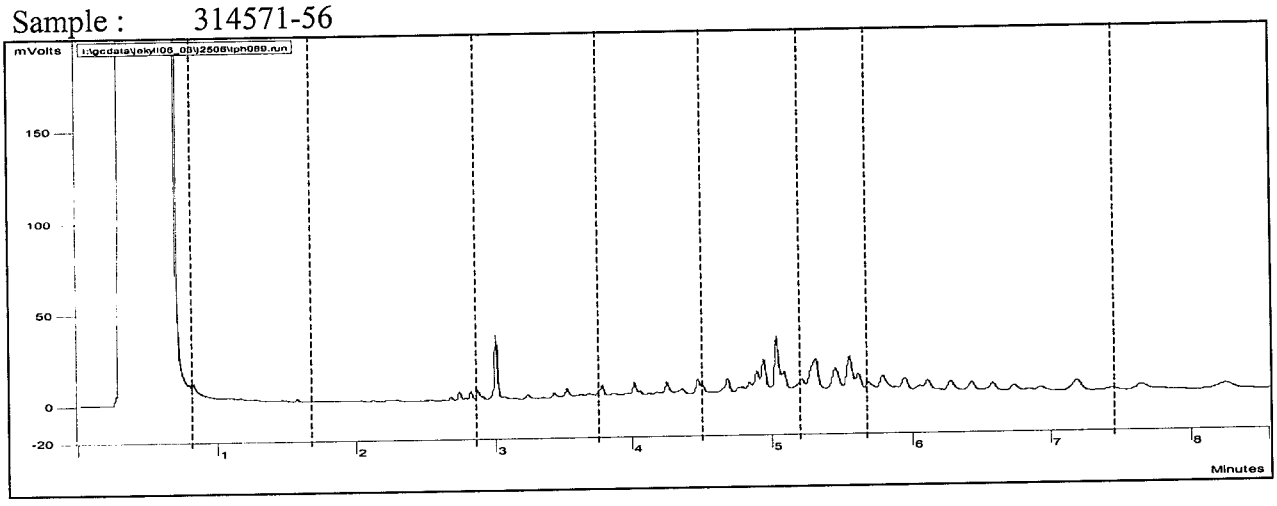
C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories, Hamilton, NZ

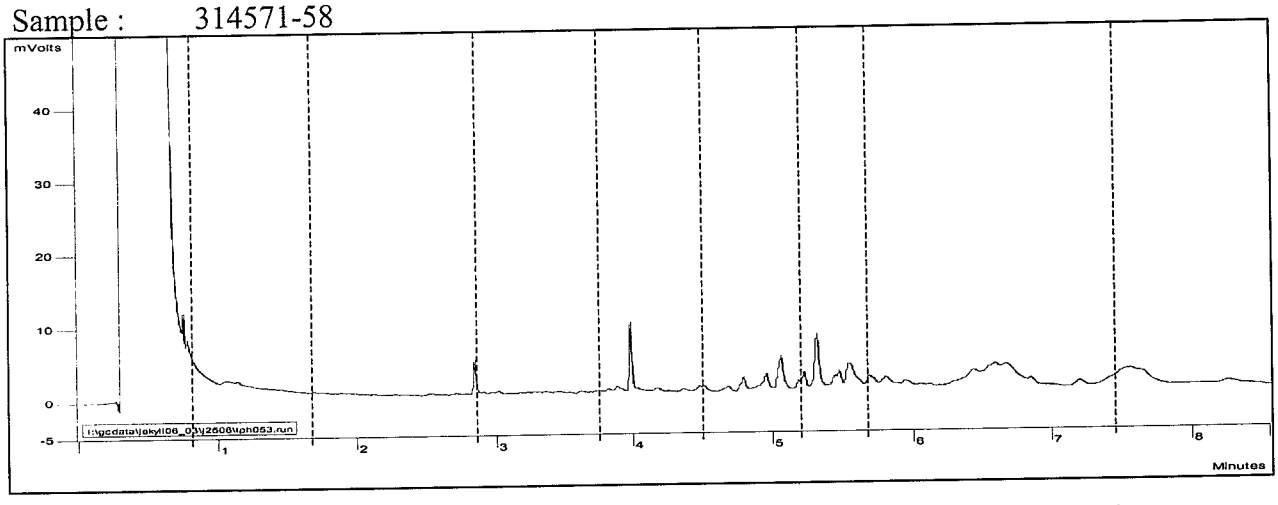
Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314571-56



Sample : 314571-58



C7 C10 C15 C20 C25 C30 C34 C44

314571

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	Hills

RESULTS ATTENTION: Carmen Sulzberger
RESULTS REQUIRED BY: —
PROJECT NO: 48253
LAB QUOTE NO: —
SAMPLER(S): CS

ANALYSES REQUIRED

CONTAINERS: Soil Jars; H_2O Bottles

ANALYTES: Analysis to be Confirmed

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS
4(A)1	Soil	20/6/03	
4(A)2	"	"	
4(A)3	"	"	
4(A)4	"	"	
4(B)1	"	"	
4(B)2	"	"	
4(B)3	"	"	
4(B)4	"	"	
4(C)1	"	"	
4(C)2	"	"	
4(C)3	"	"	
4(C)4	"	"	
4(D)1	"	"	
4(D)2	"	"	

F 23 ... 03
MEP

Total No. of Sample Bottles: 44 x Soils ; 3 x H_2O

Including: Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: URS NZ Ltd	DATE: 20/6/03	NAME: Rachel B	DATE: 21/6/03	
COMPANY: Carmen Sulzberger	TIME: 5pm	COMPANY: Hill Labs	TIME: 8:00	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER: (YES) / NO

PLEASE CONTACT THE LABORATORY

CUSTODY SEAL INTACT: (YES) / NO / NA

SAMPLES CHILLED: (YES) / NO / NA

LABORATORY BATCH NO: 314571

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☑ EMAIL ☑ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

PAGE 3 OF 4

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	
RESULTS ATTENTION:	RESULTS REQUIRED BY:
PROJECT NO:	LAB QUOTE NO:
SAMPLER(S):	

ANALYSES REQUIRED

CONTAINERS

ANALYTES

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS
4(D)3	Soil	20/6/03	
4(D)4	"	"	
4(F)1	"	"	
4(F)2	"	"	
4(F)3	"	"	
4(F)4	"	"	
4(F2)1	"	"	
4(F2)2	"	"	
4(F2)3	"	"	
4(F2)4	"	"	
4(G)1	"	"	
4(G)2	"	"	
4(G)3	"	"	
4(G)4	"	"	
Total No. of Sample Bottles:			

RECEIVED 23 JUN 2003 MHP

Including: Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME:	DATE:	NAME: R Brown	DATE: 21/6/03	
COMPANY:	TIME:	COMPANY: Hill Labs	TIME: 8:00	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	(YES) / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: (YES) / NO / NA SAMPLES CHILLED: (YES) / NO / NA LABORATORY BATCH NO: 31457/

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☐ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	
RESULTS ATTENTION:	RESULTS REQUIRED BY:
PROJECT NO:	LAB QUOTE NO:
SAMPLER(S):	

ANALYSES REQUIRED

CONTAINERS

ANALYTES

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS
4(H)1	Soil	20/6/03	
4(H)2	"	"	
4(H)3	"	"	
4(H)4	"	"	
4(I)	H_2O	"	
4(2)	H_2O	"	
4(3)	H_2O	"	
4(I) 1	Soil	"	
4(I) 2	"	"	
4(I) 3	"	"	
4(I) 4	"	"	
4(J) 1	"	"	
4(J) 2	"	"	
4(J) 3	"	"	

Including: Blank or Duplicate Samples

Total No. of Sample Bottles:

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME:	DATE:	NAME: R Brown	DATE: 21/6/03	
COMPANY:	TIME:	COMPANY: Hill Labs	TIME: 8:02	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	(YES) / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: (YES) / NO / NA
			SAMPLES CHILLED: (YES) / NO / NA
			LABORATORY BATCH NO: 314571

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☐ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	
RESULTS ATTENTION:	RESULTS REQUIRED BY:
PROJECT NO:	LAB QUOTE NO:
SAMPLER(S):	

ANALYSES REQUIRED

CONTAINERS

ANALYTES

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS	
4(J)4	Soil	20/6/03		Hold
5(A)1	"	"		Hold
5(A)2	"	"		Hold
5(A)3	"	"		Hold
5(A)4	"	"		

Total No. of Sample Bottles:

Including: Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME:	DATE:	NAME: Rachel B	DATE: 21/6/03	
COMPANY:	TIME:	COMPANY: Hill Labs	TIME: 8:00	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	(YES) / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: (YES) / NO / NA SAMPLES CHILLED: (YES) / NO / NA LABORATORY BATCH NO: 214571

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☐ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

Hill Laboratories

3 JUL 2003

R J Hill Laboratories Limited

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Hamilton, New Zealand

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Facsimile:
+64 (7) 858-2001

Email:
mail@hill-labs.co.nz
Internet:
www.hill-labs.co.nz

Client: URS New Zealand Limited
Address: P O Box 3367,
WELLINGTON
Contact: Carmen Sulzberger

Laboratory No: 314688
Date Registered: 24/06/2003
Date Completed: 30/06/2003
Page Number: 1 of 7

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	314688/27	0.7	3	< 0.1	18	13
5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	314688/28	1.7	4	< 0.1	8	7
5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	314688/29	1.0	4	0.1	15	11
5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	314688/30	1.1	3	0.1	15	9
5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)	314688/31	2.5	4	< 0.1	10	19
5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)	314688/32	2.6	< 2	0.2	10	6

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	314688/27	< 0.1	16	17.9	62	89.3
5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	314688/28	< 0.1	5	12.2	31	82.0
5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	314688/29	< 0.1	13	20.5	52	74.7
5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	314688/30	0.1	12	20.2	52	73.5

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)	314688/31	< 0.1	7	38.1	72	79.8
5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)	314688/32	< 0.1	8	10.8	57	74.6

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)
Lab No	314688/27	314688/28	314688/29	314688/30	314688/31
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	0.0017	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Acenaphthylene	0.0591	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Anthracene	0.0456	< 0.0008	< 0.0009	0.0010	0.0009
Benzo[a]anthracene	0.129	< 0.0008	0.0024	0.0051	0.0049
Benzo[a]pyrene (BAP)	0.225	< 0.0008	0.0022	0.0041	0.0054
Benzo[b]fluoranthene	0.347	0.0022	0.0074	0.0094	0.0104
Benzo[g,h,i]perylene	0.181	0.0012	0.0041	0.0048	0.0062
Benzo[k]fluoranthene	0.114	< 0.0008	0.0029	0.0029	0.0031
Chrysene	0.136	< 0.0008	0.0030	0.0040	0.0054
Dibenzo[a,h]anthracene	0.0482	< 0.0008	< 0.0009	0.0009	0.0009
Fluoranthene	0.213	0.0021	0.0061	0.0088	0.0147
Fluorene	0.0040	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Indeno(1,2,3-c,d)pyrene	0.194	0.0011	0.0031	0.0040	0.0048
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	0.0651	< 0.0008	0.0016	0.0024	0.0073
Pyrene	0.223	0.0084	0.0068	0.0101	0.0146

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
Acenaphthene	< 0.0009
Acenaphthylene	< 0.0009
Anthracene	< 0.0009
Benzo[a]anthracene	< 0.0009
Benzo[a]pyrene (BAP)	< 0.0009
Benzo[b]fluoranthene	< 0.0009
Benzo[g,h,i]perylene	< 0.0009
Benzo[k]fluoranthene	< 0.0009
Chrysene	< 0.0009

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
Dibenzo[a,h]anthracene	< 0.0009
Fluoranthene	< 0.0009
Fluorene	< 0.0009
Indeno(1,2,3-c,d)pyrene	< 0.0009
Naphthalene	< 0.004
Phenanthrene	< 0.0009
Pyrene	< 0.0009

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)
Lab No	314688/27	314688/28	314688/29	314688/30	314688/31
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 4	< 5	< 5	< 5	< 5
C10 - C11	< 4	< 5	< 5	< 5	< 5
C12 -C14	< 4	< 5	< 5	< 5	< 5
C15 - C20	< 4	25	< 5	< 5	< 5
C21 - C25	6	240	< 5	< 5	5
C26 - C29	9	13	< 5	6	11
C30 - C44	30	181	45	31	32
Total hydrocarbons (C7 - C44) mg/kg	< 30	460	50	< 40	50

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
C7 - C9	< 5
C10 - C11	< 5
C12 -C14	< 5
C15 - C20	< 5
C21 - C25	< 5
C26 - C29	6
C30 - C44	< 10
Total hydrocarbons (C7 - C44) mg/kg	< 40

Sample Type: Water,

Sample Name		5(2) 23/6/03
Lab No		314688/2
Total Boron	(g.m-3)	0.033
Total Arsenic	(g.m-3)	< 0.001
Total Cadmium	(g.m-3)	0.00010

Sample Name		5(2) 23/6/03
Lab No		314688/2
Total Chromium	(g.m-3)	< 0.0005
Total Copper	(g.m-3)	0.0491
Total Mercury	(g.m-3)	< 0.00008
Total Nickel	(g.m-3)	< 0.0005
Total Lead	(g.m-3)	0.0021
Total Zinc	(g.m-3)	0.037

Sample Type: Water,

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	5(1) 23/6/03
Lab No	314688/1
Units	(g.m-3)
C7 - C9	< 0.03
C10 - C11	0.04
C12 - C14	< 0.03
C15 - C20	< 0.03
C21 - C25	< 0.03
C26 - C29	< 0.03
C30 - C44	0.33
Total hydrocarbons (C7 - C44) g.m-3	0.4

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass for TPH (250 or 500 mL)	250	1
Nitric Preserved (100 mL)	100	1
Glass Jar (Soils)	500	24

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt

Parameter	Method Used	Detection Limit
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

This test is not accredited.

Substance Type: Water

Parameter	Method Used	Detection Limit
Total (nitric) acid digest for low level metals	Boiling nitric acid digestion. APHA 3030 E 20th ed. 1998	N/A
Total Boron	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.005 g.m-3
Total Arsenic	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Total Cadmium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.00005 g.m-3
Total Chromium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Copper	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Mercury	Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2	0.00008 g.m-3
Total Nickel	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Lead	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0001 g.m-3
Total Zinc	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Petroleum hydrocarbons by GC-FID, carbon banding	Solvent extraction (hexane), GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

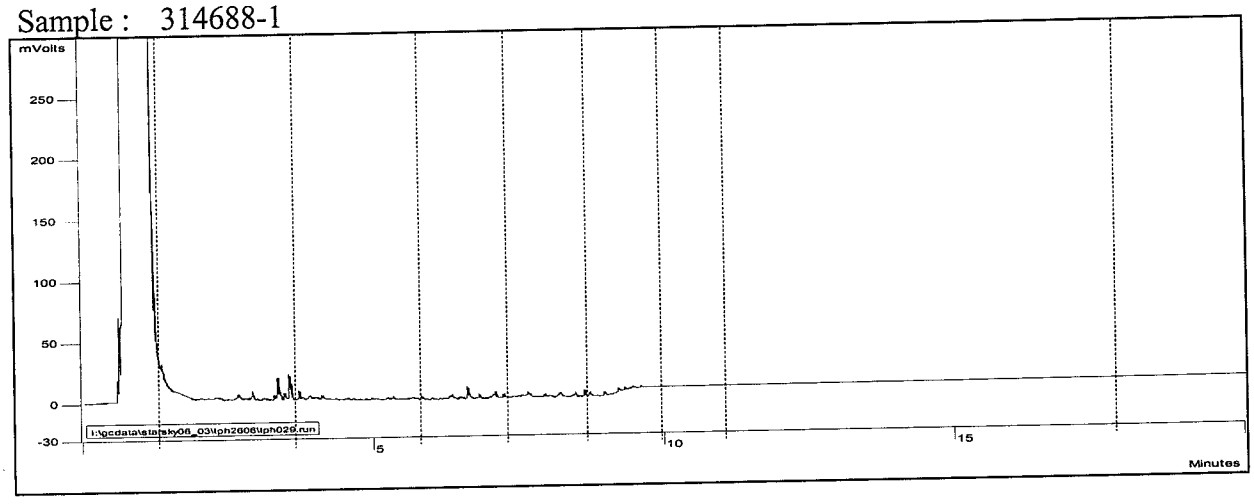
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

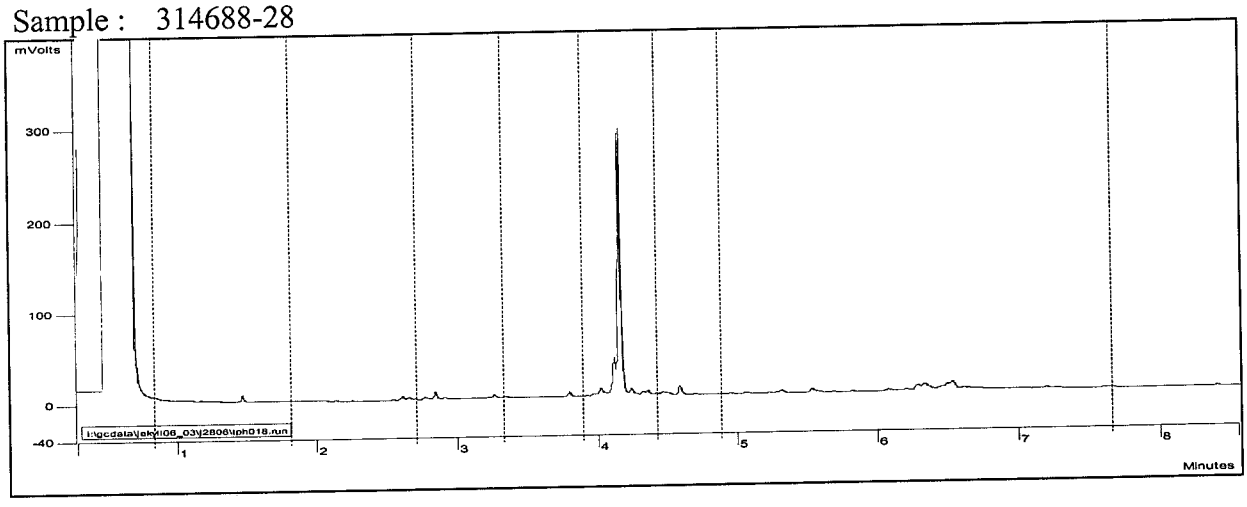
Total Petroleum Hydrocarbon Chromatograms

Appendix

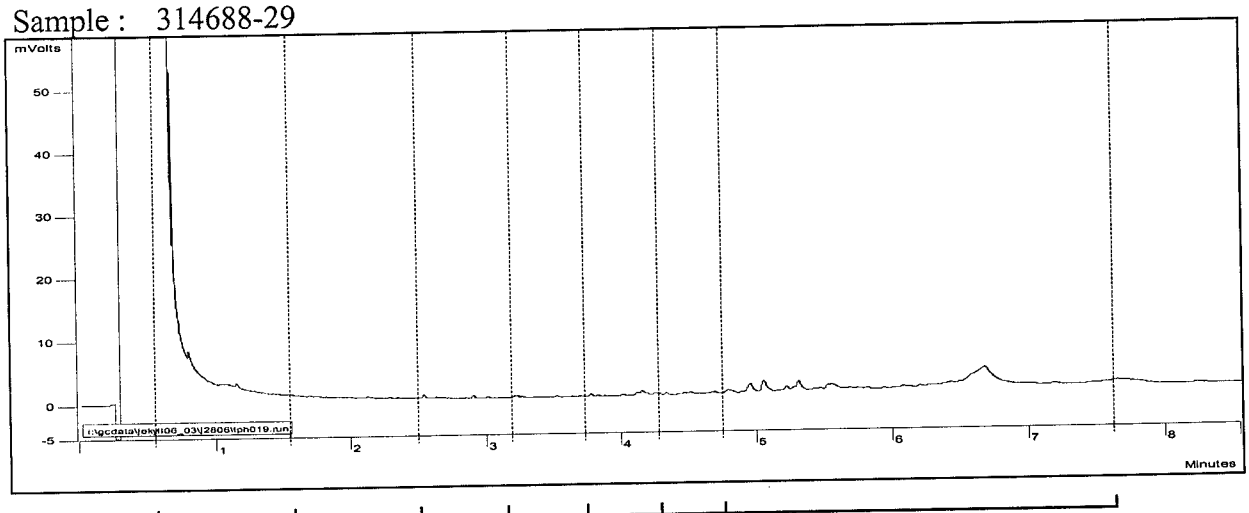
Sample : 314688-1



Sample : 314688-28



Sample : 314688-29



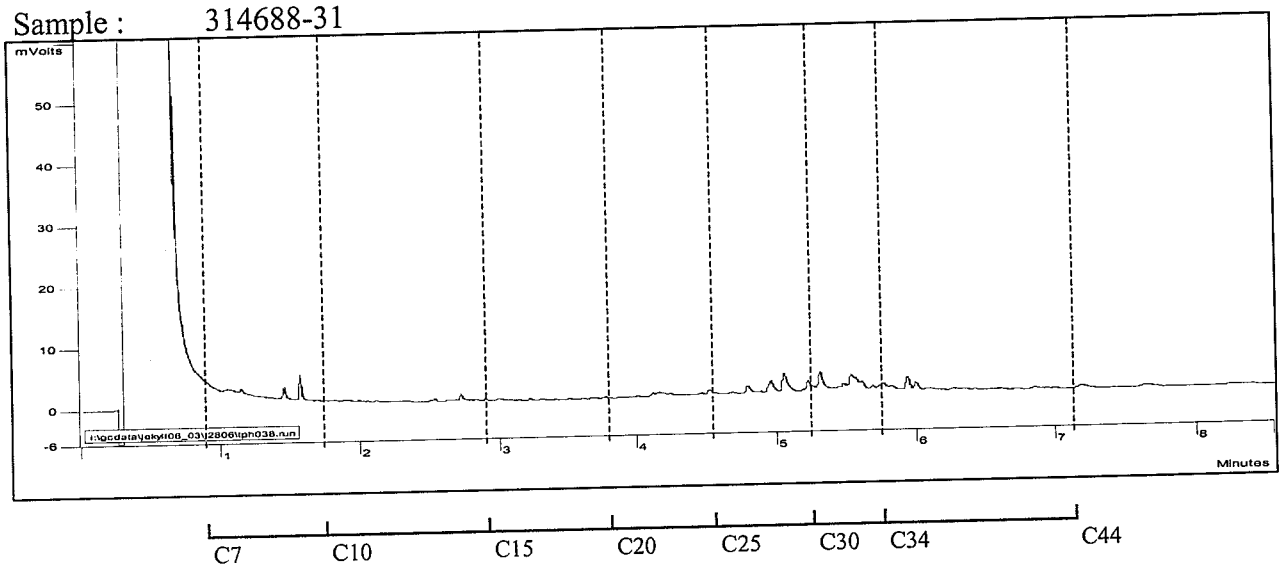
C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories, Hamilton, NZ

Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314688-31



C7 C10 C15 C20 C25 C30 C34 C44

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	Hills
RESULTS ATTENTION: Carmen Sutzberger	RESULTS REQUIRED BY: —
PROJECT NO: 48253	LAB QUOTE NO: —
SAMPLER(S): CS	

ANALYSES REQUIRED

CONTAINERS: Soil Jars; H2O Bottles

ANALYTES: See attached notes.

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS
4(K)1	Soil	23/6/03	
4(K)2	"	"	
4(K)3	"	"	
4(K)4	"	"	
5(A)1	"	"	
5(A)2	"	"	
5(A)3	"	"	
5(A)4	"	"	
5(B)1	"	"	
5(B)2	"	"	
5(B)3	"	"	
5(B)4	"	"	
5(B2)1	"	"	
5(B2)2	"	"	

FAXED
25 JUN 2003

Total No. of Sample Bottles: 24x Soil j 2x H2O

Including: Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME: Carmen Sutzberger	DATE: 23/6/03	NAME: Jacob Lawson	DATE:	
COMPANY: URS	TIME: 5pm	COMPANY: Hill Labs	TIME:	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	(YES) / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: (YES) / NO / NA SAMPLES CHILLED: (YES) / NO / NA LABORATORY BATCH NO: 31488

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☑ EMAIL ☑ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

URS CHAIN OF CUSTODY AND SAMPLE RECEIPT DOCUMENTATION

FROM:	TO:
URS NEW ZEALAND LTD HAYMAN CENTRE, 3RD FLOOR 24 JOHNSTON STREET PO BOX 3367 WELLINGTON PH: (04) 496 3750 FAX: (04) 496 3755	
RESULTS ATTENTION:	RESULTS REQUIRED BY:
PROJECT NO:	LAB QUOTE NO:
SAMPLER(S):	

ANALYSES REQUIRED

CONTAINERS

ANALYTES

FAXED
25 JUN 2003

SAMPLE ID	MATRIX	DATE/TIME	COMMENTS
5(B2)3	Soil	28/6/03	
5(B2)4	"	"	
5(1)	H_2O	"	
5(2)	H_2O	"	
5(C)1	Soil	"	
5(C)2	"	"	
5(C)3	"	"	
5(C)4	"	"	
5(D)1	"	"	
5(D)2	"	"	
5(D)3	"	"	
5(D)4	"	"	

Total No. of Sample Bottles: | Including: | Blank or Duplicate Samples

CHAIN OF CUSTODY DATA

RELINQUISHED BY		RECEIVED BY		METHOD OF SHIPMENT
NAME:	DATE:	NAME:	DATE:	
COMPANY:	TIME:	COMPANY:	TIME:	

SAMPLE RECEIPT DATA

PLEASE COMPLETE THIS SECTION (CIRCLE AS APPROPRIATE) AND RETURN FAX A COPY IMMEDIATELY AFTER RECEIVING SAMPLES)

ALL SAMPLES AND ASSOCIATED DOCUMENTATION WERE RECEIVED IN GOOD ORDER	(YES) / NO	PLEASE CONTACT THE LABORATORY	CUSTODY SEAL INTACT: (YES) / NO / NA SAMPLES CHILLED: (YES) / NO / NA LABORATORY BATCH NO: 314688

SPECIAL HANDLING/STORAGE OR DISPOSAL INSTRUCTIONS:

CAUTION - SAMPLES MAY CONTAIN HAZARDOUS SUBSTANCES

REPORTING

REPORT FORMAT: FAX ☐ LETTER ☐ EMAIL ☐ DISK ☐

EMAIL ADDRESS:

INTERNAL USE - URS WORK INSTRUCTIONS AND CHECKLIST OVERLEAF

Hill Laboratories

3 JUL 2003

R J Hill Laboratories Limited

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Email:
mail@hill-labs.co.nz
Internet:
www.hill-labs.co.nz

Client: URS New Zealand Limited
Address: P O Box 3367,
WELLINGTON
Contact: Carmen Sulzberger

Laboratory No: 314688
Date Registered: 24/06/2003
Date Completed: 30/06/2003
Page Number: 1 of 7

Client's Reference: 48253

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Soil

Sample Name	Lab No	Hot Water Soluble Boron* (mg/kg dry wt)	Total Recoverable Arsenic (mg/kg dry wt)	Total Recoverable Cadmium (mg/kg dry wt)	Total Recoverable Chromium (mg/kg dry wt)	Total Recoverable Copper (mg/kg dry wt)
4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	314688/27	0.7	3	< 0.1	18	13
5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	314688/28	1.7	4	< 0.1	8	7
5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	314688/29	1.0	4	0.1	15	11
5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	314688/30	1.1	3	0.1	15	9
5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)	314688/31	2.5	4	< 0.1	10	19
5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)	314688/32	2.6	< 2	0.2	10	6

* This test is not accredited.

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	314688/27	< 0.1	16	17.9	62	89.3
5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	314688/28	< 0.1	5	12.2	31	82.0
5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	314688/29	< 0.1	13	20.5	52	74.7
5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	314688/30	0.1	12	20.2	52	73.5

Sample Name	Lab No	Total Recoverable Mercury (mg/kg dry wt)	Total Recoverable Nickel (mg/kg dry wt)	Total Recoverable Lead (mg/kg dry wt)	Total Recoverable Zinc (mg/kg dry wt)	Dry matter (g/100g as rcvd)
5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)	314688/31	< 0.1	7	38.1	72	79.8
5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)	314688/32	< 0.1	8	10.8	57	74.6

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)
Lab No	314688/27	314688/28	314688/29	314688/30	314688/31
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
Acenaphthene	0.0017	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Acenaphthylene	0.0591	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Anthracene	0.0456	< 0.0008	< 0.0009	0.0010	0.0009
Benzo[a]anthracene	0.129	< 0.0008	0.0024	0.0051	0.0049
Benzo[a]pyrene (BAP)	0.225	< 0.0008	0.0022	0.0041	0.0054
Benzo[b]fluoranthene	0.347	0.0022	0.0074	0.0094	0.0104
Benzo[g,h,i]perylene	0.181	0.0012	0.0041	0.0048	0.0062
Benzo[k]fluoranthene	0.114	< 0.0008	0.0029	0.0029	0.0031
Chrysene	0.136	< 0.0008	0.0030	0.0040	0.0054
Dibenzo[a,h]anthracene	0.0482	< 0.0008	< 0.0009	0.0009	0.0009
Fluoranthene	0.213	0.0021	0.0061	0.0088	0.0147
Fluorene	0.0040	< 0.0008	< 0.0009	< 0.0009	< 0.0008
Indeno(1,2,3-c,d)pyrene	0.194	0.0011	0.0031	0.0040	0.0048
Naphthalene	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
Phenanthrene	0.0651	< 0.0008	0.0016	0.0024	0.0073
Pyrene	0.223	0.0084	0.0068	0.0101	0.0146

Polycyclic Aromatic Hydrocarbons (PAH)

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
Acenaphthene	< 0.0009
Acenaphthylene	< 0.0009
Anthracene	< 0.0009
Benzo[a]anthracene	< 0.0009
Benzo[a]pyrene (BAP)	< 0.0009
Benzo[b]fluoranthene	< 0.0009
Benzo[g,h,i]perylene	< 0.0009
Benzo[k]fluoranthene	< 0.0009
Chrysene	< 0.0009

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
Dibenzo[a,h]anthracene	< 0.0009
Fluoranthene	< 0.0009
Fluorene	< 0.0009
Indeno(1,2,3-c,d)pyrene	< 0.0009
Naphthalene	< 0.004
Phenanthrene	< 0.0009
Pyrene	< 0.0009

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	4(K)1 + 4(K)2 + 4(K)3 + 4(K)4 23/6/03 (Composite)	5(A)1 + 5(A)2 + 5(A)3 + 5(A)4 20/6/03 (Composite)	5(B)1 + 5(B)2 + 5(B)3 + 5(B)4 23/6/03 (Composite)	5(B2)1 + 5(B2)2 + 5(B2)3 + 5(B2)4 23/6/03 (Composite)	5(C)1 23/6/03 + 5(C)2 23/6/03 + 5(C)3 20/6/03 + 5(C)4 20/6/03 (Composite)
Lab No	314688/27	314688/28	314688/29	314688/30	314688/31
Units	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)	(mg/kg dry wt)
C7 - C9	< 4	< 5	< 5	< 5	< 5
C10 - C11	< 4	< 5	< 5	< 5	< 5
C12 -C14	< 4	< 5	< 5	< 5	< 5
C15 - C20	< 4	25	< 5	< 5	< 5
C21 - C25	6	240	< 5	< 5	5
C26 - C29	9	13	< 5	6	11
C30 - C44	30	181	45	31	32
Total hydrocarbons (C7 - C44) mg/kg	< 30	460	50	< 40	50

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	5(D)1 20/6/03 + 5(D)2 20/6/03 + 5(D)3 23/6/03 + 5(D)4 20/6/03 (Composite)
Lab No	314688/32
Units	(mg/kg dry wt)
C7 - C9	< 5
C10 - C11	< 5
C12 -C14	< 5
C15 - C20	< 5
C21 - C25	< 5
C26 - C29	6
C30 - C44	< 10
Total hydrocarbons (C7 - C44) mg/kg	< 40

Sample Type: Water,

Sample Name		5(2) 23/6/03
Lab No		314688/2
Total Boron	(g.m-3)	0.033
Total Arsenic	(g.m-3)	< 0.001
Total Cadmium	(g.m-3)	0.00010

Sample Name		5(2) 23/6/03
Lab No		314688/2
Total Chromium	(g.m-3)	< 0.0005
Total Copper	(g.m-3)	0.0491
Total Mercury	(g.m-3)	< 0.00008
Total Nickel	(g.m-3)	< 0.0005
Total Lead	(g.m-3)	0.0021
Total Zinc	(g.m-3)	0.037

Sample Type: Water,

Petroleum hydrocarbons by GC-FID, carbon banding

Sample Name	5(1) 23/6/03
Lab No	314688/1
Units	(g.m-3)
C7 - C9	< 0.03
C10 - C11	0.04
C12 - C14	< 0.03
C15 - C20	< 0.03
C21 - C25	< 0.03
C26 - C29	< 0.03
C30 - C44	0.33
Total hydrocarbons (C7 - C44) g.m-3	0.4

Sample Containers

The following table shows the sample containers that were associated with this job.

Container Description	Container Size (mL)	Number of Containers
Glass for TPH (250 or 500 mL)	250	1
Nitric Preserved (100 mL)	100	1
Glass Jar (Soils)	500	24

Details of sample bottle preparation procedures are available upon request.

Summary of Methods Used and Detection Limits

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.

Substance Type: Environmental Solids

Parameter	Method Used	Detection Limit
Dry and sieve sample	Air dry (35°C), sieved to pass 2mm.	N/A
Compositing	Manual compositing of samples	N/A
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Hot Water Soluble Boron*	0.01M Calcium chloride extraction, ICP-OES determination.	0.1 mg/kg dry wt
Total Recoverable Arsenic	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Cadmium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Chromium	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt

Parameter	Method Used	Detection Limit
Total Recoverable Copper	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Mercury	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.1 mg/kg dry wt
Total Recoverable Nickel	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	2 mg/kg dry wt
Total Recoverable Lead	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	0.4 mg/kg dry wt
Total Recoverable Zinc	Nitric / hydrochloric acid digestion, ICP-MS. US EPA 200.2	4 mg/kg dry wt
Dry matter	Dried at 103°C, gravimetric (removes 3-5% more water than air dry)	0.1 g/100g as rcvd
Petroleum hydrocarbons by GC-FID, carbon banding	Accelerated Solvent Extraction or Sonication Extraction with dichloromethane, GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A
Polycyclic Aromatic Hydrocarbons (PAH)	Sonication Extraction, silica gel cleanup, GC-MS selected ion monitoring quantitation. USEPA 3540 & 3630	N/A

This test is not accredited.

Substance Type: Water

Parameter	Method Used	Detection Limit
Total (nitric) acid digest for low level metals	Boiling nitric acid digestion. APHA 3030 E 20th ed. 1998	N/A
Total Boron	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.005 g.m-3
Total Arsenic	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Total Cadmium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.00005 g.m-3
Total Chromium	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Copper	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Mercury	Permanganate / Persulphate digestion. Analysis by FIMS. US EPA 245.2	0.00008 g.m-3
Total Nickel	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0005 g.m-3
Total Lead	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.0001 g.m-3
Total Zinc	Nitric acid digestion. ICP-MS. APHA 3125 B 20th ed. 1998	0.001 g.m-3
Petroleum hydrocarbons by GC-FID, carbon banding	Solvent extraction (hexane), GC-FID quantitation. US EPA 8015B/NZ OIEWG	N/A

* This test is not accredited.

Analyst's Comments:

These samples were collected by yourselves 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 submitter.

T.J. Cooney

Peter Robinson, MSc(Hons), PhD FNZIC
Environmental Division Manager

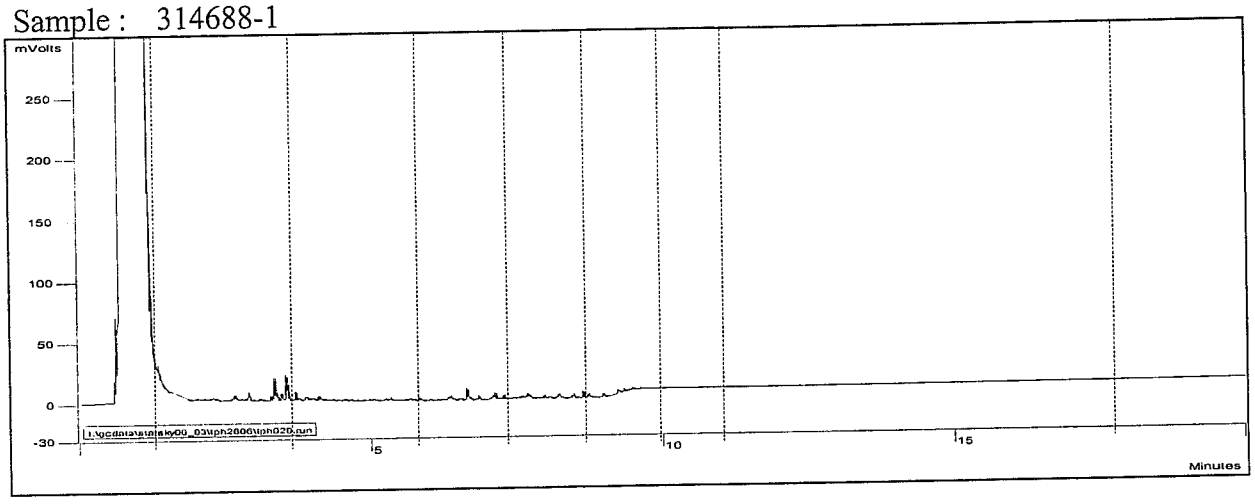
Terry Cooney, MSc(Hons), PhD MNZIC
General Manager

Hill Laboratories, Hamilton, NZ

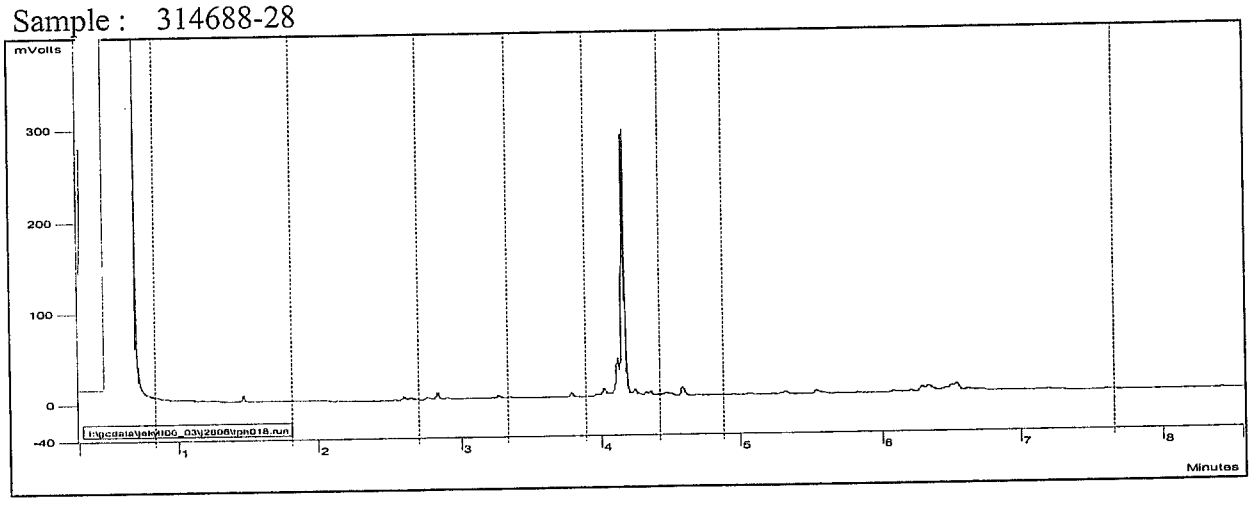
Total Petroleum Hydrocarbon Chromatograms

Appendix

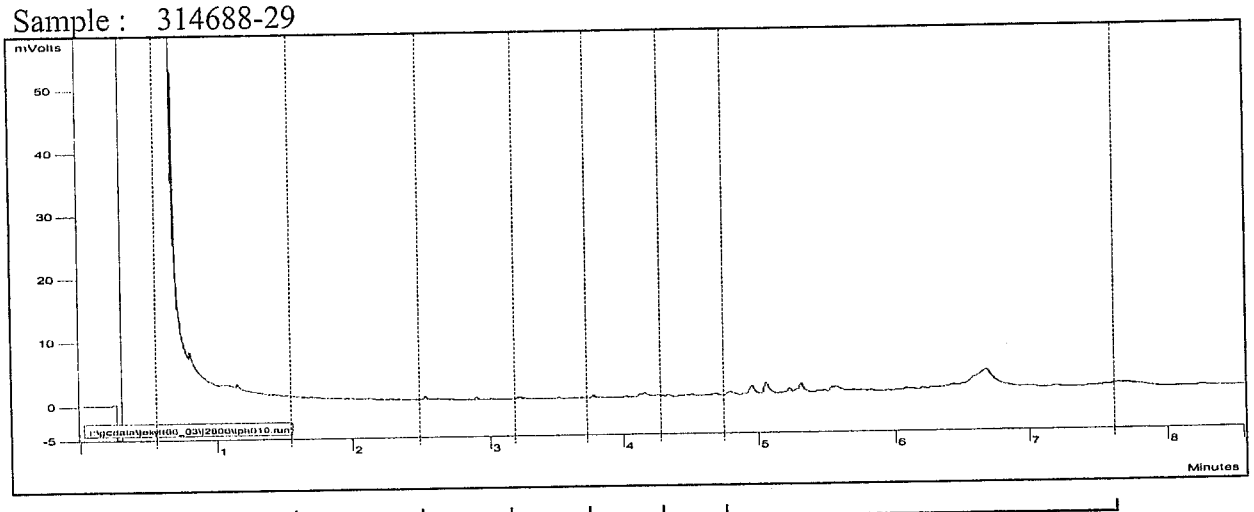
Sample : 314688-1



Sample : 314688-28



Sample : 314688-29



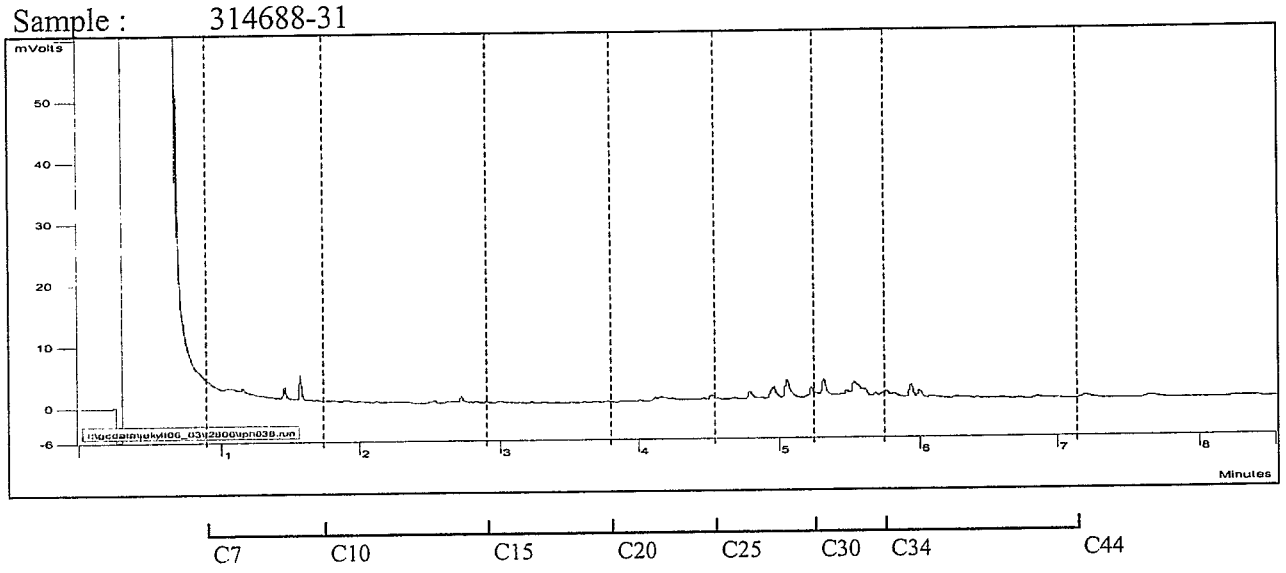
C7 C10 C15 C20 C25 C30 C34 C44

Hill Laboratories, Hamilton, NZ

Total Petroleum Hydrocarbon Chromatograms

Appendix

Sample : 314688-31



C7 C10 C15 C20 C25 C30 C34 C44

Appendix D
Evaluated Data - Box Plots, Descriptive Statistics Kurskal-Wallis Test and Fisher LSD Test

Evaulated Data Set for Main Soil Type 1

	Metals and TPH							
Sample ID	1(A)	1(A2)	1(B)	1(C)	1(D)	1(E)	1(F)	EB1
Location	Forest Lakes	Duplicate	Otaki Reserve	Private Reserve, Te Horo	Nga Manu Nature Reserve, Waikanae	Mazengarb Reserve, Paraparaumu	Paekakariki Domain	Equipment Blank
Landuse	Private Bush	Private Bush	Public Reserve	Private Bush	Private Bush	Public Reserve	Public Reserve	QA/QC
Lab No	313773 / 30	313773 / 34	313773 / 31	313773 / 32	313773 / 33	313773 / 35	313773 / 36	313773 / 1
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	9/06/03	9/06/03	9/06/03	9/06/2003	9/06/03	9/06/03	9/06/03	9/06/2003
Soluble Boron	2.1	1.9	0.5	1.7	0.3	0.4	0.6	0.012
Total Recoverable As	1	1	5	2	3	4	7.0	0.0005
Total Recoverable Cd	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.00006
Total Recoverable Cr	7	7	9	12	8	7	8	0.00025
Total Recoverable Cu	6	6	6	10	4	7	9	0.0492
Total Recoverable Hg	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.00004
Total Recoverable Ni	4	4	9	9	6	5	6	0.00025
Total Recoverable Pb	5.7	5.3	8.5	13.5	4.5	5.3	180	0.0002
Total Recoverable Zn	38	31	55	69	30	28	79	0.011
TPH (C_7 - C_{44})	20	60	80	110	80	100	70	0.1

Notes:

EB - Equipment blank: wash water from hand auger

	PAH						
Sample ID	1(A)	1(A2)	1(B)	1(C)	1(D)	1(E)	1(F)
Location	Forest Lakes	Duplicate	Otaki Reserve	Private Reserve, Te Horo	Nga Manu Nature Reserve, Waikanae	Mazengarb Reserve, Paraparaumu	Paekakariki Domain
Landuse	Private Bush	Private Bush	Public Reserve	Private Bush	Private Bush	Public Reserve	Public Reserve
Lab No	313773 / 30	313773 / 34	313773 / 31	313773 / 32	313773 / 33	313773 / 35	313773 / 36
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003	9/06/2003
Acenaphthene	0.0010	0.0004	0.0008	0.00045	0.0004	0.0004	0.0011
Acenaphthylene	0.0004	0.0004	0.0009	0.00045	0.0004	0.0004	0.0170
Anthracene	0.0004	0.0004	0.00035	0.00045	0.0004	0.0010	0.0130
Benzo[a]anthracene	0.0017	0.0009	0.0008	0.00045	0.0004	0.0004	0.0545
Benzo[a]pyrene (BAP)	0.0027	0.0018	0.0013	0.0011	0.0004	0.0004	0.0779
Benzo[b]fluoranthene	0.0042	0.0030	0.0032	0.0030	0.0004	0.0022	0.118
Benzo[g,h,i]perylene	0.0016	0.0013	0.0012	0.00045	0.0004	0.0004	0.0500
Benzo[k]fluoranthene	0.0015	0.0009	0.0008	0.00045	0.0004	0.0004	0.0378
Chrysene	0.0055	0.0042	0.0044	0.00045	0.0004	0.0034	0.0703
Dibenzo[a,h]anthracene	0.0004	0.0004	0.00035	0.00045	0.0004	0.0041	0.0410
Fluoranthene	0.0047	0.0022	0.0028	0.0014	0.0004	0.0027	0.136
Fluorene	0.0011	0.0004	0.0009	0.00045	0.0004	0.0004	0.0034
Indeno(1,2,3-c,d)pyrene	0.0024	0.0017	0.0018	0.0010	0.0004	0.0051	0.120
Naphthalene	0.002	0.002	0.010	0.010	0.002	0.007	0.005
Phenanthrene	0.0004	0.0004	0.00035	0.00045	0.0004	0.0004	0.0660
Pyrene	0.0044	0.0021	0.0028	0.0012	0.0004	0.0013	0.122

Notes:

EB - Equipment blank: wash water from hand auger

1A2 - Duplicate

Rugged Axis Soils, mainly to the west of the Wairarapa Fault, which comprise mainly Brown Soils associated with the Greywacke bedrock

Evaulated Data Set for Main Soil Type 2

	Metals and TPH											
Sample ID	2(A)	2(B)	2(C)	2(D)	2(E)	2(F)	2(G)	2(H)	2(I)	2(K)	2(L)	2(M)
Location	Raroa Reserve, Pukerua Bay	Small Reserve, Plimmerton	Samwell Drive Reserve, Whitby	Porirua Scenic Reserve	Wilf Mexted Scenic Reserve, Tawa	Johnsonville Park	Northern Walkway	Southern Walkway	Rangitatau Reserve, Wellington	Eastern Walkway	Karori park	Wainuiomata Scenic Reserve
Landuse	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve
Lab No	313417 / 45	313417 / 46	313417 / 47	313417 / 48	313417 / 49	313417 / 50	313417 / 51	313417 / 52	313417 / 53	313417 / 54	313417 / 55	314144 / 49
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	03/06/03	03/06/03	03/06/03	03/06/03	04/06/03	04/06/03	04/06/03	04/06/03	04/06/03	05/06/03	05/06/03	13/06/2003
Soluble Boron	1.2	1.3	1.8	1.2	1.3	1.1	1.1	1.7	1.3	1.8	2.2	0.9
Total Recoverable As	1	6	3	7	6	5	3	7	5	5	4	3
Total Recoverable Cd	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.1	0.05	0.05	0.05	0.1
Total Recoverable Cr	6	11	10	13	14	16	15	14	14	15	13	9
Total Recoverable Cu	3	7	6	18	10	11	11	25	6	15	8	8
Total Recoverable Hg	0.05	0.05	0.1	0.1	0.1	0.05	0.1	0.2	0.05	0.05	0.1	0.05
Total Recoverable Ni	4	7	6	12	7	9	9	13	6	12	6	9
Total Recoverable Pb	5.9	13.1	9.3	21.2	14.5	22.1	31.2	78.6	20.7	29.9	24.5	14.4
Total Recoverable Zn	24	39	33	74	36	57	53	105	52	80	32	53
TPH	15	70	50	40	50	40	140	80	20	160	190	35

	PAH											
Sample ID	2(A)	2(B)	2(C)	2(D)	2(E)	2(F)	2(G)	2(H)	2(I)	2(K)	2(L)	2(M)
Location	Raroa Reserve, Pukerua Bay	Small Reserve, Plimmerton	Samwell Drive Reserve, Whitby	Porirua Scenic Reserve	Wilf Mexted Scenic Reserve, Tawa	Johnsonville Park	Northern Walkway	Southern Walkway	Rangitatau Reserve, Wellington	Eastern Walkway	Karori park	Wainuiomata Scenic Reserve
Landuse	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve
Lab No	313417 / 45	313417 / 46	313417 / 47	313417 / 48	313417 / 49	313417 / 50	313417 / 51	313417 / 52	313417 / 53	313417 / 54	313417 / 55	314144 / 49
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	03/06/03	03/06/03	03/06/03	03/06/03	04/06/03	04/06/03	04/06/03	04/06/03	04/06/03	05/06/03	05/06/03	13/06/2003
Acenaphthene	0.00035	0.0004	0.0004	0.0004	0.00045	0.0004	0.0004	0.0063	0.0004	0.0029	0.0004	0.0005
Acenaphthylene	0.00035	0.0004	0.0004	0.0004	0.00045	0.0022	0.0004	0.0469	0.0073	0.0086	0.0004	0.0005
Anthracene	0.00035	0.0004	0.0004	0.0004	0.00045	0.0025	0.0027	0.0481	0.0041	0.0099	0.0008	0.0005
Benzo[a]anthracene	0.0029	0.0018	0.0004	0.0013	0.00045	0.0079	0.0083	0.206	0.0188	0.0445	0.0060	0.001
Benzo[a]pyrene (BAP)	0.0033	0.0017	0.0004	0.0015	0.0013	0.0092	0.0106	0.270	0.0326	0.0477	0.0070	0.002
Benzo[b]fluoranthene	0.0061	0.0032	0.0004	0.0027	0.0024	0.0142	0.0173	0.407	0.0512	0.0712	0.0152	0.004
Benzo[g,h,i]perylene	0.0024	0.0013	0.0004	0.0012	0.0012	0.0071	0.0096	0.229	0.0323	0.0349	0.0061	0.002
Benzo[k]fluoranthene	0.0022	0.0012	0.0004	0.0004	0.0009	0.0050	0.0057	0.131	0.0202	0.0275	0.0049	0.001
Chrysene	0.0074	0.0061	0.0004	0.0049	0.00045	0.0139	0.0129	0.260	0.0254	0.0565	0.0110	0.004
Dibenzo[a,h]anthracene	0.00035	0.0004	0.0004	0.0004	0.00045	0.0021	0.0029	0.0718	0.0103	0.0115	0.0018	0.0005
Fluoranthene	0.0068	0.0050	0.0013	0.0034	0.0025	0.0218	0.0206	0.547	0.0317	0.126	0.0154	0.004
Fluorene	0.00035	0.0004	0.0004	0.0004	0.00045	0.0009	0.0004	0.0108	0.0004	0.0056	0.0004	0.0005
Indeno(1,2,3-c,d)pyrene	0.0035	0.0015	0.0004	0.0016	0.0014	0.0082	0.0119	0.315	0.0440	0.0461	0.0090	0.002
Naphthalene	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.012	0.002	0.002	0.002	0.0025
Phenanthrene	0.0016	0.0025	0.0004	0.0016	0.0009	0.0125	0.0087	0.257	0.0085	0.0934	0.0033	0.001
Pyrene	0.0068	0.0050	0.0012	0.0034	0.0025	0.0201	0.0209	0.574	0.0316	0.124	0.0148	0.003

Evaulated Data Set for Main Soil Type 3

	Metals and TPH									
Sample ID	3(A)	3(B)	3(C)	3(D)	3(E)	3(F)	3(F2)	3(G)	3(H)	3(1)+3(2)
Location	Kaitoke Regional Park	Harcourt Park Reserve, Upper Hutt	Heretaunga Park, Upper Hutt	Willow Park, Silverstream	Delaney Park, Stokes Valley	Fraser Park, Lower Hutt	Duplicate	Hutt River Terrace, Lower Hutt	Ewan Park, Lower Hutt	Equipment Blank
Landuse	Public Bush Reserve	Public Bush Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	QA/QC
Lab No.	314144 / 42	314144 / 43	314144 / 44	314144 / 45	314144 / 46	314144 / 47	314144 / 48	314144 / 50	314144 / 51	314144/1
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	12/06/2003	12/06/2003	12/06/2003	12/06/2003	13/06/2003	13/06/2003	13/06/2003	15/06/2003	15/06/2003	12/06/2003
Soluble Boron	0.9	1.6	0.6	0.9	1.0	0.4	0.3	0.3	0.4	Not reported
Total Recoverable As	2	3	7	5	5	5	5	4	7	0.0005
Total Recoverable Cd	0.05	0.05	0.1	0.1	0.2	0.05	0.05	0.05	0.1	0.00005
Total Recoverable Cr	9	15	18	12	14	16	17	17	17	0.00025
Total Recoverable Cu	6	5	13	13	18	13	13	11	19	0.0961
Total Recoverable Hg	2.6	0.1	0.05	0.1	0.2	0.1	0.1	0.05	0.1	0.00004
Total Recoverable Ni	5	7	14	9	7	13	13	14	14	0.0009
Total Recoverable Pb	16.7	17.9	31.1	53.9	73.3	33.1	31.6	32.7	51.9	0.0021
Total Recoverable Zn	38	42	86	109	201	73	72	76	97	0.008
TPH (C_7-C_{44})	260	200	50	20	20	100	120	25	30	0.1

Notes:

3(1) +3(2) - Equipment blank: wash water from hand auger

3(F2) - Duplicate

	PAH								
Sample ID	3(A)	3(B)	3(C)	3(D)	3(E)	3(F)	3(F2)	3(G)	3(H)
Location	Kaitoke Regional Park	Harcourt Park Reserve, Upper Hutt	Heretaunga Park, Upper Hutt	Willow Park, Silverstream	Delaney Park, Stokes Valley	Fraser Park, Lower Hutt	Duplicate	Hutt River Terrace, Lower Hutt	Ewan Park, Lower Hutt
Landuse	Public Bush Reserve	Public Bush Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve	Public Reserve
Lab No	314144 / 42	314144 / 43	314144 / 44	314144 / 45	314144 / 46	314144 / 47	314144 / 48	314144 / 50	314144 / 51
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	12/06/2003	12/06/2003	12/06/2003	12/06/2003	13/06/2003	13/06/2003	13/06/2003	15/06/2003	15/06/2003
Acenaphthene	0.001	0.0004	0.0004	0.0089	0.00045	0.00035	0.0004	0.0004	0.0019
Acenaphthylene	0.009	0.0011	0.0021	0.0080	0.0076	0.0020	0.0018	0.0036	0.0590
Anthracene	0.006	0.0010	0.0010	0.0250	0.0063	0.0009	0.0004	0.0021	0.0362
Benzo[a]anthracene	0.013	0.0051	0.0060	0.126	0.0450	0.0032	0.0024	0.0093	0.196
Benzo[a]pyrene (BAP)	0.014	0.0048	0.0095	0.136	0.0660	0.0049	0.0039	0.0155	0.328
Benzo[b]fluoranthene	0.021	0.0076	0.0153	0.192	0.0828	0.0082	0.0065	0.0222	0.369
Benzo[g,h,i]perylene	0.010	0.0035	0.0083	0.0847	0.0525	0.0052	0.0046	0.0152	0.255
Benzo[k]fluoranthene	0.007	0.0027	0.0047	0.0560	0.0261	0.0027	0.0021	0.0073	0.132
Chrysene	0.017	0.0072	0.0100	0.122	0.0555	0.0056	0.0064	0.0125	0.197
Dibenzo[a,h]anthracene	0.004	0.0004	0.0024	0.0396	0.0166	0.0016	0.0011	0.0043	0.0898
Fluoranthene	0.031	0.0126	0.0127	0.259	0.103	0.0071	0.0062	0.0199	0.386
Fluorene	0.004	0.0004	0.0009	0.0069	0.0014	0.00035	0.0004	0.0015	0.0079
Indeno(1,2,3-c,d)pyrene	0.010	0.0049	0.0098	0.126	0.0603	0.0053	0.0043	0.0141	0.323
Naphthalene	0.006	0.008	0.002	0.002	0.002	0.002	0.002	0.002	0.012
Phenanthrene	0.038	0.0063	0.0069	0.112	0.0348	0.0049	0.0048	0.0131	0.118
Pyrene	0.033	0.0144	0.0145	0.238	0.124	0.0083	0.0072	0.0247	0.461

Notes:

3(F2) - Duplicate

The Wairarapa Soils, located to the east of the Wairarapa Fault, which comprise Gley and Immature Pallic Soils associated with Holocene flood plain and terrace deposits

Evaulated Data Set for Main Soil Type 4

	Metals and TPH													
Sample ID	4(A)	4(B)	4(C)	4(D)	4(F)	4(F2)	4(G)	4(H)	4(I)	4(J)	4(K)	4(1)	4(2)	4(3)
Location	Featherston Reserve	Halford Farm, Martinborough	DOC Reserve, South Wairarapa	Spring Rock Farm, Martinborough	Solider Memorial Park, Greytown	Duplicate	Farm, Carterton	Private Reserve, Carterton	Farm, Masterton	Bush Reserve, Masterton	Mel Parkinson Reserve, Opaki	Equipment Blank	Equipment Blank	Trip Blank
Landuse	Public Bush Reserve	Pastoral Beef & Sheep	Private Bush Reserve	Private Bush Reserve	Public Bush Reserve	Public Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Public Bush Reserve	QA/QC	QA/QC	QA/QC
Lab No.	314571 / 48	314571 / 49	314571 / 50	314571 / 51	314571 / 52	314571 / 53	314571 / 54	314571 / 55	314571 / 56	314571 / 57	314688/27	314571 / 1	314571 / 2	314571 / 3
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L	mg/L	mg/L
Date	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003
Soluble Boron	2.0	1.2	1.6	1.8	2.7	2.8	0.9	2.2	1.7	2.7	0.7	-	0.02	-
Total Recoverable As	4	5	2	3	7	7	4	3	4	7	3	-	0.0005	-
Total Recoverable Cd	0.05	0.2	0.05	0.05	0.1	0.1	0.2	0.05	0.2	0.1	0.05	-	0.00007	-
Total Recoverable Cr	13	21	14	14	20	20	16	14	11	19	18	-	0.0025	-
Total Recoverable Cu	15	18	9	7	18	18	8	11	11	19	13	-	0.0301	-
Total Recoverable Hg	0.05	0.05	0.1	0.05	0.1	0.1	0.05	0.05	0.05	0.05	0.05	-	0.00004	-
Total Recoverable Ni	13	21	11	10	20	20	10	10	6	21	16	-	0.00025	-
Total Recoverable Pb	21.6	18.1	18.3	9.4	32.0	31.3	21.4	15.2	16.3	34.0	17.9	-	0.0015	-
Total Recoverable Zn	87	90	67	44	121	125	70	61	63	118	62	-	0.011	-
TPH (C_7-C_{44})	20	20	25	90	60	20	20	80	820	130	15	0.1	0.1	0.1

Notes:

4(1) +4(2) - Equipment blank: wash water from hand auger

4(F2) - Duplicate

4(3) - Trip Blank

	PAH										
Sample ID	4(A)	4(B)	4 (C)	4(D)	4(F)	4(F2)	4(G)	4(H)	4(I)	4(J)	4(K)
Location	Featherston Reserve	Halford Farm, Martinborough	DOC Reserve, South Wairarapa	Spring Rock Farm, Martinborough	Soldier Memorial Park, Greytown	Duplicate	Farm, Carterton	Private Reserve, Carterton	Farm, Masterton	Bush Reserve, Masterton	Mel Parkinson Reserve, Opaki
Landuse	Public Bush Reserve	Pastoral Beef & Sheep	Private Bush Reserve	Private Bush Reserve	Public Bush Reserve	Public Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Dry Stock (Sheep)	Private Bush Reserve	Public Bush Reserve
Lab No	314571 / 48	314571 / 49	314571 / 50	314571 / 51	314571 / 52	314571 / 53	314571 / 54	314571 / 55	314571 / 56	314571 / 57	314688/27
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003	21/06/2003
Acenaphthene	0.0004	0.0009	0.0005	0.0004	0.0010	0.00045	0.00045	0.0004	0.0065	0.0130	0.0017
Acenaphthylene	0.0004	0.0004	0.0005	0.0008	0.0023	0.0009	0.00045	0.0004	0.00045	0.0287	0.0591
Anthracene	0.0004	0.0010	0.0005	0.0004	0.0030	0.0024	0.0009	0.0004	0.0019	0.0402	0.0456
Benzo[a]anthracene	0.0015	0.0026	0.0005	0.0004	0.0071	0.0092	0.0043	0.0018	0.0059	0.188	0.129
Benzo[a]pyrene (BAP)	0.0017	0.0026	0.0005	0.0004	0.0070	0.0132	0.0049	0.0015	0.0051	0.313	0.225
Benzo[b]fluoranthene	0.0051	0.0130	0.004	0.0004	0.0205	0.0342	0.0105	0.0063	0.0124	0.423	0.347
Benzo[g,h,i]perylene	0.0032	0.0071	0.002	0.0004	0.0067	0.0146	0.0061	0.0031	0.0049	0.268	0.181
Benzo[k]fluoranthene	0.0011	0.0032	0.0005	0.0004	0.0052	0.0100	0.0028	0.0014	0.0033	0.123	0.114
Chrysene	0.0019	0.0069	0.0005	0.0004	0.0153	0.0183	0.0043	0.0024	0.0079	0.232	0.136
Dibenzo[a,h]anthracene	0.0004	0.0013	0.0005	0.0004	0.0018	0.0038	0.0009	0.0004	0.00045	0.0519	0.0482
Fluoranthene	0.0036	0.0089	0.001	0.0004	0.0277	0.0236	0.0117	0.0061	0.0182	0.568	0.213
Fluorene	0.0004	0.0031	0.0005	0.0004	0.0036	0.0044	0.00045	0.0004	0.00045	0.0188	0.0040
Indeno(1,2,3-c,d)pyrene	0.0022	0.0027	0.0005	0.0004	0.0050	0.0117	0.0053	0.0028	0.0050	0.233	0.194
Naphthalene	0.002	0.002	0.00025	0.002	0.002	0.002	0.002	0.002	0.00025	0.019	0.002
Phenanthrene	0.0014	0.0192	0.002	0.0004	0.0320	0.0340	0.0051	0.0026	0.0116	0.350	0.0651
Pyrene	0.0048	0.0124	0.002	0.0004	0.0217	0.0287	0.0126	0.0064	0.0208	0.595	0.223

Notes:

4(F2) - Duplicate

Evaulated Data Set for Main Soil Type 5

	Metals and TPH					
Sample ID	5(A)	5(B)	5(B2)	5(C)	5(D)	5(1)+5(2)
Location	Ngaumu Forest, Stronvar	Clarke Memorial, Mauriceville	Duplicate	Public Reserve, Tinui	Private Reserve, Masterton	Equipment Blank
Landuse	Exotic Forest	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Private Bush Reserve	QA/QC
Lab No.	314688/28	314688/29	314688/30	314688/31	314688/32	314688 / 1
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/L
Date	20/06/2003	20/06/2003	20/06/2003	20/06/2003	20/06/2003	23/06/2003
Soluble Boron	1.7	1.0	1.1	2.5	2.6	0.033
Total Recoverable As	4	4	3	4	1	0.0005
Total Recoverable Cd	0.05	0.1	0.1	0.05	0.2	0.00010
Total Recoverable Cr	8	15	15	10	10	0.00025
Total Recoverable Cu	7	11	9	19	6	0.0491
Total Recoverable Hg	0.05	0.05	0.1	0.05	0.05	0.00004
Total Recoverable Ni	5	13	12	7	8	0.00025
Total Recoverable Pb	12.2	20.5	20.2	38.1	10.8	0.0021
Total Recoverable Zn	31	52	52	72	57	0.037
TPH (C_7-C_{44})	460	50	20	50	20	0.4

Notes:

5(1) - Equipment blank: wash water from hand auger

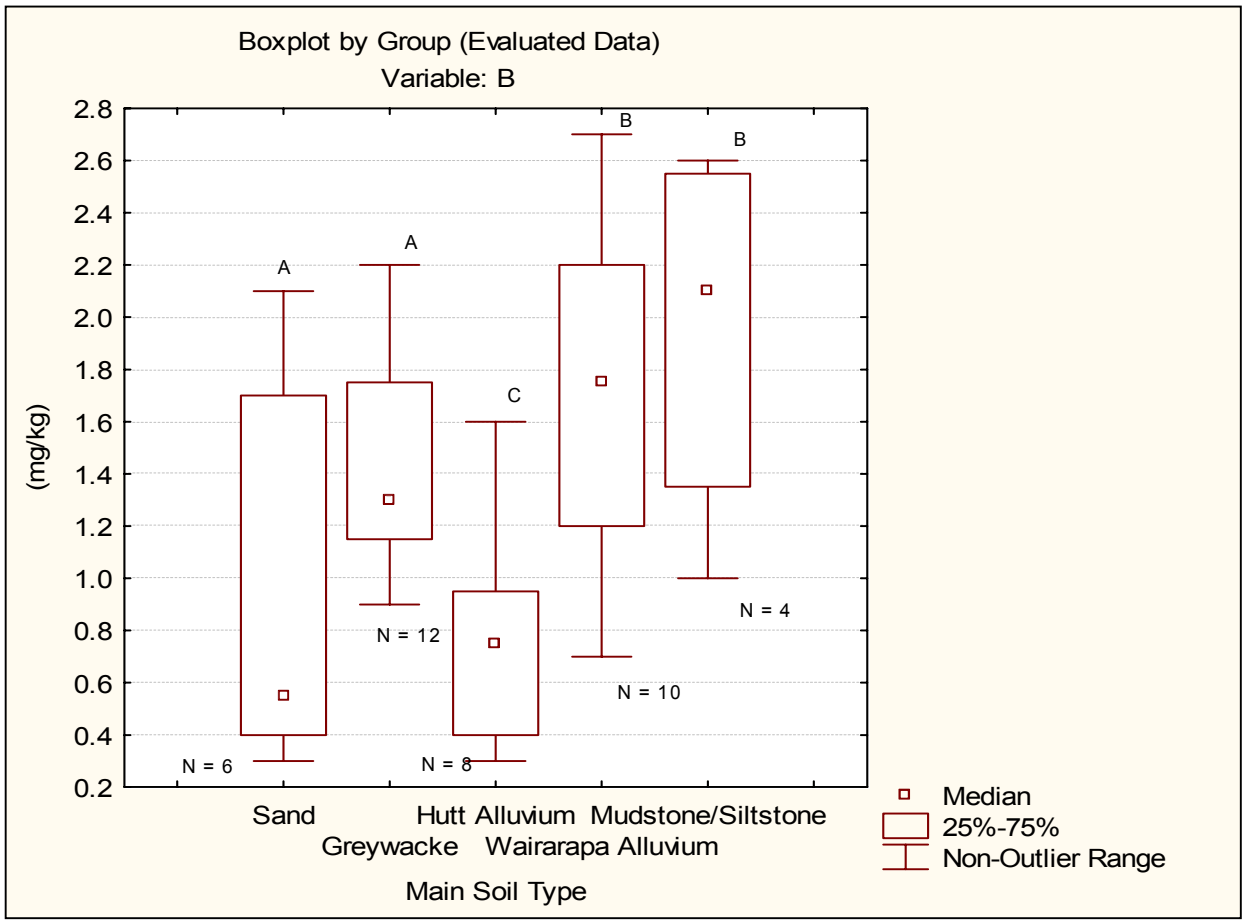
5(F2) - Duplicate

	PAH				
Sample ID	5(A)	5(B)	5(B2)	5(C)	5(D)
Location	Ngaumu Forest, Stronvar	Clarke Memorial, Mauriceville	Duplicate	Public Reserve, Tinui	Private Bush Reserve, Masterton
Landuse	Exotic Forest	Public Bush Reserve	Public Bush Reserve	Public Bush Reserve	Private Bush Reserve
Lab No	314688/28	314688/29	314688/30	314688/31	314688/32
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date	20/06/2003	20/06/2003	20/06/2003	20/06/2003	20/06/2003
Acenaphthene	0.0004	0.00045	0.00045	0.0004	0.00045
Acenaphthylene	0.0004	0.00045	0.00045	0.0004	0.00045
Anthracene	0.0004	0.00045	0.0010	0.0009	0.00045
Benzo[a]anthracene	0.0004	0.0024	0.0051	0.0049	0.00045
Benzo[a]pyrene (BAP)	0.0004	0.0022	0.0041	0.0054	0.00045
Benzo[b]fluoranthene	0.0022	0.0074	0.0094	0.0104	0.00045
Benzo[g,h,i]perylene	0.0012	0.0041	0.0048	0.0062	0.00045
Benzo[k]fluoranthene	0.0004	0.0029	0.0029	0.0031	0.00045
Chrysene	0.0004	0.0030	0.0040	0.0054	0.00045
Dibenzo[a,h]anthracene	0.0004	0.00045	0.0009	0.0009	0.00045
Fluoranthene	0.0021	0.0061	0.0088	0.0147	0.00045
Fluorene	0.0004	0.00045	0.00045	0.0004	0.00045
Indeno(1,2,3-c,d)pyrene	0.0011	0.0031	0.0040	0.0048	0.00045
Naphthalene	0.002	0.002	0.002	0.002	0.002
Phenanthrene	0.0004	0.0016	0.0024	0.0073	0.00045
Pyrene	0.0084	0.0068	0.0101	0.0146	0.00045

Notes:

5(B2) - Duplicate

Boron

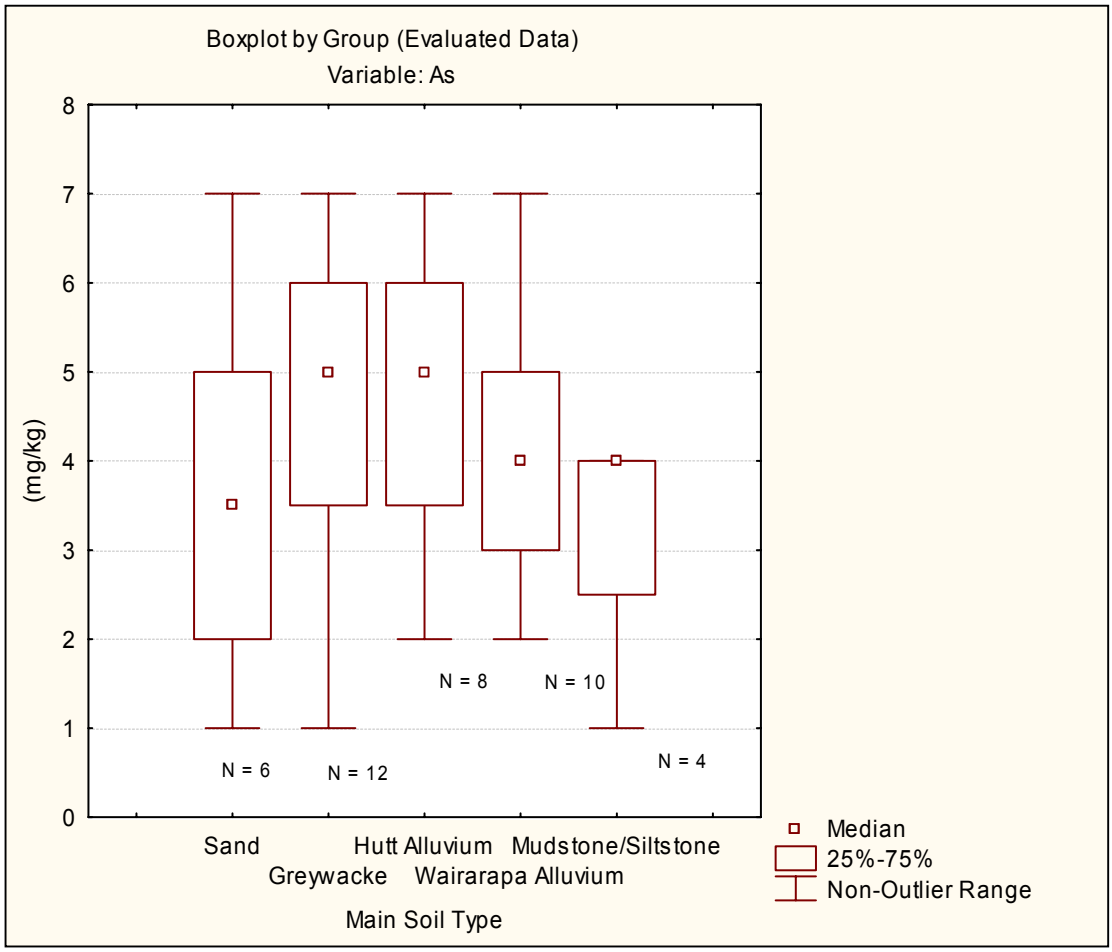

Boxplot by Group (Evaluated Data)
Variable: B
(mg/kg)
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
A
A
C
B
B
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range

Kruskal-Wallis ANOVA by Ranks; B (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =14.66357 p =.0055

Depend.: B	Code	Valid N	Sum of Ranks
Sand	101	6	80.5000
Greywacke	102	12	273.5000
Hutt Alluvium	104	8	79.0000
Wairarapa Alluvium	105	10	270.0000
Mudstone/Siltstone	106	4	117.0000

Cell No.	LSD test; variable B (All Data (Final) in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = .33532, df = 35.000 Main Soil Type	{1} .93333	{2} 1.4083	{3} .76250	{4} 1.7500	{5} 1.9500
1	Sand		0.109846	0.588353	*0.009821*	*0.010098*
2	Greywacke	0.109846		*0.019730*	0.176948	0.114171
3	Hutt Alluvium	0.588353	*0.019730*		*0.000989*	*0.001953*
4	Wairarapa Alluvium	*0.009821*	0.176948	*0.000989*		0.563098
5	Mudstone/Siltstone	*0.010098*	0.114171	*0.001953*	0.563098	

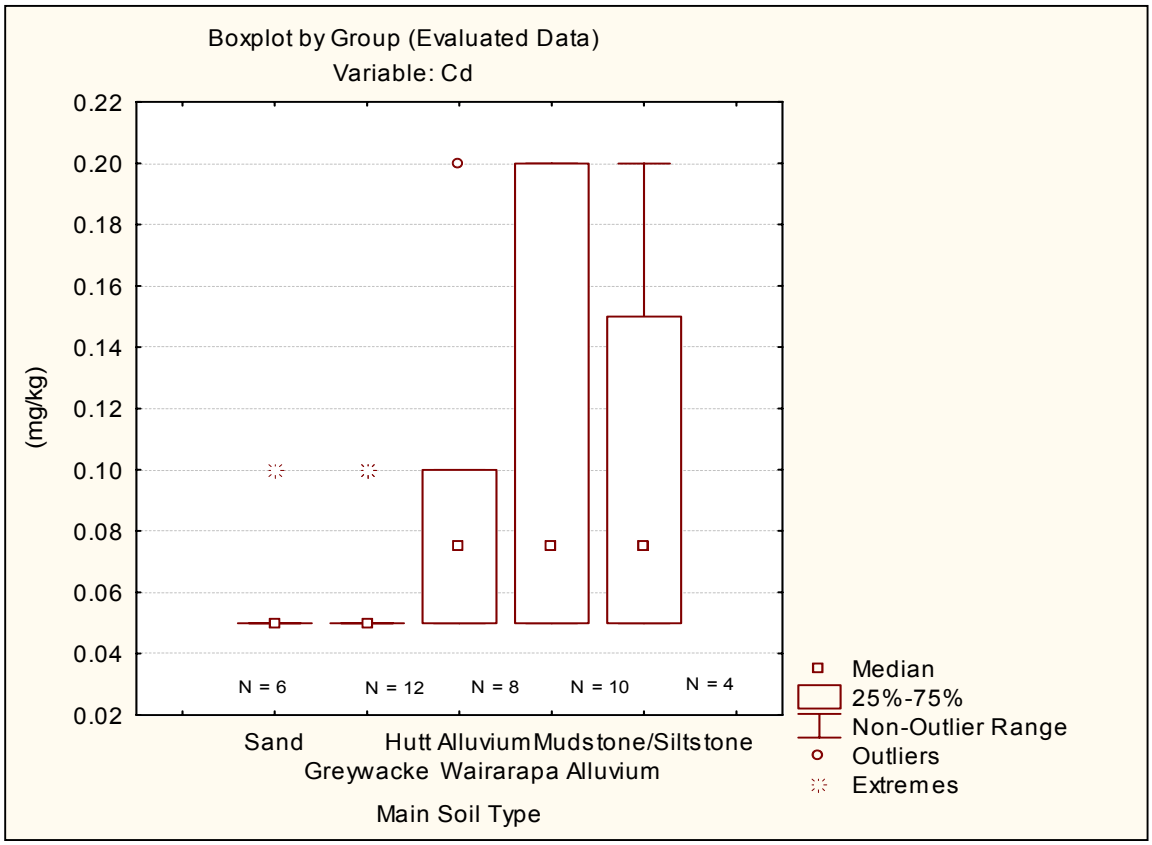
Arscenic


Boxplot by Group (Evaluated Data)
Variable: As
(mg/kg)
8
7
6
5
4
3
2
1
0
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range

Kruskal-Wallis ANOVA by Ranks; As (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =3.326307 p =.5048

Depend.: As	Code	Valid N	Sum of Ranks
Sand	101	6	100.0000
Greywacke	102	12	280.5000
Hutt Alluvium	104	8	190.0000
Wairarapa Alluvium	105	10	192.0000
Mudstone/Siltstone	106	4	57.5000

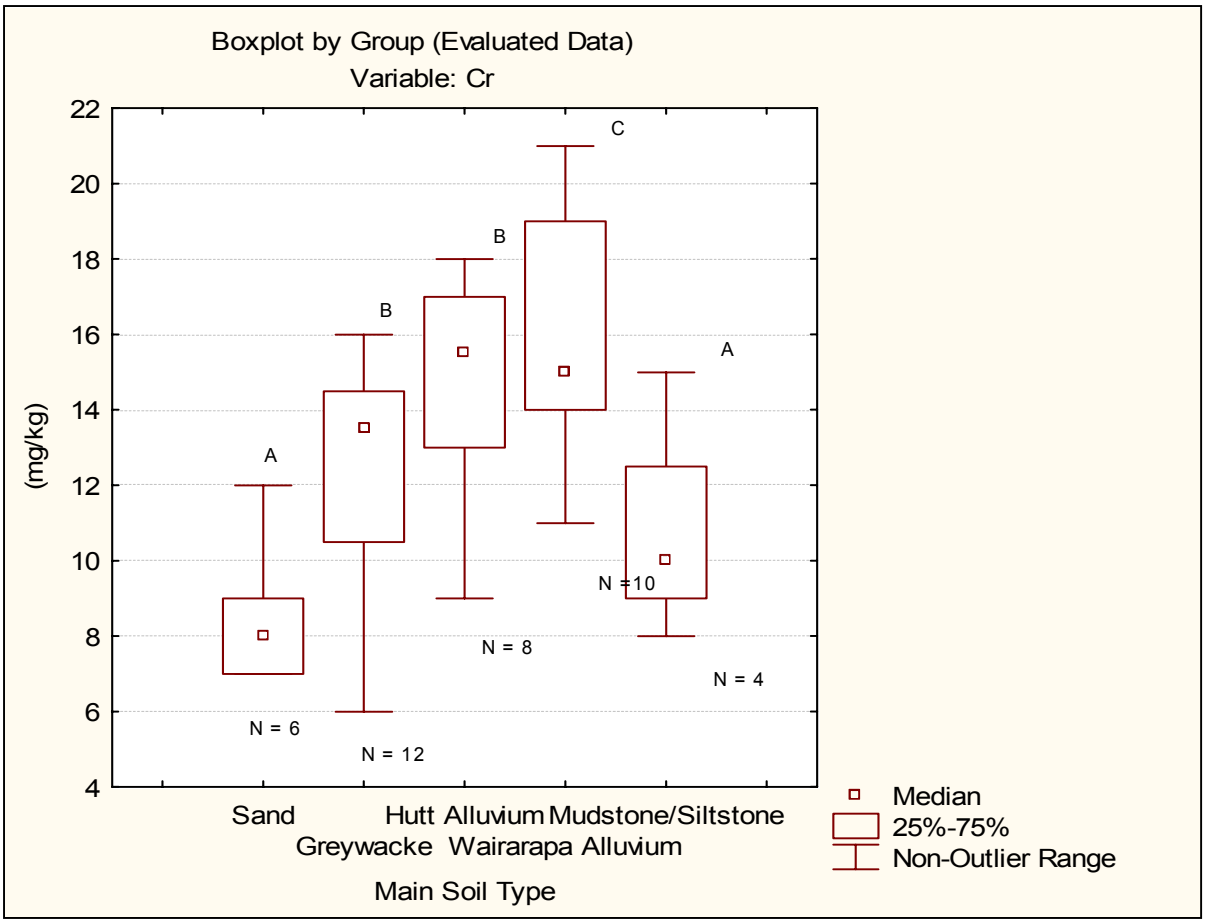
Cadmium


Boxplot by Group (Evaluated Data)
Variable: Cd
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
(mg/kg)
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Kruskal-Wallis ANOVA by Ranks; Cd (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =5.673871 p =.2249

Depend.: Cd	Code	Valid N	Sum of Ranks
Sand	101	6	98.5000
Greywacke	102	12	197.0000
Hutt Alluvium	104	8	185.0000
Wairarapa Alluvium	105	10	243.5000
Mudstone/Siltstone	106	4	96.0000

Chromium

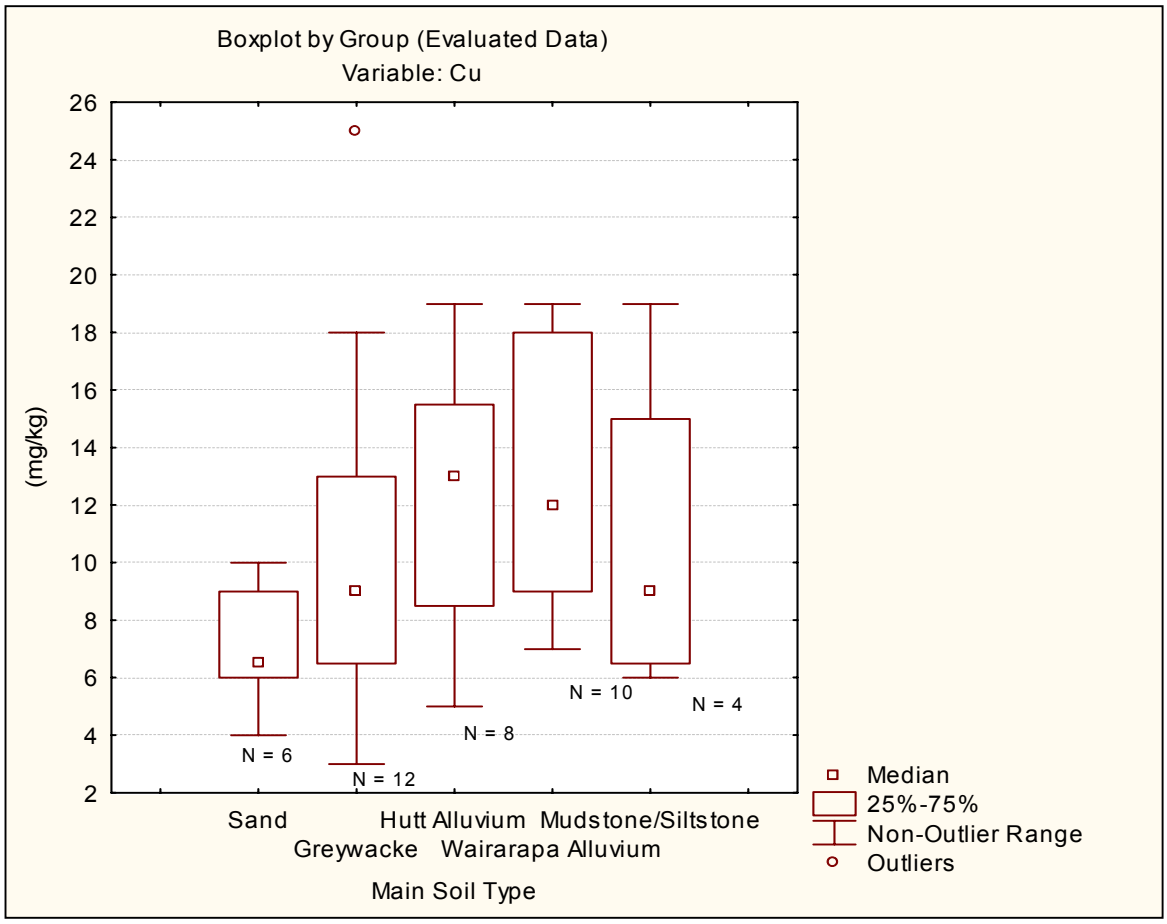

Boxplot by Group (Evaluated Data)
Variable: Cr
(mg/kg)
22
20
18
16
14
12
10
8
6
4
A
B
B
C
A
N = 6
N = 12
N = 8
N =10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range

Kruskal-Wallis ANOVA by Ranks; Cr (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =17.30078 p =.0017

Depend.: Cr	Code	Valid N	Sum of Ranks
Sand	101	6	38.5000
Greywacke	102	12	227.5000
Hutt Alluvium	104	8	212.5000
Wairarapa Alluvium	105	10	286.0000
Mudstone/Siltstone	106	4	55.5000

Cell No.	LSD test; variable Cr (All Data excluding Outliers in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = 8.6500, df = 35.000 Main Soil Type	{1} 8.5000	{2} 12.500	{3} 14.750	{4} 16.000	{5} 10.750
1	Sand		*0.010093*	*0.000377*	*0.000019*	0.243936
2	Greywacke	*0.010093*		0.102634	*0.008704*	0.309797
3	Hutt Alluvium	*0.000377*	0.102634		0.376371	*0.032922*
4	Wairarapa Alluvium	*0.000019*	*0.008704*	0.376371		*0.004731*
5	Mudstone/Siltstone	0.243936	0.309797	*0.032922*	*0.004731*	

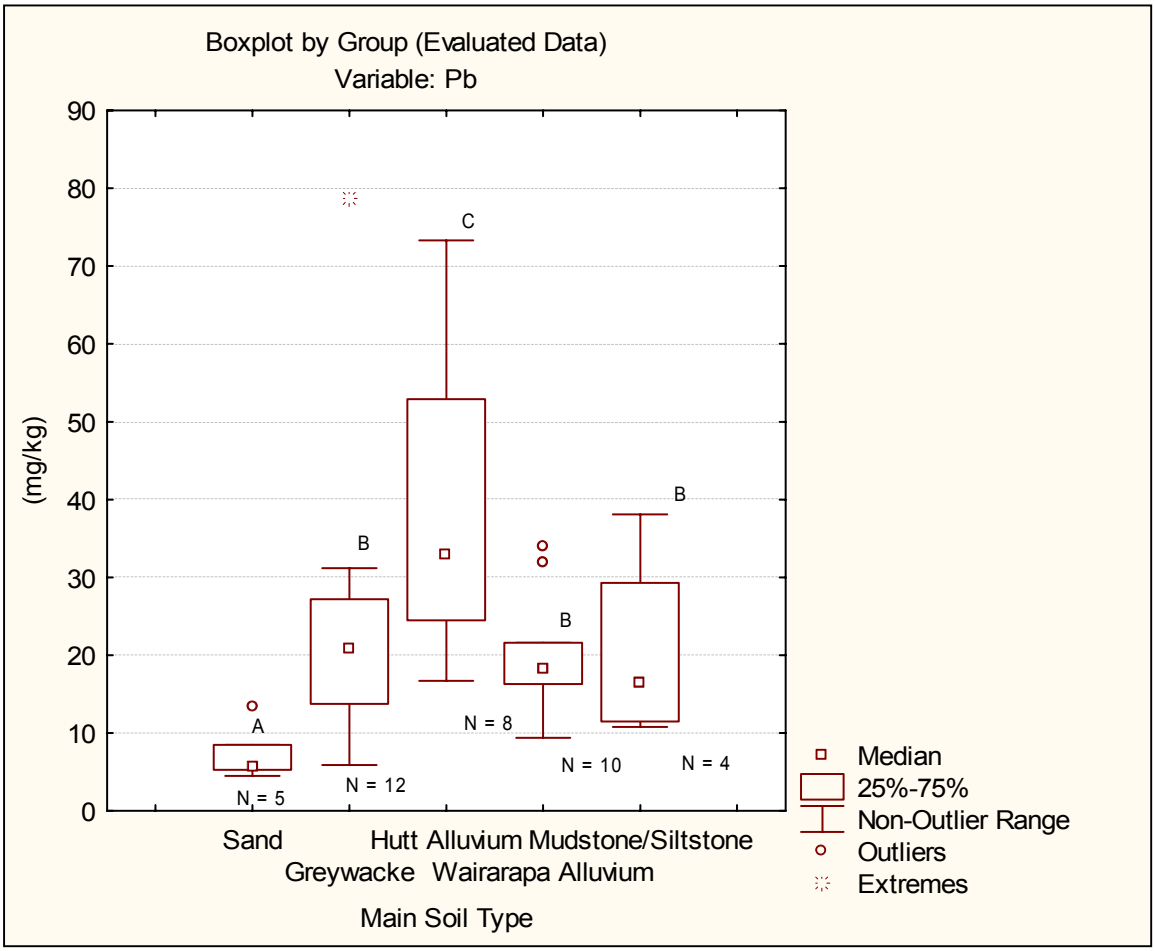
Copper


Boxplot by Group (Evaluated Data)
Variable: Cu
(mg/kg)
26
24
22
20
18
16
14
12
10
8
6
4
2
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers

Kruskal-Wallis ANOVA by Ranks; Cu (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =7.324777 p =.1197

Depend.: Cu	Code	Valid N	Sum of Ranks
Sand	101	6	63.5000
Greywacke	102	12	228.0000
Hutt Alluvium	104	8	191.0000
Wairarapa Alluvium	105	10	258.0000
Mudstone/Siltstone	106	4	79.5000

Lead

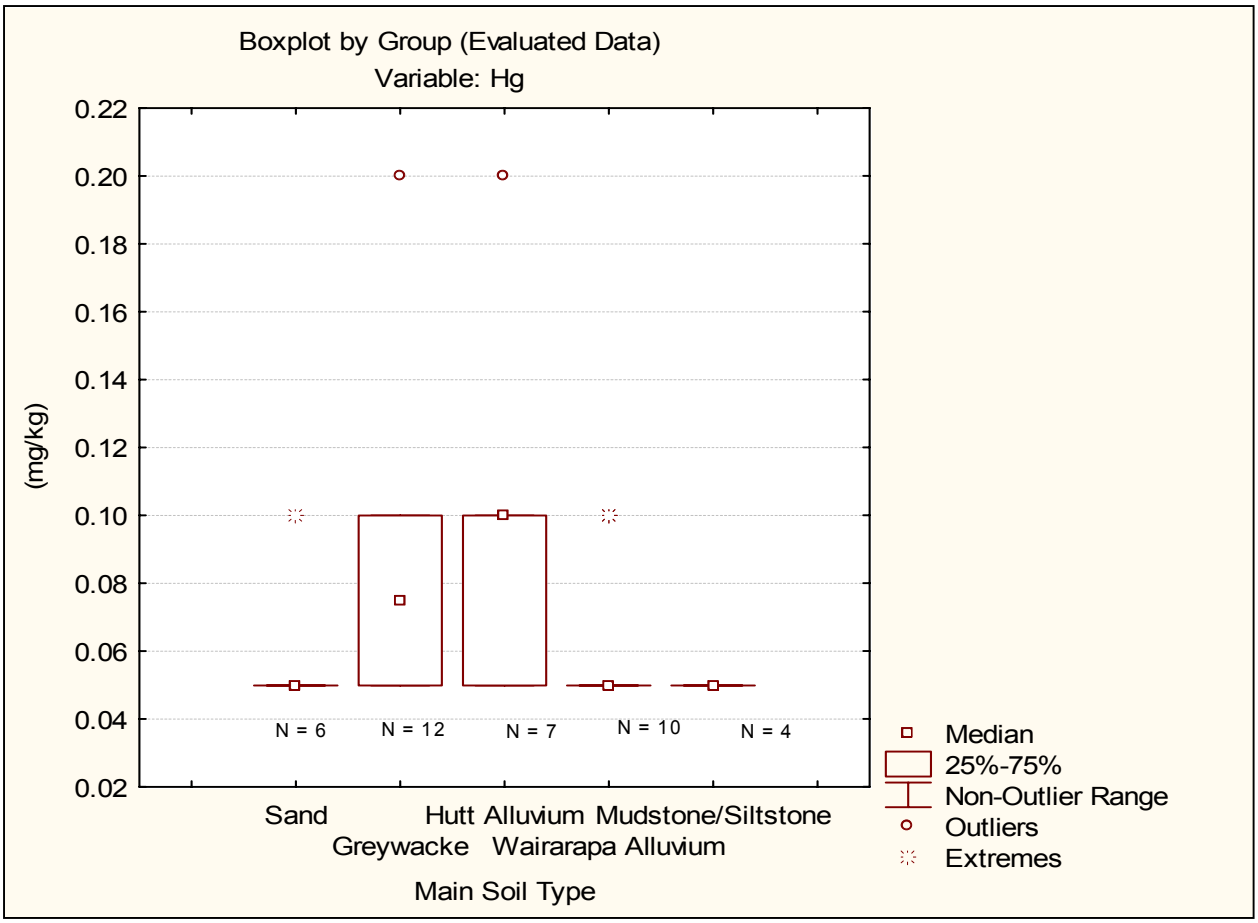

Boxplot by Group (Evaluated Data)
Variable: Pb
(mg/kg)
90
80
70
60
50
40
30
20
10
0
A
B
C
B
B
N = 5
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone Alluvium
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Kruskal-Wallis ANOVA by Ranks; Pb (All Data (Final) in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =9.786939 p =.0442

Depend.: Pb	Code	Valid N	Sum of Ranks
Sand	101	6	62.0000
Greywacke	102	12	240.0000
Hutt Alluvium	104	8	238.5000
Wairarapa Alluvium	105	10	206.5000
Mudstone/Siltstone	106	4	73.0000

Cell No.	LSD test; variable Pb (All Data (Final) in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = 925.86, df = 35.000 Main Soil Type	{1} 36.250	{2} 23.783	{3} 38.825	{4} 20.420	{5} 20.400
1	Sand		0.418092	0.876384	0.320634	0.425130
2	Greywacke	0.418092		0.286197	0.797802	0.848394
3	Hutt Alluvium	0.876384	0.286197		0.210646	0.329537
4	Wairarapa Alluvium	0.320634	0.797802	0.210646		0.999120
5	Mudstone/Siltstone	0.425130	0.848394	0.329537	0.999120	

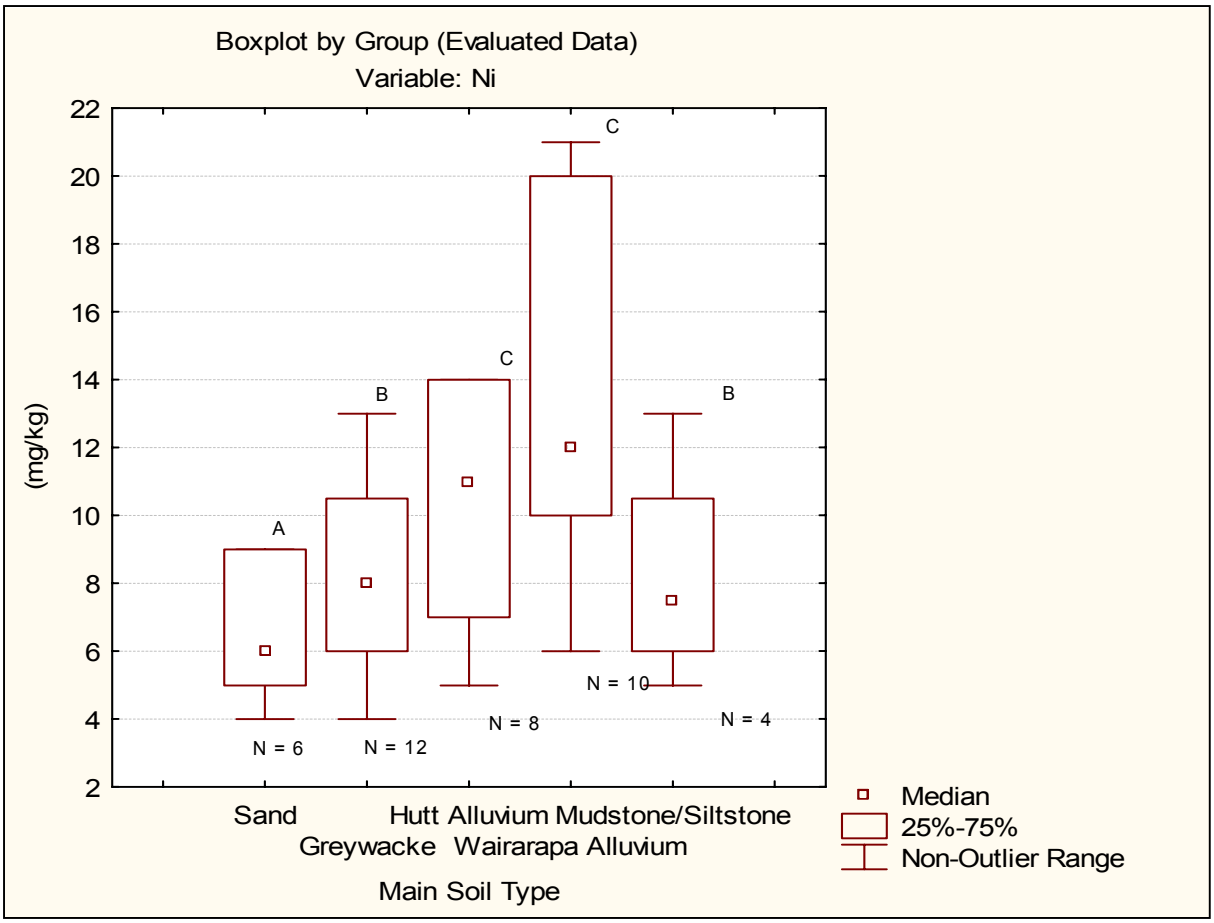
Mercury


Boxplot by Group (Evaluated Data)
Variable: Hg
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
(mg/kg)
N = 6
N = 12
N = 7
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Depend.: Hg	Kruskal-Wallis ANOVA by Ranks; Hg (All Data excluding Outliers in WRCData Independent (grouping) variable: Main Soil Type Kruskal-Wallis test: H (4, N= 40) =11.08393 p =.0256		
	Code	Valid N	Sum of Ranks
Sand	101	6	96.5000
Greywacke	102	12	274.0000
Hutt Alluvium	104	8	230.5000
Wairarapa Alluvium	105	10	167.0000
Mudstone/Siltstone	106	4	52.0000

Cell No.	LSD test; variable Hg (All Data (Final) in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = .15747, df = 35.000 Main Soil Type	{1} .05833	{2} .08333	{3} .41250	{4} .06000	{5} .05000
1	Sand		0.900453	0.107360	0.993557	0.974232
2	Greywacke	0.900453		0.077735	0.891559	0.885157
3	Hutt Alluvium	0.107360	0.077735		0.069483	0.144728
4	Wairarapa Alluvium	0.993557	0.891559	0.069483		0.966266
5	Mudstone/Siltstone	0.974232	0.885157	0.144728	0.966266	

Nickel

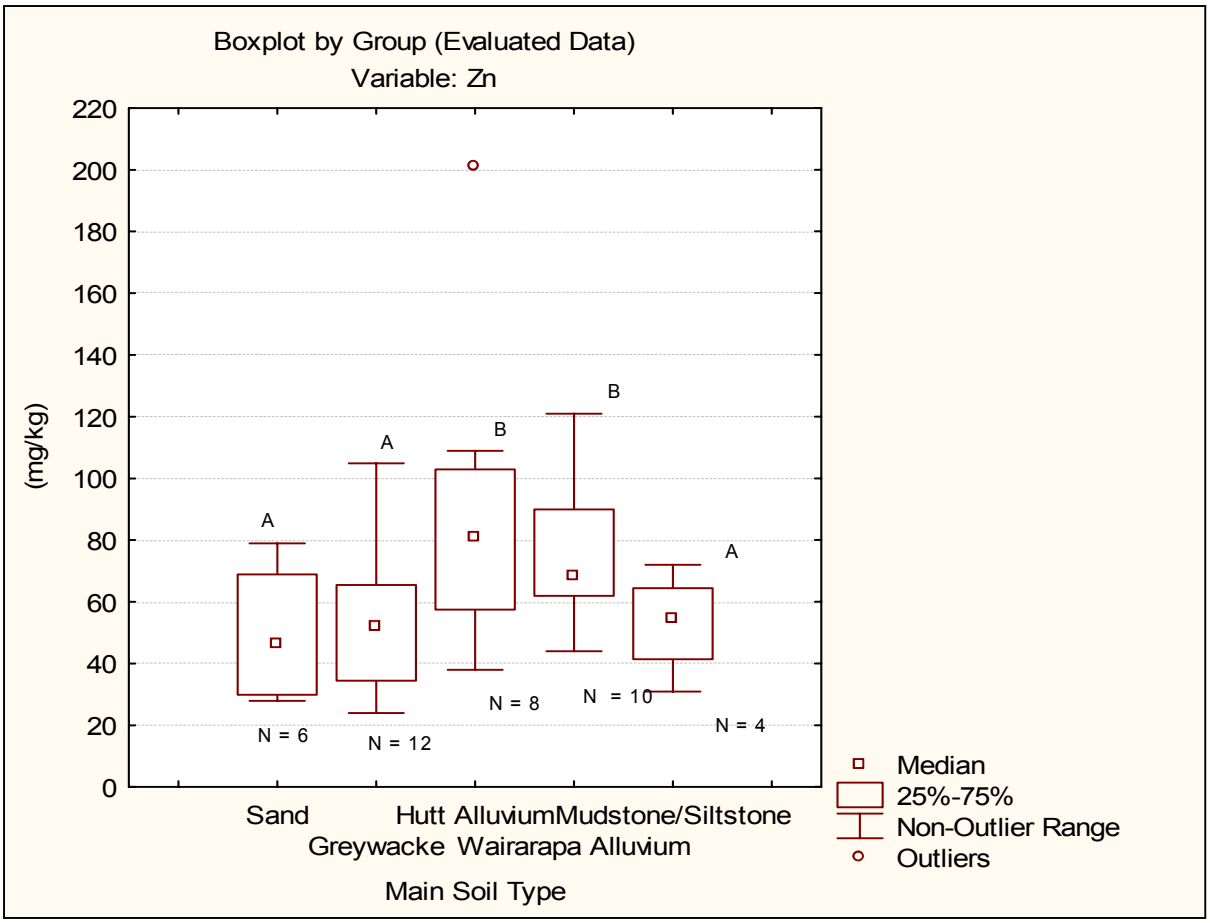

Boxplot by Group (Evaluated Data)
Variable: Ni
(mg/kg)
22
20
18
16
14
12
10
8
6
4
2
A
B
C
C
B
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium Wairarapa Alluvium
Mudstone/Siltstone
Main Soil Type
Median
25%-75%
Non-Outlier Range

Kruskal-Wallis ANOVA by Ranks; Ni (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =12.54814 p =.0137

Depend.: Ni	Code	Valid N	Sum of Ranks
Sand	101	6	63.5000
Greywacke	102	12	205.0000
Hutt Alluvium	104	8	189.0000
Wairarapa Alluvium	105	10	296.0000
Mudstone/Siltstone	106	4	66.5000

Cell No.	LSD test; variable Ni (All Data excluding Outliers in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = 14.411, df = 35.000 Main Soil Type	{1} 6.5000	{2} 8.3333	{3} 10.375	{4} 13.800	{5} 8.2500
1	Sand		0.340733	0.067053	*0.000688*	0.479866
2	Greywacke	0.340733		0.246627	*0.001878*	0.969887
3	Hutt Alluvium	0.067053	0.246627		0.065421	0.366919
4	Wairarapa Alluvium	*0.000688*	*0.001878*	0.065421		*0.018479*
5	Mudstone/Siltstone	0.479866	0.969887	0.366919	*0.018479*	

Zinc

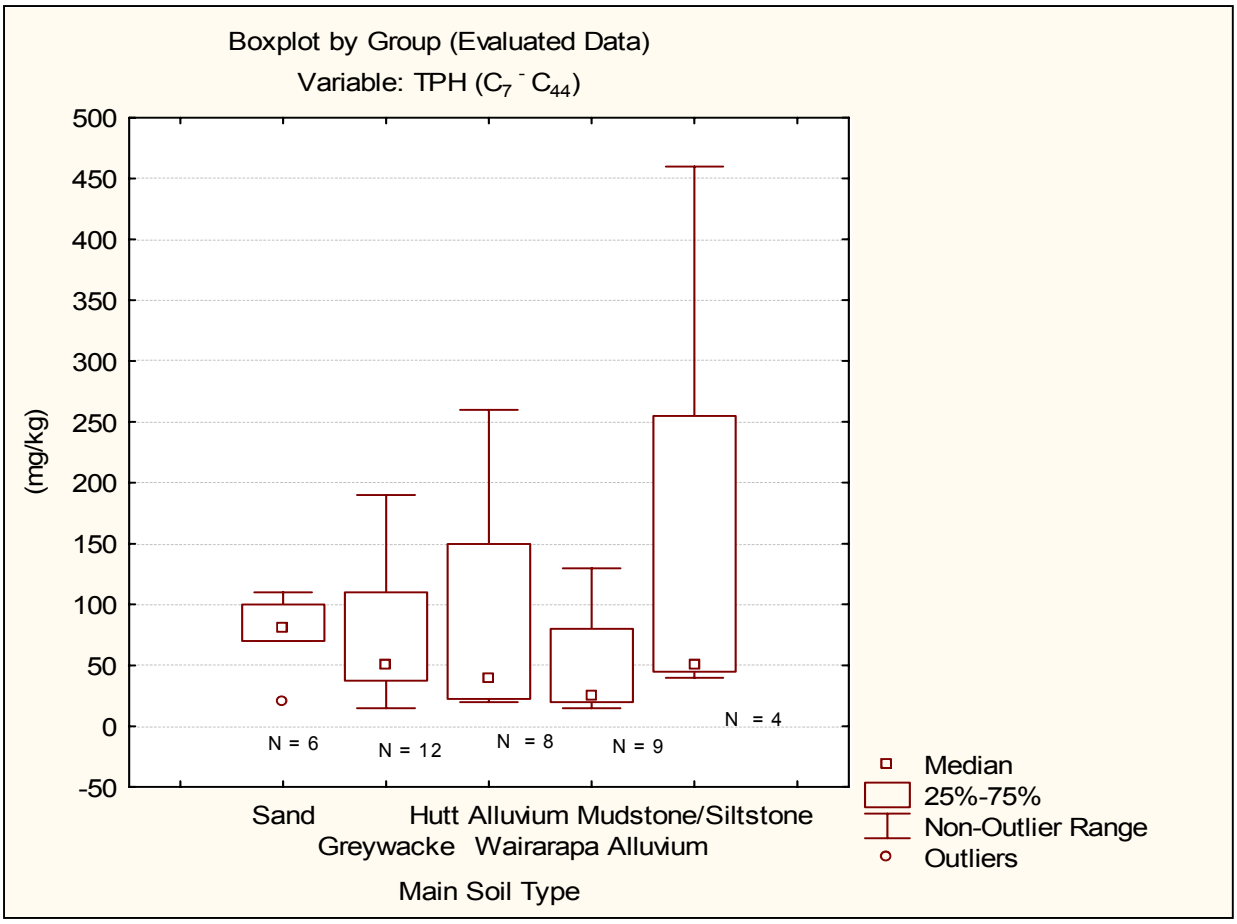

Boxplot by Group (Evaluated Data)
Variable: Zn
(mg/kg)
220
200
180
160
140
120
100
80
60
40
20
0
A
A
B
B
A
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium
Mudstone/Siltstone Wairarapa Alluvium
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers

Kruskal-Wallis ANOVA by Ranks; Zn (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =10.29574 p =.0357

Depend.: Zn	Code	Valid N	Sum of Ranks
Sand	101	6	84.5000
Greywacke	102	12	187.0000
Hutt Alluvium	104	8	219.5000
Wairarapa Alluvium	105	10	267.0000
Mudstone/Siltstone	106	4	62.0000

Cell No.	LSD test; variable Zn (All Data excluding Outliers in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = 948.52, df = 35.000 Main Soil Type	{1} 49.833	{2} 53.167	{3} 90.250	{4} 78.300	{5} 53.000
1	Sand		0.829883	*0.020370*	0.082125	0.874357
2	Greywacke	0.829883		*0.012360*	0.064899	0.992575
3	Hutt Alluvium	*0.020370*	*0.012360*		0.418891	0.056186
4	Wairarapa Alluvium	0.082125	0.064899	0.418891		0.173742
5	Mudstone/Siltstone	0.874357	0.992575	0.056186	0.173742	

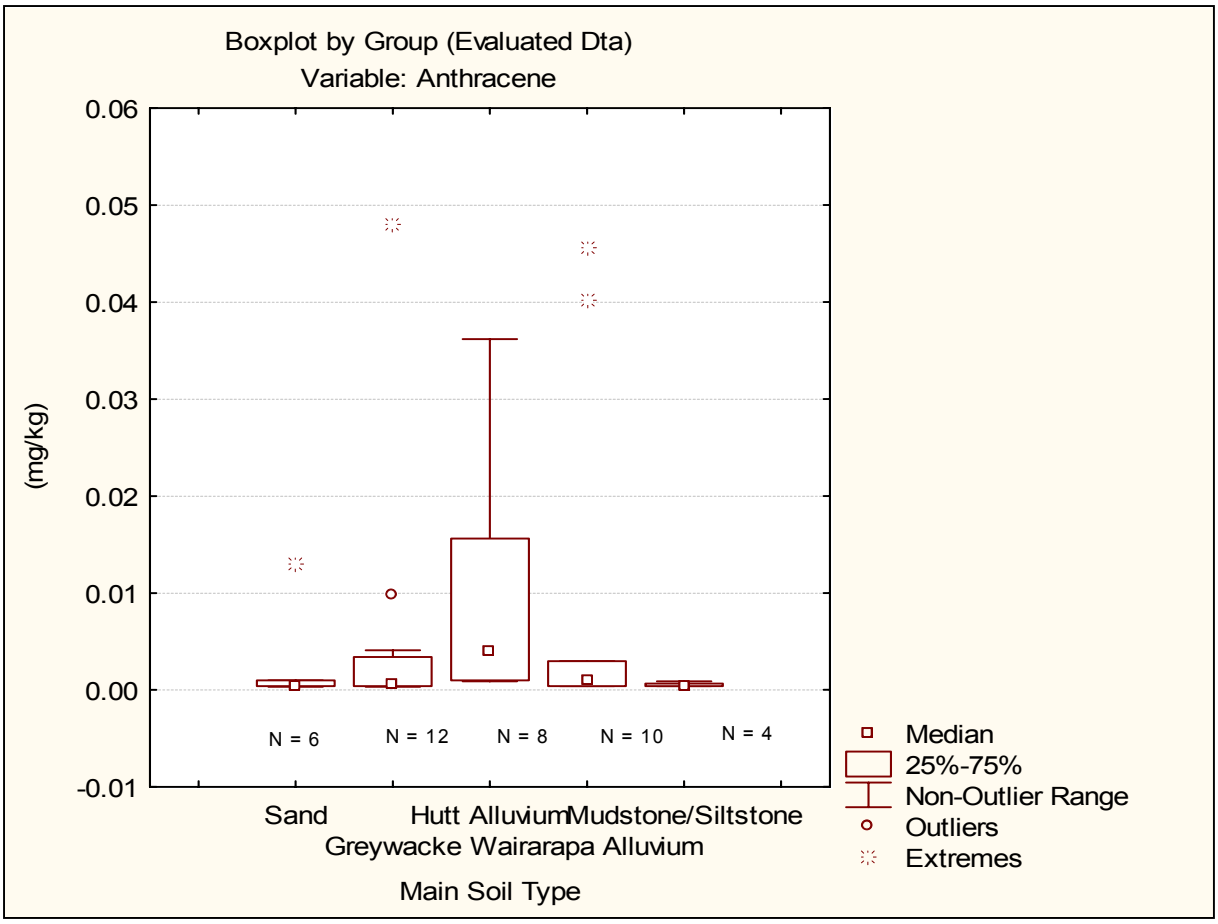
TPH


Boxplot by Group (Evaluated Data)
Variable: TPH (C_7 - C_{44})
500
450
400
350
300
250
200
150
100
50
0
-50
(mg/kg)
N = 6
N = 12
N = 8
N = 9
N = 4
Sand Greywacke
Hutt Alluvium
Mudstone/Siltstone Wairarapa Alluvium
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers

Kruskal-Wallis ANOVA by Ranks; TPH (C_7 - C_{44}) (All Data (Final) in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =.9903543 p =.9113

Depend.: TPH (C_7 - C_{44})	Code	Valid N	Sum of Ranks
Sand	101	6	145.5000
Greywacke	102	12	246.0000
Hutt Alluvium	104	8	162.0000
Wairarapa Alluvium	105	10	183.0000
Mudstone/Siltstone	106	4	83.5000

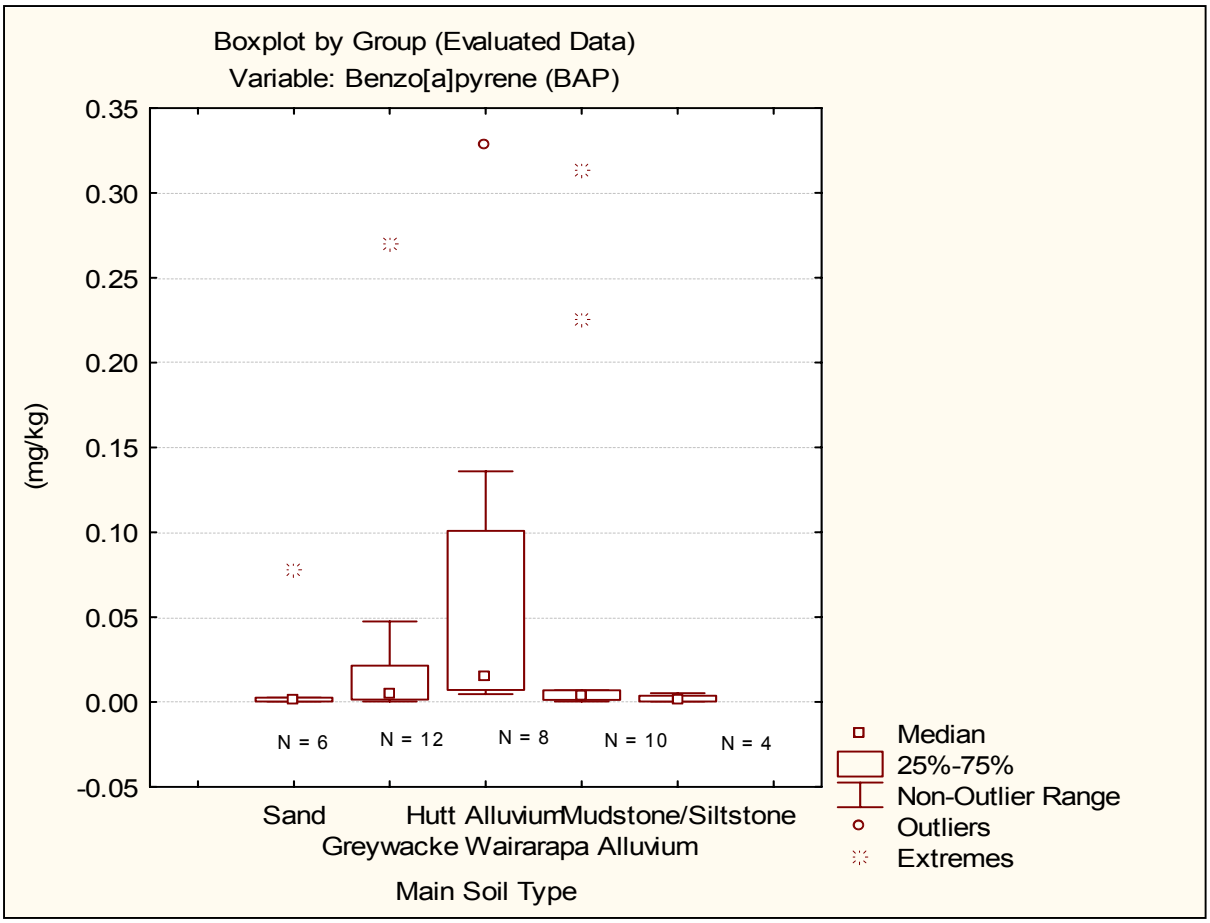
Anthracene


Boxplot by Group (Evaluated Dta)
Variable: Anthracene
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
(mg/kg)
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium
Mudstone/Siltstone Wairarapa Alluvium
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Kruskal-Wallis ANOVA by Ranks; Anthracene (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =7.473053 p =.1129

Depend.: Anthracene	Code	Valid N	Sum of Ranks
Sand	101	6	87.5000
Greywacke	102	12	232.5000
Hutt Alluvium	104	8	232.0000
Wairarapa Alluvium	105	10	214.0000
Mudstone/Siltstone	106	4	54.0000

Benzo[a]pyrene



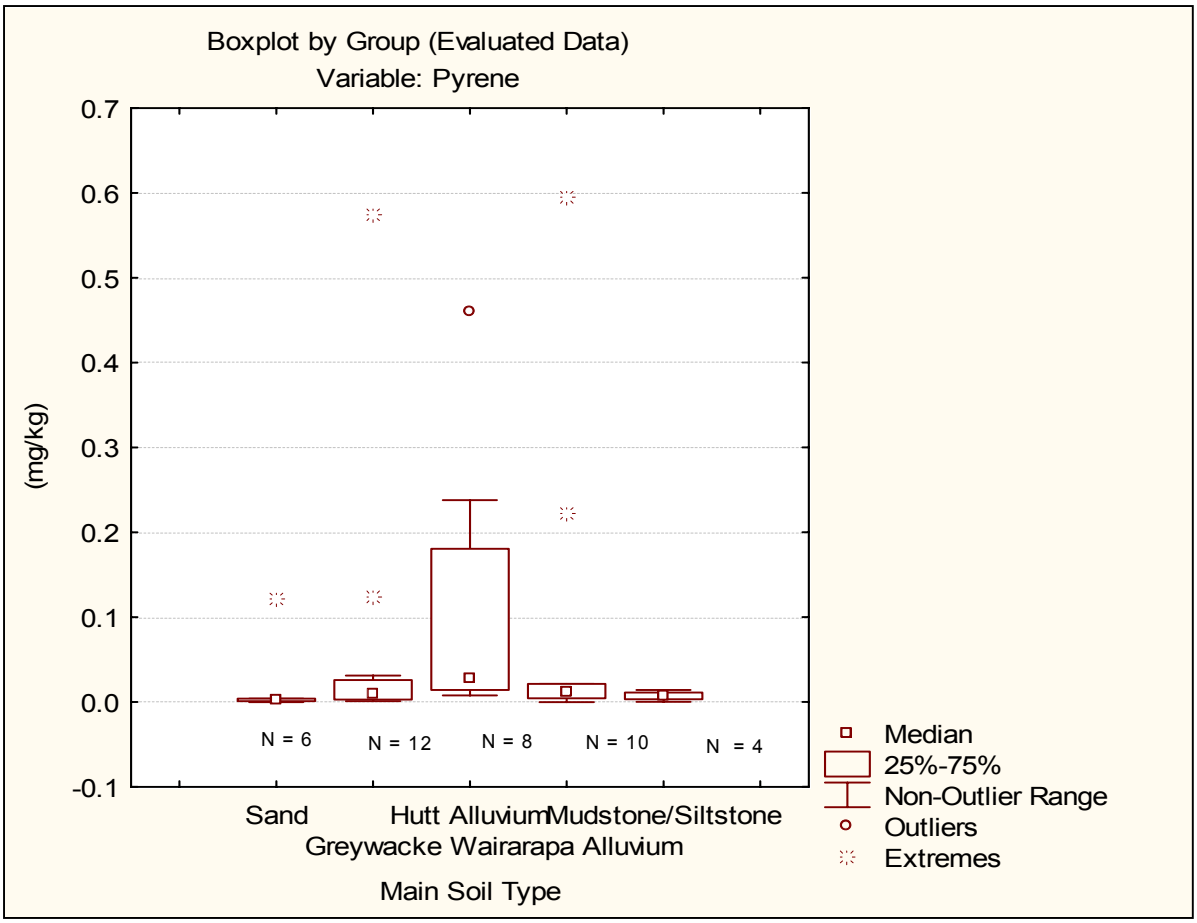
Kruskal-Wallis ANOVA by Ranks; Benzo[a]pyrene (BAP) (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =10.10215 p =.0387

Depend.: Benzo[a]pyrene (BAP)	Code	Valid N	Sum of Ranks
Sand	101	6	76.5000
Greywacke	102	12	256.0000
Hutt Alluvium	104	8	240.5000
Wairarapa Alluvium	105	10	198.0000
Mudstone/Siltstone	106	4	49.0000

LSD test; variable Benzo[a]pyrene (BAP) (All Data excluding Outliers in WRCData.stw)
Probabilities for Post Hoc Tests
Error: Between MS = .00786, df = 35.000

Cell No.	Main Soil Type	{1} .01397	{2} .03227	{3} .07234	{4} .05617	{5} .00211
1	Sand		0.682186	0.231068	0.363043	0.837139
2	Greywacke	0.682186		0.329071	0.533228	0.559557
3	Hutt Alluvium	0.231068	0.329071		0.703039	0.204419
4	Wairarapa Alluvium	0.363043	0.533228	0.703039		0.309891
5	Mudstone/Siltstone	0.837139	0.559557	0.204419	0.309891	

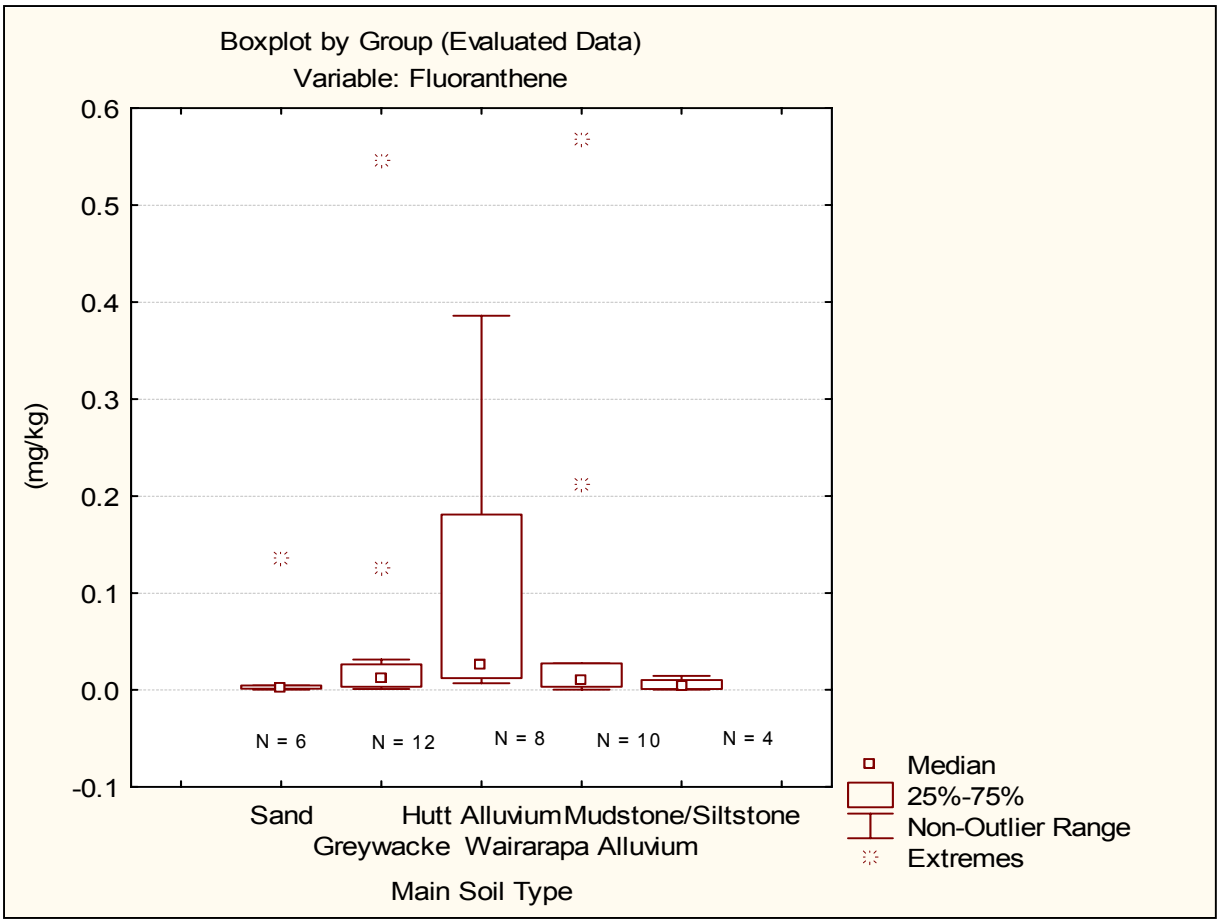
Pyrene


Boxplot by Group (Evaluated Data)
Variable: Pyrene
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
(mg/kg)
N = 6
N = 12
N = 8
N = 10
N = 4
Sand Greywacke
Hutt Alluvium
Mudstone/Siltstone Wairarapa Alluvium
Main Soil Type
Median
25%-75%
Non-Outlier Range
Outliers
Extremes

Kruskal-Wallis ANOVA by Ranks; Pyrene (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =9.223385 p =.0558

Depend.: Pyrene	Code	Valid N	Sum of Ranks
Sand	101	6	66.0000
Greywacke	102	12	247.5000
Hutt Alluvium	104	8	234.5000
Wairarapa Alluvium	105	10	209.5000
Mudstone/Siltstone	106	4	62.5000

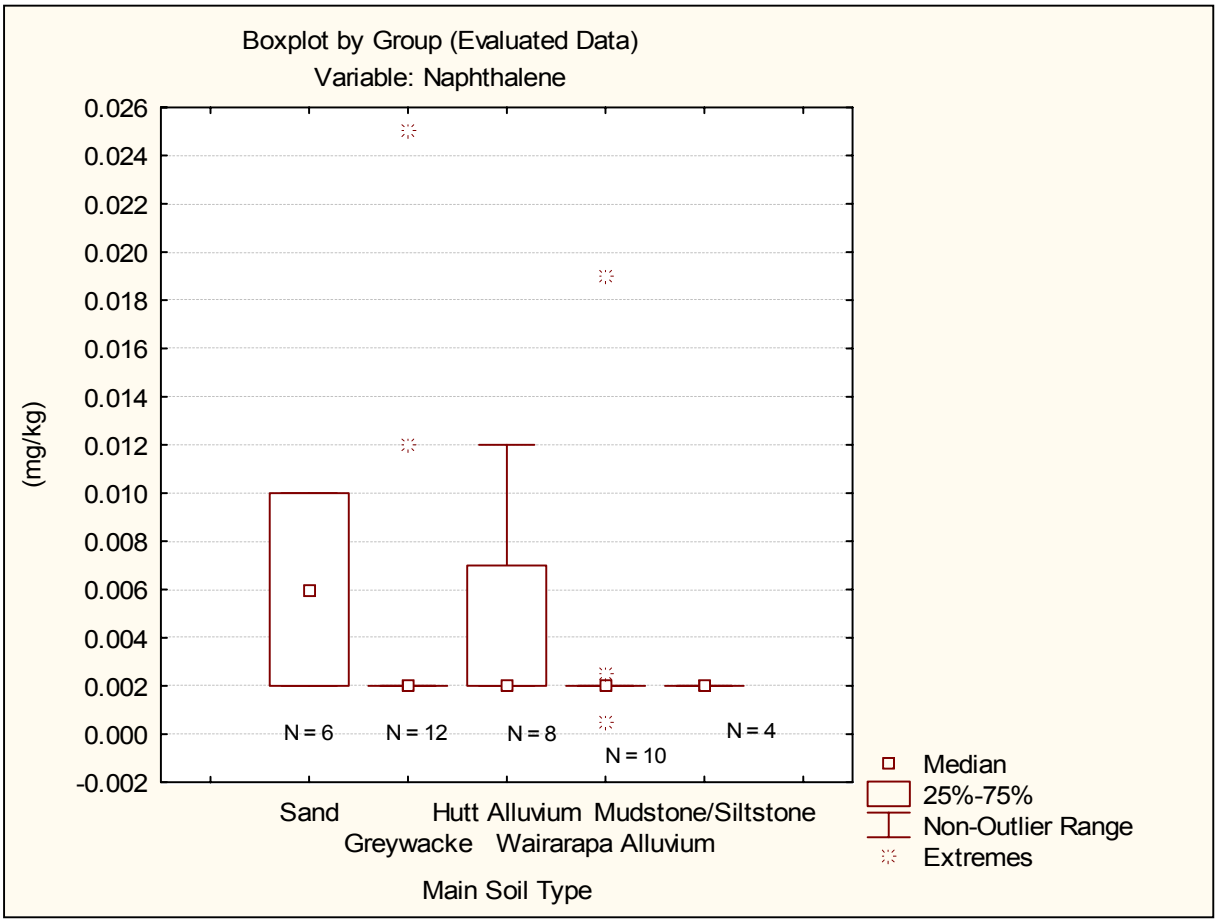
Fluoranthene



Kruskal-Wallis ANOVA by Ranks; Fluoranthene (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =8.629088 p =.0711

Depend.: Fluoranthene	Code	Valid N	Sum of Ranks
Sand	101	6	75.5000
Greywacke	102	12	257.0000
Hutt Alluvium	104	8	230.0000
Wairarapa Alluvium	105	10	207.0000
Mudstone/Siltstone	106	4	50.5000

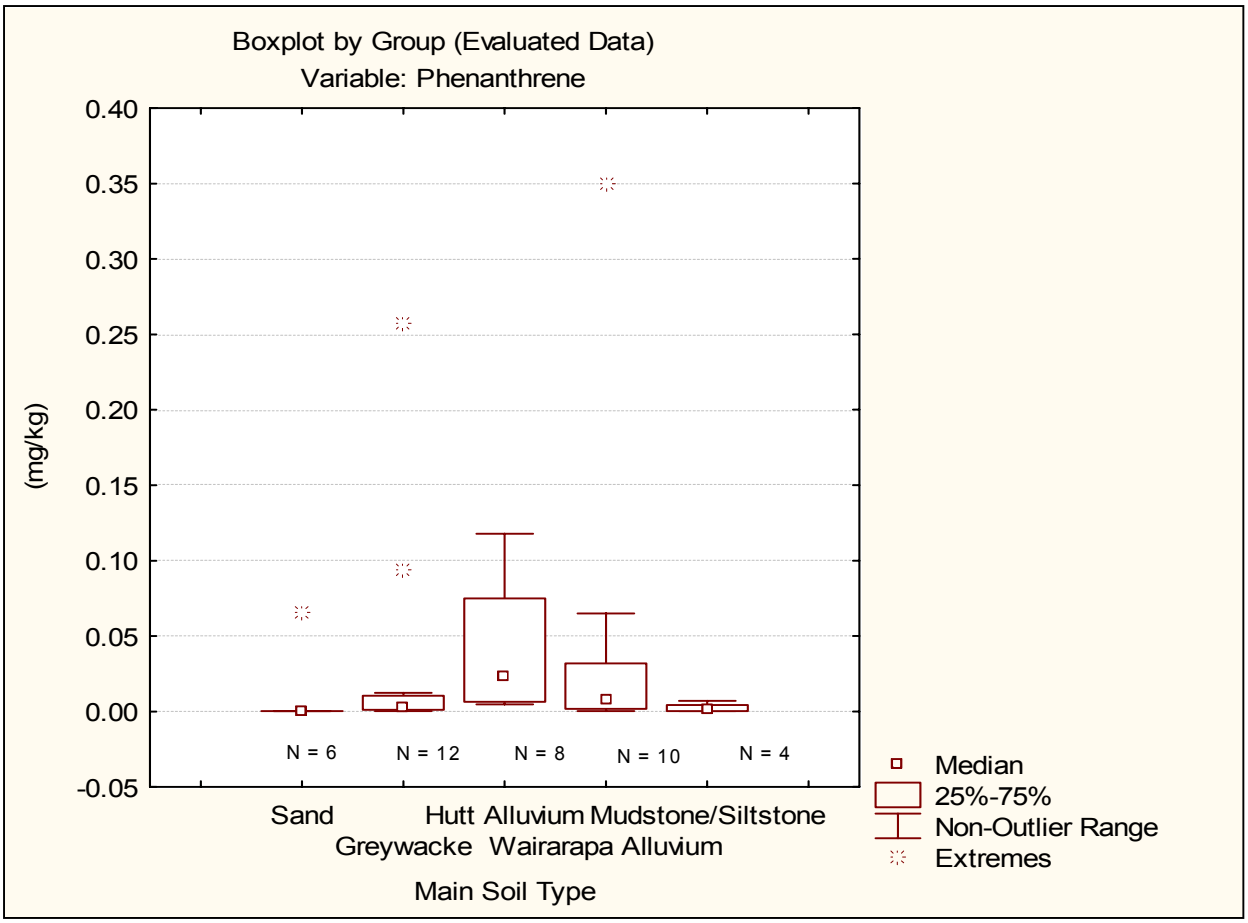
Naphthalene



Kruskal-Wallis ANOVA by Ranks; Naphthalene (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =5.905231 p =.2063

Depend.: Naphthalene	Code	Valid N	Sum of Ranks
Sand	101	6	167.0000
Greywacke	102	12	223.0000
Hutt Alluvium	104	8	176.0000
Wairarapa Alluvium	105	10	198.0000
Mudstone/Siltstone	106	4	56.0000

Phenanthrene



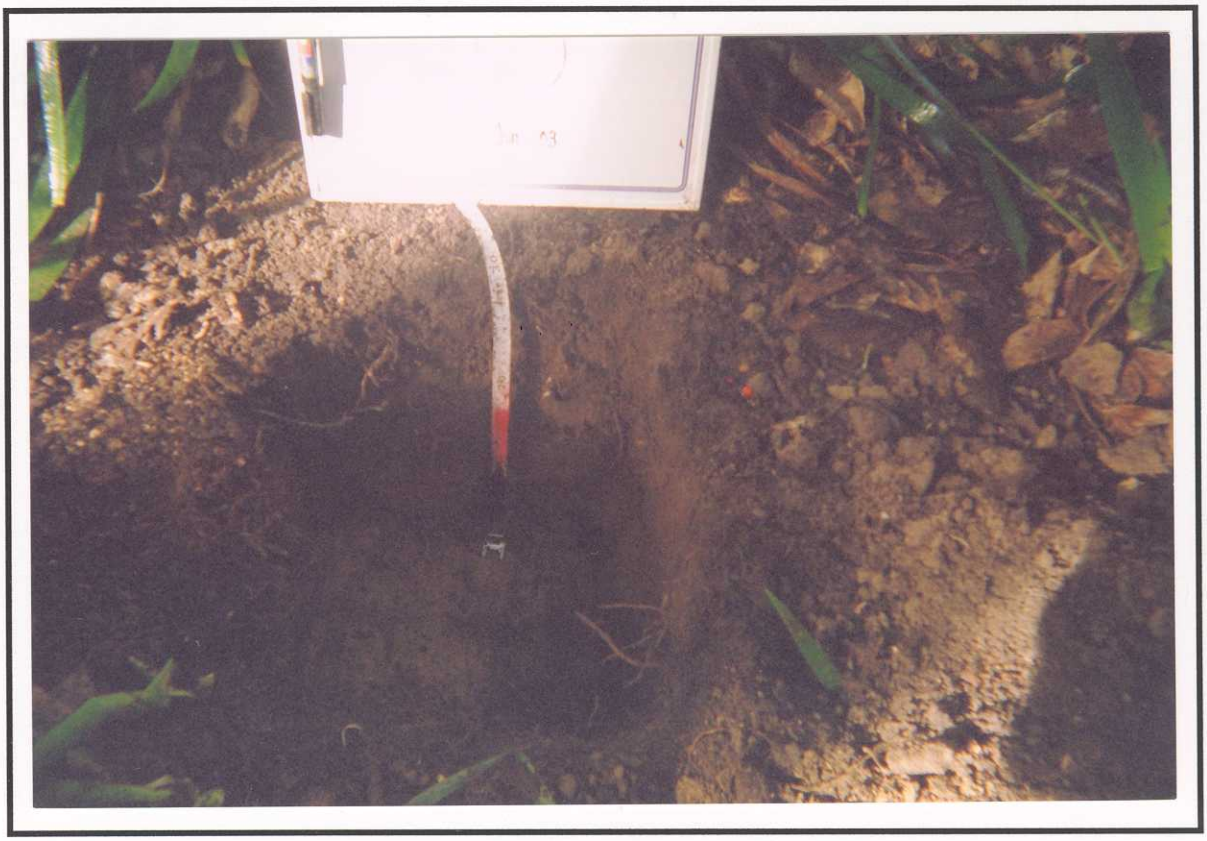
Kruskal-Wallis ANOVA by Ranks; Phenanthrene (All Data excluding Outliers in WRCData.stw)
Independent (grouping) variable: Main Soil Type
Kruskal-Wallis test: H (4, N= 40) =12.03537 p =.0171

Depend.: Phenanthrene	Code	Valid N	Sum of Ranks
Sand	101	6	58.0000
Greywacke	102	12	243.5000
Hutt Alluvium	104	8	234.0000
Wairarapa Alluvium	105	10	233.5000
Mudstone/Siltstone	106	4	51.0000

Cell No.	LSD test; variable Phenanthrene (All Data excluding Outliers in WRCData.stw) Probabilities for Post Hoc Tests Error: Between MS = .00531, df = 35.000 Main Soil Type	{1} .01133	{2} .03262	{3} .04175	{4} .04894	{5} .00244
1	Sand		0.562782	0.444673	0.324362	0.851056
2	Greywacke	0.562782		0.785191	0.604075	0.477833
3	Hutt Alluvium	0.444673	0.785191		0.836389	0.384233
4	Wairarapa Alluvium	0.324362	0.604075	0.836389		0.288001
5	Mudstone/Siltstone	0.851056	0.477833	0.384233	0.288001	

Appendix E
Sample Site Photos

Photograph 1(A): Forest Lakes, Otaki – Sample location.



Photograph 1(A): Forest Lakes, Otaki – Soil Pit.

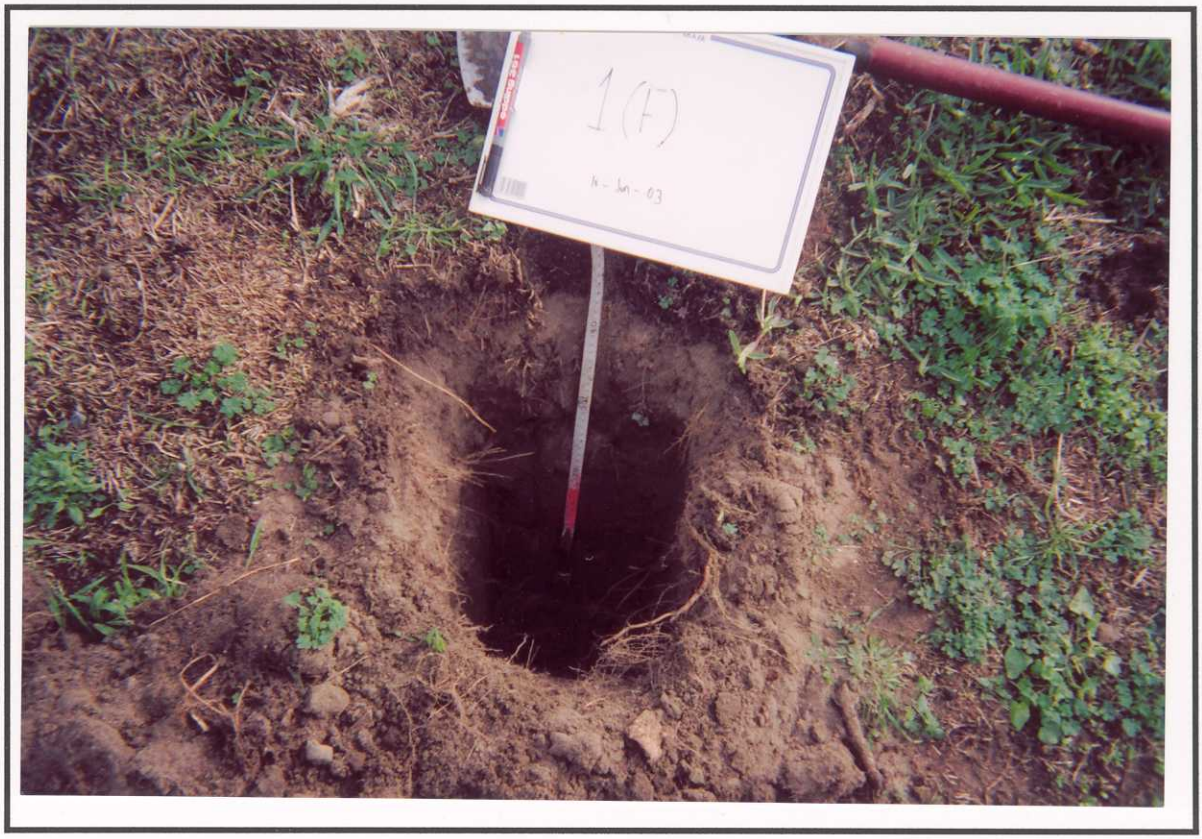
Photograph 1(B): Otaki Reserve, Otaki – Sample location.

Photograph 1(C): Private Reserve, Te Horo – Sample location.

Photograph 1(D): Nga Manu Nature Reserve, Waikanae – Sample location.

Photograph 1(D): Nga Manu Nature Reserve, Waikanae – Soil Pit.

Photograph 1(F): Paekakariki Domain, Paekakariki – Sample location.



Photograph 1(F): Paekakariki Domain, Paekakariki - Soil Pit.

Photograph 2(A): Raroa Reserve, Pukeura Bay – Sample location.

Photograph 2(A): Raroa Reserve, Pukeura Bay – Soil Pit.

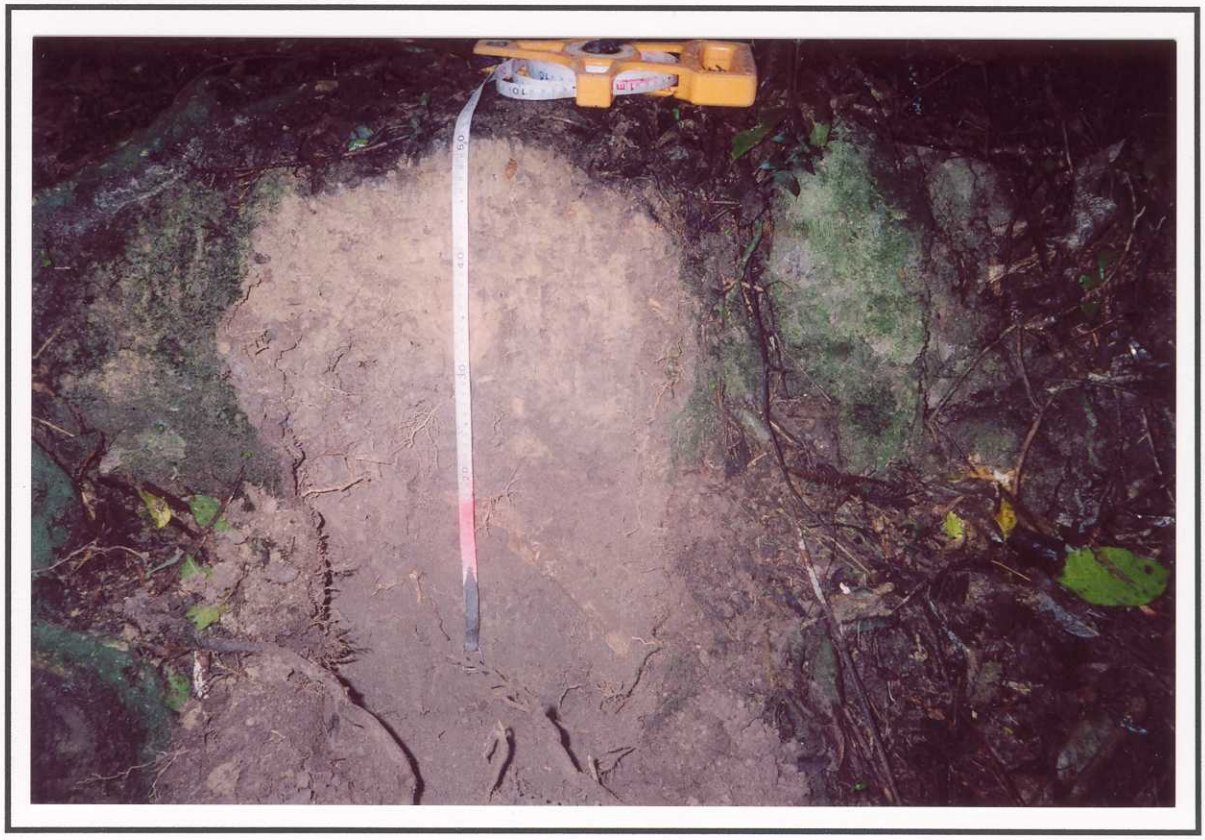
Photograph 2(B): Reserve, Plimmerton – Sample location.

Photograph 2(B): Reserve, Plimmerton – Soil Pit.

Photograph 2(C): Samwell Drive Reserve, Whitby – Sample location.

Photograph 2(C): Samwell Drive Reserve, Whitby – Soil Pit.

Photograph 2(F): Johnsonville Park, Johnsonville – Sample location.



Photograph 2(F): Johnsonville Park, Johnsonville – Soil Pit.

Photograph 2(G): Town Belt Northern Walkway, Wellington – Sample location.

Photograph 2(G): Town Belt Northern Walkway, Wellington – Soil Pit.

Photograph 2(H): Town Belt Southern Walkway, Wellington – Sample location.

Photograph 2(H): Town Belt Southern Walkway, Wellington – Soil Pit.

Photograph 2(I): Rangitatau Reserve, Wellington – Sample location.

Photograph 2(K): Town Belt Eastern Walkway, Wellington – Sample location.

Photograph 2(K): Town Belt Eastern Walkway, Wellington – Soil Pit.

Photograph 2(L): Karori Park, Wellington – Soil Pit.

Photograph 2(M): Wainuiomata Scenic Reserve, Wainuiomata – Sample location.

Photograph 3(A): Kaitoke Regional Park, Upper Hutt – Sample location.

Photograph 3(B): Harcourt Park, Upper Hutt – Sample location.

Photograph 3(B): Harcourt Park, Upper Hutt – Soil Pit.

Photograph 3(C): Heretaunga Park, Upper Hutt – Sample location.

Photograph 3(C): Heretaunga Park, Upper Hutt – Soil Pit.

Photograph 3(D): Willow Park, Silverstream – Sample location.

Photograph 3(D): Willow Park, Silverstream – Soil Pit.

Photograph 3(E): Delaney Park, Stokes Valley – Sample location.

Photograph 3(E): Delaney Park, Stokes Valley – Soil Pit.

Photograph 3(F): Fraser Park, Lower Hutt – Sample location.

Photograph 3(G): Hutt River Bank, Lower Hutt – Sample location.

Photograph 3(G): Hutt River Bank, Lower Hutt – Soil Pit.

Photograph 3(H): Ewan Park, Lower Hutt – Sample location.

Photograph 3(H): Ewan Park, Lower Hutt – Soil Pit.

Photograph 4(A): Featherston Reserve, Featherston – Sample location.

Photograph 4(B): Halford Farm, Martinborough – Sample location.

Photograph 4(B): Halford Farm, Martinborough – Soil Pit.

Photograph 4(C): DOC Reserve, Kahutara Rd, South Wairarapa – Sample location.

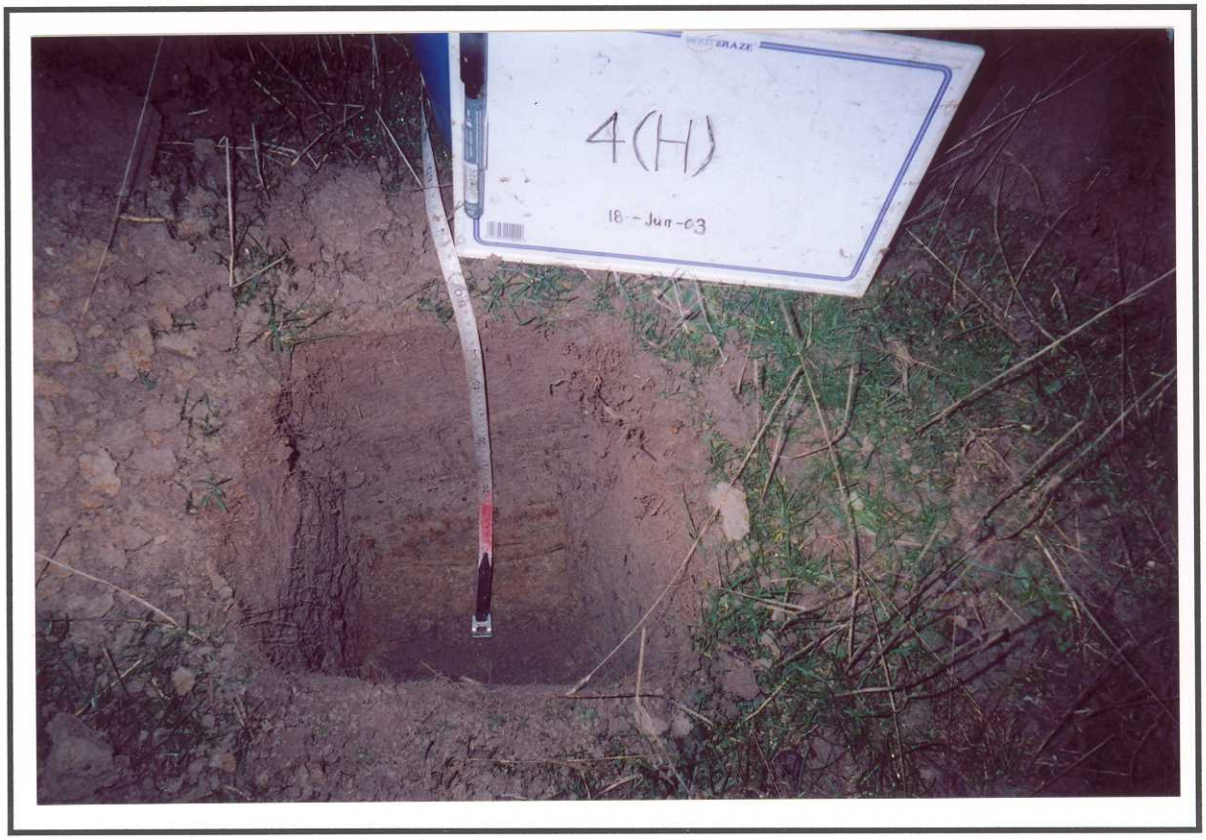
Photograph 4(D): Spring Rock, Martinborough– Sample location.

Photograph 4(D): Spring Rock, Martinborough – Soil Pit.

Photograph 4(F): Solider Memorial Park, Greytown – Sample location.

Photograph 4(F): Solider Memorial Park, Greytown – Soil Pit.

Photograph 4(G): 157 Park Rd, Carterton – Sample location.



Photograph 4(G): 157 Park Rd, Carterton – Soil Pit.

Photograph 4(H): 34 Perry Rd, Carterton – Sample location.

Photograph 4(H): 34 Perry Rd, Carterton – Soil Pit.

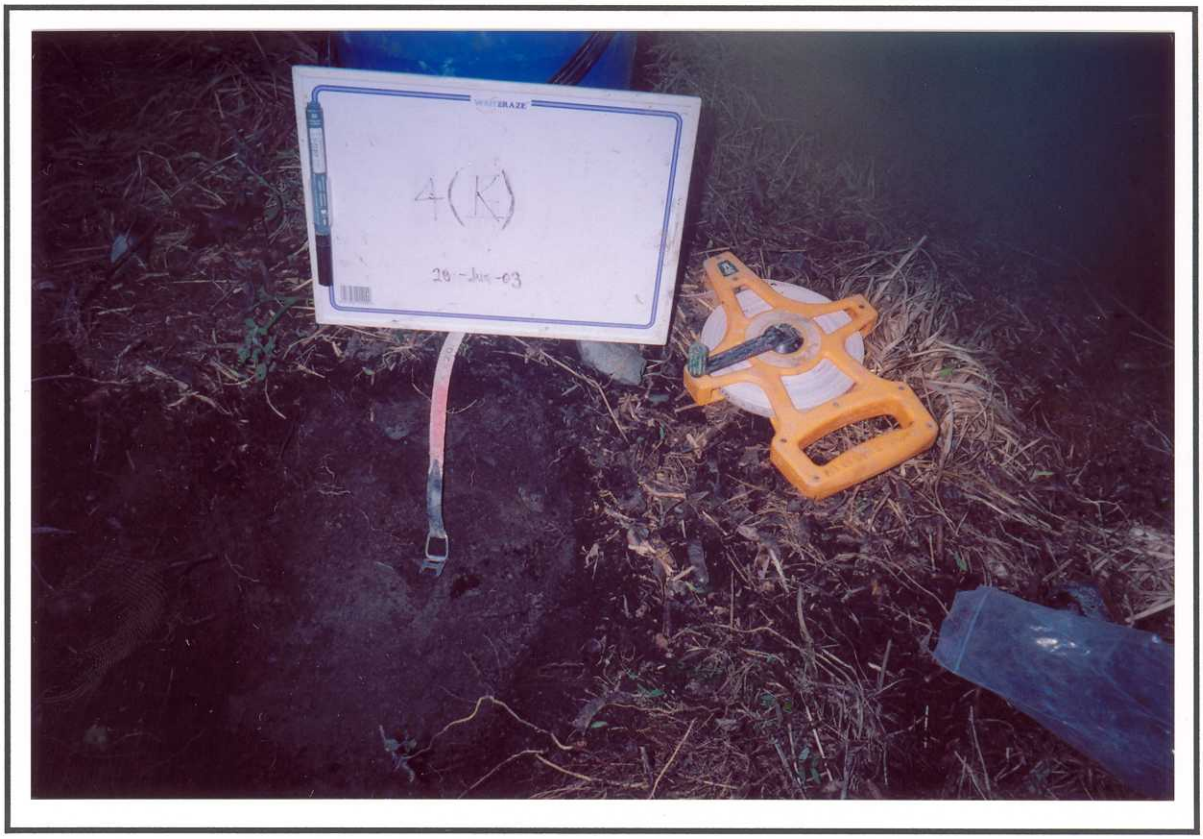
Photograph 4(I): Norfolk Rd, Masterton – Sample location.

Photograph 4(I): Norfolk Rd, Masterton - Soil Pit.

Photograph 4(J): Reserve, Masterton – Sample location.

Photograph 4(J): Reserve, Masterton – Soil Pit.

Photograph 4(K): Mel Parkinson Reserve, Opaki – Sample location.



Photograph 4(K): Mel Parkinson Reserve, Opaki – Soil Pit.

Photograph 5(A): Ngaumu Forest, Stronvar – Sample location.

Photograph 5(A): Ngaumu Forest, Stronvar – Soil Pit.

Photograph 5(A): Ngaumu Forest, Stronvar – Established undergrowth.

Photograph 5(B): Clarke Memorial, Mauriceville – Sample location.

Photograph 5(B): Clarke Memorial, Mauriceville – Soil Pit.

Photograph 5(C): Public Reserve, Tinui – Sample location.

Photograph 5(D): Thistle Top Bush Reserve, Masterton – Sample location.

Photograph 5(D): Thistle Top Bush Reserve, Masterton – Soil Pit.

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