THE WEST COAST
REGIONAL COUNCIL

Technical Report

PCP and dioxin investigation: Totara Lagoon, Bittern Ck, Ruatapu dredge pond

July 2009

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Technical Report 09001

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1 Introduction

1.1 Scope

This report presents the results of an investigation into possible environmental impacts from PCP and dioxins on aquatic environments in the Ruatapu area, including Totara Lagoon, Bittern Ck mouth, and the Ruatapu dredge pond. This investigation focussed on the human health threat posed from the consumption of eels. Consideration was also given to the likely impacts on the aquatic ecosystem and sought to assess the level of chemical contamination in water and sediments.

1.2 Background

It is assumed that the source of PCP and dioxins comes from historic timber treatment activities at the sawmill in Ruatapu. Fletchers constructed the original sawmill at Ruatapu in 1965, passing ownership to Carter Holt Harvey in the late 1980's, and the site is now owned independently by Westco MTP Ltd. The timber treatment chemicals used on site were boric and antisapstain compounds. Up until 1988 the antisapstain treatment involved sodium pentachlorophenate (Royds 1994). Potential has existed for the transportation of pentachlorophenol (PCP) to aquatic environments beyond the sawmill boundary, via leachate and sediments associated with stormwater run-off.

The Department of Conservation conducted an ecological survey of the Totara Lagoon and associated wetlands in 2005-2007. The lagoon's associated wetland and non wetland habitat harbours high biodiversity values and is home or part home to one threatened bat species, at least 13 threatened bird species, two threatened freshwater fish species, and at least four threatened plant species (van Mierlo 2007). Both Lake Mahinapua and the Totara Lagoon are recognised in the West Coast Regional Council's (WCRC) Water Plan (WCRC 2007) for having cultural significance to local iwi for mahinga kai (traditional food and other natural resources and the places where those resources are obtained).

As part of the ecological survey conducted by the Department of Conservation (DoC) investigations were made into the presence of a variety of contaminants, including PCP. There are no New Zealand guidelines referring to PCP levels in aquatic sediment, but the Wisconsin Dept. of Natural Resources Consensus-Based Sediment Quality Guidelines - Recommendations for Use and Application – Interim Guidance (December, 2003), were used as a reference. Previous sampling found one sediment sample at the mouth of Rocky Creek with PCP concentrations five times above the Wisconsin guideline. Further PCP sampling was carried out in response to this result. Two samples were taken from the drainage channel that runs from the west of the sawmill site into Rocky Creek. PCP was not detectable in either sample above the laboratory detection limit of 0.05 mg/kg. A sediment sample was collected from the Ruatapu dredge pond and this had high levels of PCP. Discussion between DoC Hokitika, WCRC, Community Public Health (CPH), and the Ministry for the Environment (MfE) identified the need to investigate the potential of PCP and dioxin contamination in more detail. This report details the subsequent investigation, along with documentation and discussion of earlier PCP results.

1.2.1 Chlorophenols

Chlorophenols are found in a variety of environmental media including air, soil, sediment and biota. In the aquatic environment they tend to be mainly bound to sediment and suspended particles in the water.

Industries such as pulp mills using chlorine are well known sources of chlorophenols. The chlorophenol group of chemicals are aromatic organic compounds based on a single benzene ring with a hydroxyl (OH) group attached. Substitution of the hydrogen atoms with 1 – 5 chlorine atoms produces chlorophenols. The best known of these compounds is PCP or pentachlorophenol, which is the most halogenated of the phenols with five chlorine atoms attached. Toxicity of the lower halogenated phenols is low and increases with increasing chlorine substitution. PCP is the most toxic of the group. PCP is relatively non-toxic to birds but can be very toxic to fish. It is not highly accumulated in biota as it can be metabolised and removed from tissues and the blood stream. Toxicity is most often expressed by damage to the liver, kidneys and central nervous system. It has not been proven to be carcinogenic. Many of the toxicity studies have not used pure PCP and many of the effects observed are likely to be the result of other contaminants. Dioxin is a common contaminant of technical grade PCP that has been used extensively in the past for wood treatment.

1.2.2 Dioxins/furans

Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzo-furans (PCDFs) are commonly known as dioxins and furans. They are found in a variety of environmental media including air, soil, sediment and biota. The compounds are all very hydrophobic in nature, which means that they do not dissolve well in water. As a result they tend to attach quite strongly to other particulate matter and have a high affinity to bind with fatty compounds. This leads to the compounds being retained strongly by biota and being magnified at each step in a food chain. Their toxicity even at concentrations several orders of magnitude lower than most other chemicals has resulted in a great deal of public concern. The dioxin and furan group of chemicals are aromatic organic compounds comprising of two benzene rings joined by either one or two oxygen atoms. They are classified as halogenated hydrocarbons due to the attachment of up to eight chlorine atoms. The different amounts of chlorine attachment and the sites at which they attach to the benzene rings results in a total of 75 possible dioxin congeners and 135 possible furan congeners. The most widely studied and known compound is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

Dioxins are generally found in mixtures containing several kinds of dioxins and dioxin-like compounds, each having its own degree of toxicity. To express the overall toxicity of such a mixture as a single number, the concept of "Toxic Equivalents" (TEQ) has been developed. The TEQ scheme weighs the toxicity of the less toxic compounds as fractions of the toxicity of the most toxic TCDD. Each compound is given a specific "Toxic Equivalency Factor" (TEF). This factor indicates the degree of toxicity compared to 2,3,7,8-TCDD, which is given a reference value of 1. To calculate the total TCDD toxic equivalent (TEQ) of a dioxin mixture, the amounts of each toxic compound are multiplied with their Toxic Equivalency Factor (TEF) and then added together.

TEF's presented in this report were agreed at a 1997 World Health Organization (WHO) consultation (Van den Berg et al., 1998). The term dioxins will be used to refer to both dioxins and furans in this report.

1.3 Location

The sawmill site is situated in the township of Ruatapu, ~ 10 km south of Hokitika, along SH 6. Drainage from the sawmill site, and areas where activities associated with it, enter: Totara Lagoon via Rocky Creek, Lake Mahinapua via Bittern Creek, and the southern of two dredge ponds situated north of the site (refer to maps in Appendix 7.1). Ruatapu Lagoon runs from opposite Ruatapu township southward to the Totara River near Ross. Exact locations of sampling sites are provided in the methods section.

2 Methods

Five sites were chosen for testing: three in the lagoon, one in the dredge pond, and one at the mouth of Bittern Creek (refer Table 2.1 and map in Appendix 7.2). Pictures of these sites are presented in Appendix 7.3. At each site, a composite sample was taken that comprised of three sediment cores. These were sometimes quite deep due to a requirement to go through very light, soft surface sediments so as to reach firmer material that could be retained by the corer. All sediment samples were collected with a stainless steel corer. Composite samples were collected and mixed in a stainless steel bucket prior to a sample being put into an approved container for shipment to the lab.

Table 2.1 Location of sites sampled in March 2009.

Sample	Composite	Date	Easting	Northing	Sampling depth mm
Bittern Ck @ Mouth	Bittern Ck north	4/3/09	2337807	5820246	50-80
	Bittern Ck middle	4/3/09	2337840	5820158	40-70
	Bittern Ck south	4/3/09	2337814	5820088	40-70
Ruatapu dredge pond	Dredge pond north	4/3/09	2337887	5820742	50-80
	Dredge pond south	4/3/09	2337793	5820557	30-60
	Dredge pond feeder sump	4/3/09	2337748	5820471	20-50
Totara Lagoon north	North one	3/3/09	2336597	5819623	20-50
	North two	3/3/09	2336531	5819528	20-50
	North three	3/3/09	2336506	5819461	20-50
Totara Lagoon middle	Middle @ Rocky	3/3/09	2335019	5816689	10-40
	Middle @ Rocky/Camp	3/3/09	2334963	5816672	20-50
	Middle @ downstream R/C	3/3/09	2334926	5816634	20-50
Totara Lagoon south	South one	3/3/09	2333262	5814826	10-40
	South two	3/3/09	2333240	5814820	10-40
	South three	3/3/09	2333254	5814780	10-40

Chemical analyses were all done by the IANZ accredited laboratory of AssureQuality New Zealand Limited which specialises in ultra low level analysis of organochlorine compounds. Specially prepared sample containers were provided by AssureQuality. All sampling was done using clean sampling methods. Chain of custody procedure was followed for the dispatch of all samples for analysis. AssureQuality's PCP detection levels, used in this study, are much lower than those previously available from other labs.

Eels were collected a day after the sediment samples were collected using two baited fyke nets (25 mm mesh) per site, set overnight as close as possible to the same locations from which sediment and water samples were taken. A composite sample was obtained from each site of approximately four moderately sized (80-100 cm) longfin eels (*Anguilla dieffenbachii*), which were the dominant species present at all sites. Attempts to catch eels were made at all sites, but no eels were caught in the Ruatapu dredge pond despite two separate single nights of trapping effort.

Whole eels were wrapt in tinfoil, frozen, and sent for analysis. Analysis for PCP was based on a composite sample of eel bile from each site. Dioxin analysis was based on wet weight of eel flesh. Testing for all dioxin congeners was conducted. Despite having eels available from the Totara Lagoon north site, dioxins were not tested for as low sediment PCP at this site indicated that it was un-necessary. Other PCP results from previous sampling have been compiled and presented in Appendix 7.4.

3 Results

3.1 Levels of PCP in aquatic sediment and eel bile

Levels of PCP measured in composite sediment samples and composite eel bile samples are presented in Table 3.1. More detailed results are located in Appendix 7.1 and 7.5.

Table 3.1 Concentrations of PCP in aquatic sediment and eel bile, March 2009.

Sample	Sediment mg/kg	Eel bile mg/kg	Section of sediment horizon sampled - depth mm
Bittern Ck @ Mouth	0.0025	0.012	50-80
Ruatapu dredge pond	1.43	N/A	50-80
Totara Lagoon north	0.00056	0.0019	20-50
Totara Lagoon middle	0.00095	0.0027	10-40
Totara Lagoon south	0.00094	0.0014	10-40
Lab Blank for dredge pond (sediment)	0.00029	-	-
Lab Blank for other sites (sediment)	0.00016	-	-
Lab Blank for Bittern Ck (bile)	-	0.00012	-
Lab Blank for other sites (bile)	-	0.00012	-

The Wisconsin Department of Natural Resources recommended minimum limit for PCP in aquatic sediment is 0.150 mg/kg. Earlier sampling conducted by DoC found high PCP levels in the dredge pond (17 mg/kg), and Rocky Creek (0.97 mg/kg). Of the recent sampling associated with this study, only the Ruatapu dredge pond had significantly high levels of PCP (1.43 mg/kg), which breached the Wisconsin guideline. DoC's Rocky Creek site and the Totara Lagoon middle site are located in the same place; hence the previously high PCP result at Rocky Creek was not replicated.

Eel bile results for PCP indicated that any historically contaminated sediments are not presently a source of ongoing exposure of PCP to eels, and toxicity risk for human consumption of eels is considered to be insignificant. Historical contamination of sediments in the lagoon and in the washout zone from Bittern Creek are likely to have been overlain with new and relatively non-contaminated sediments. Even so, samples in most instances were collected from firmer more permanent material that was beneath softer surface sediments. Therefore, if there were any deeper layers containing higher PCP concentrations, they should be well buried to the point that no natural processes are likely to re-introduce them into any exposure pathways. If eels were exposed to PCP on an on-going basis, then we would expect to see this reflected by the presence of PCP in the bile at levels of concern. As this was not the case, we can conclude that even if the underlying sediments were contaminated with PCP, which they appear not to be, PCP is no longer entering the food chain.

3.2 Levels of dioxins in eel flesh

Data for dioxin testing of eel flesh is presented in Appendix 7.6. There was no discernible difference between the lab blank and the results for eel flesh. This conclusion is based on the congener results for the 2,3,7-8 chlorinated congeners (the ones considered toxic and from which TEQ is calculated), and the fact that results for many congeners are below detection limits. Contact was made with the lab at Assure Quality who confirmed that the level of detection (LOD) was reasonable for the samples analysed.

4 Discussion

Low levels of PCP found in sediments, and in eel bile, considerably de-escalates the level of concern triggered by the previous high result for the (one) sample taken at Rocky Creek, by DoC. If PCP was high in both sediment and eel bile, it would have indicated that gross contamination was present and exposure was ongoing, but this was not the case. Why the previous Rocky Creek sample was high in PCP remains open to conjecture

PCP is not bio-accumulative, but dioxins are. As well as their bio-accumulative nature, they break down slower, adsorb more readily to sediment, and are more toxic than PCP. So while PCP results informed us on the present situation - i.e. no ongoing exposure - the absence of elevated PCP in bile did not rule out the possibility that eels were exposed in the past and had accumulated a dioxin body burden. Eels can be long-lived, and their flesh is likely to be eaten by other eels when they die, and hence recycle contaminants. Because eels are high in the food chain they would be expected to have one of the highest dioxin concentrations of any animal in the ecosystem. This was a potential ecological issue and a concern for any people eating eels caught at these locations.

The results showed that there was no discernible differences between dioxin in the lab blanks and eel flesh, and considering the many non-detects for the more crucial congeners (eg Hx, Hp and OCDD), there is unlikely to be any significant dioxin contamination in the lagoon. Because of this, it is not necessary to calculate any dietary intake restrictions from these results for eel consumption.

The dredge pond was the only location where high levels of PCP could be definitively affirmed. There is no surface discharge from this pond where contaminated sediment and water might migrate and contaminate other areas, which has also been confirmed by other investigations in the area (Royds 1993). The pond is located in bush and there are no tracks leading to it. The sides of the pond are steep and lead into very soft sediment. No eels were caught in the pond despite efforts to catch them, and given that there is no outlet, there is no way fish can colonise the pond. There would appear to be no real opportunities for contact recreation and food gathering at the pond i.e. there are no complete exposure pathways to people, or to areas beyond the pond. Hence PCP, and any other associated contaminants, should present no environmental threat beyond the dredge pond itself. It is important to note however that due caution is taken should any further development involving movement of soil, sediment or water from the area around the pond be considered.

5 References

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Wisconsin Department of Natural Resources, December, 2003. Consensus-Based Sediment Quality Guidelines, Recommendations for Use and Application, Interim Guidance.

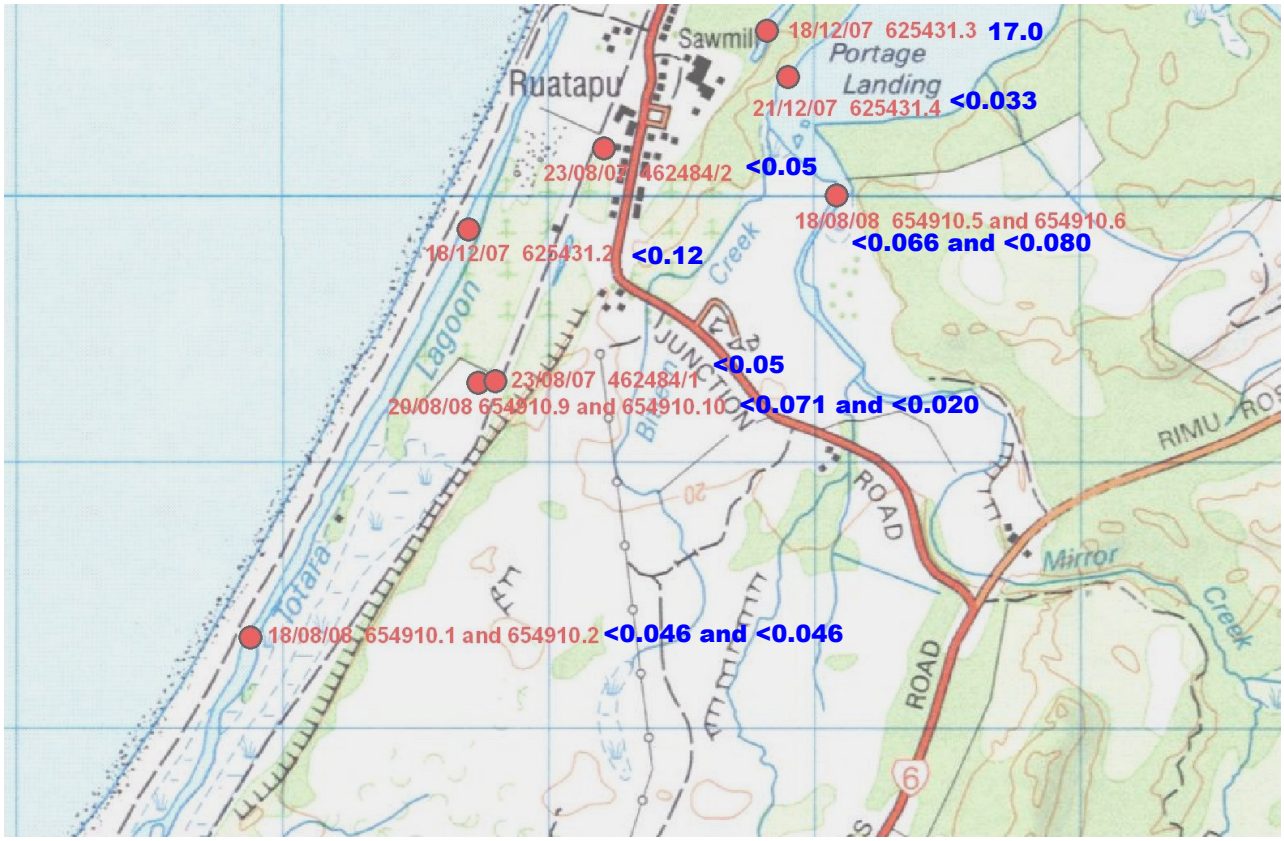
6 Acknowledgements

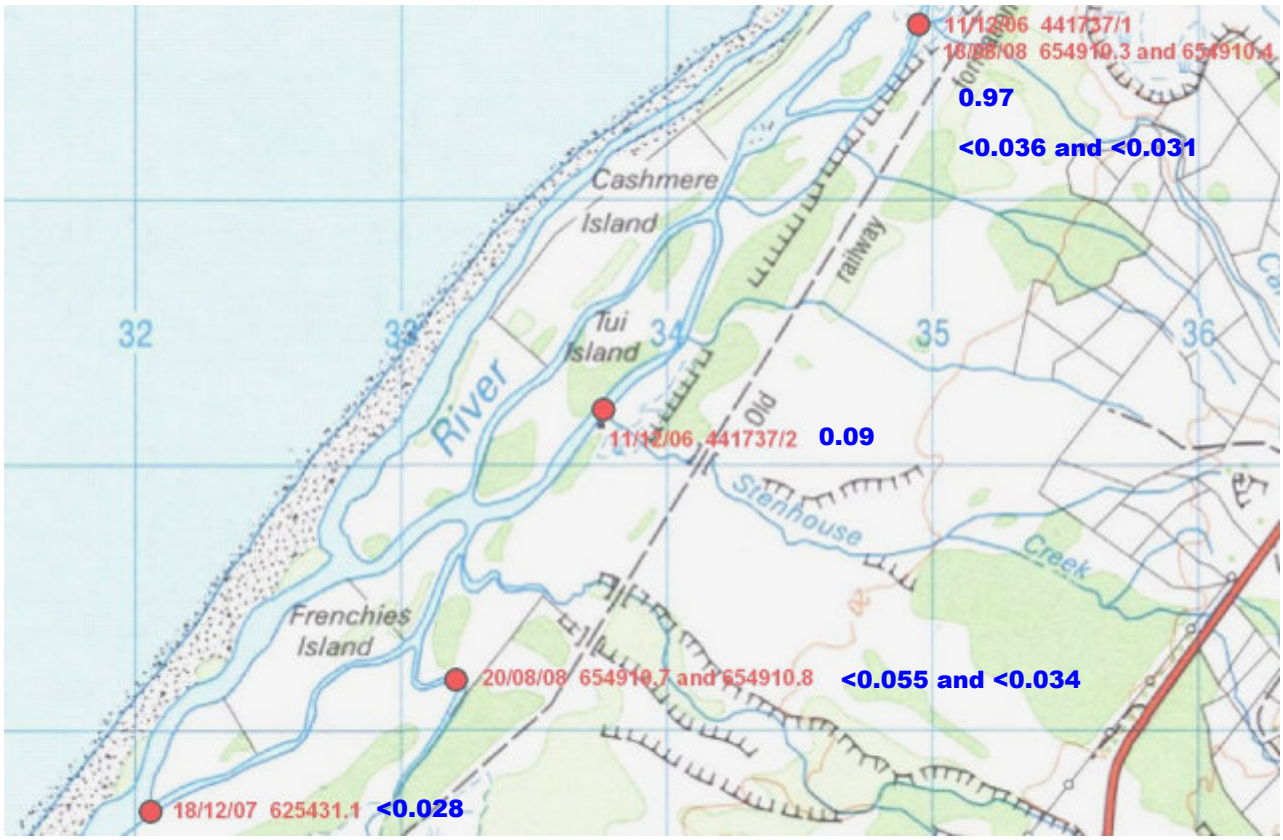
This project could not have been undertaken without valuable assistance from:

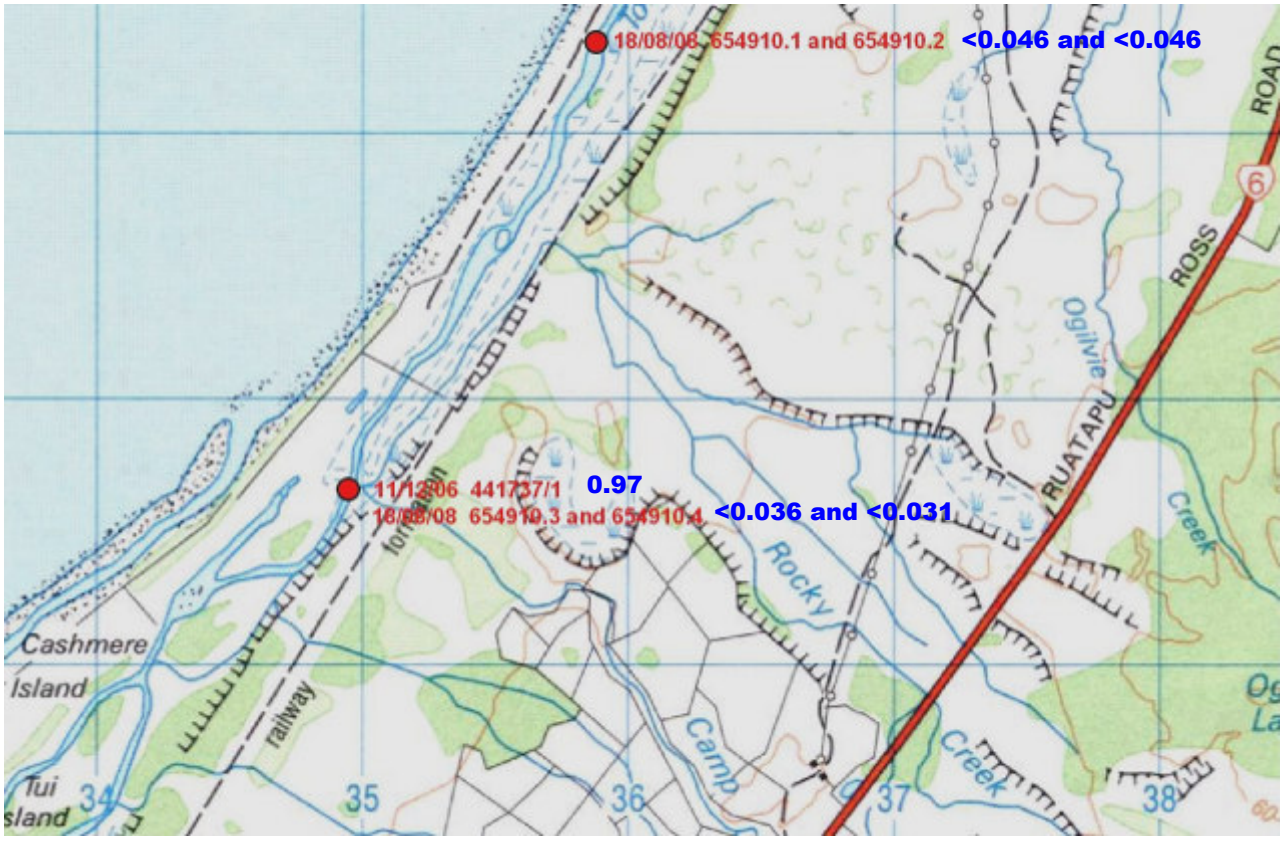
- Ron van Mierlo and Dave Eastwood, Department of Conservation, Hokitika, who conducted substantial early investigations, and provided logistical support with all fieldwork.
- Howard Ellis and MfE who provided crucial technical guidance and financial support for this work.
- Chris Bergin and Sheryl Brunton from CPH, for their involvement and support.
- Sally Gore from Canterbury University.

7 Appendices

7.1 Previous PCP sediment sampling locations and PCP levels (mg/kg)




11/12/06 441737/1
18/08/08 654910.3 and 654910.4
0.97
<0.036 and <0.031
Cashmere
Island
railway
Tui
Island
River
11/12/06 441737/2 0.09
Old
Stenhouse
Creek
Frenchies
Island
20/08/08 654910.7 and 654910.8 <0.055 and <0.034
18/12/07 625431.1 <0.028


18/08/08 654910.1 and 654910.2 <0.046 and <0.046
ROAD
6
ROSS
Ogilvie
RUATAPU
11/12/06 441737/1 0.97
18/08/08 654910.3 and 654910.4 <0.036 and <0.031
Rocky
Creek
Cashmere
Island
railway
Camp
Creek
Tui
Island

7.2 Map of locations of sampling sites where eels and sediment samples were obtained in March 2009

7.3 Photographs of sites where eels and sediment samples were obtained in March 2009

Looking downstream and upstream (left/right respectively) at the Bittern Creek mouth into Lake Mahinapua. Sediment samples were collected from three points within the photos. 3/3/09.

Mixed composite sediment sample from Bittern Creek mouth at Lake Mahinapua. 4/3/09.

Northern and southern sampling points (left/right respectively) at the Ruatapu dredge pond site. 4/3/09.

Feeder sump sampling point at the Ruatapu dredge pond site. 4/3/09.


Looking southwest and northwest (left/right respectively) at the Totara Lagoon south sampling site. Sediment samples were collected from points within the photos. 3/3/09.


Composite samples from the Totara Lagoon south sampling site (left). Sediment sampling corer (right). 3/3/09.


Rocky Creek sampling point at Totara Lagoon Middle site (left). Confluence of Camp and Rocky Creeks – sample collected from area on right of picture - Totara Lagoon Middle site (right).

Sampling point (where corer is located) downstream of the Rocky/Camp Creek mouth - Totara Lagoon Middle site.


Totara Lagoon north site (left and right).

7.4 Previous PCP sampling records from the Department of Conservation, Hokitika

Date	Sample id	Site description	GPS/map reference	Notes
11/12/2006	441737/1	Rocky Creek confluence with main Totara Lagoon channel. Water at this point within main lagoon channel flows NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence.	E2334960 N5816710	Sediment sample sent to Hills Laboratories 12/12/06. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
11/12/2006	441737/2	Stenhouse Creek confluence with main Totara Lagoon channel. Water at this point within main lagoon channel flows NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence	E2333760 N5815210	Sediment sample sent to Hills Laboratories 12/12/06. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
23/08/2007	462484/2	Ruatapu drain upper. Drain containing black water, flowing from Ruatapu sawmill into wetland bordering Totara Lagoon. Sample from close downstream of sawmill site.	E2337203 N5820182	Single core sampled by Regional Council, analysed by Hills Laboratories
23/08/2007	468424/1	Ruatapu drain lower. Drain containing black water, flowing from Ruatapu sawmill into wetland bordering Totara Lagoon. Sample taken from drain outlet into wetland.	E2336800 N5819309	Single core sampled by Regional Council, analysed by Hills Laboratories
18/12/2007	625431.1	Totara Lagoon - south end of Frenchies Island. Water at this point within main lagoon channel flows NE to SW at low tide and reverses as tide rises. Definitely some saltwater influence.	E2332052 N5813692	Sediment sample sent to Hills laboratories 07/01/08 to determine PCP and other phenol levels. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
18/12/2007	625431.2	Totara Lagoon - near Ruatapu end of lagoon. Little detectable flow at this end of the lagoon.	E2336694 N5819874	Sediment sample sent to Hills laboratories 07/01/08 to determine PCP and other phenol levels. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
18/12/2007	625431.3	Mahinapua Forest - old gold dredge pond adjacent Ruatapu sawmill	NZMS 260 J33 E23378 N58206	Sediment sample sent to Hills laboratories 07/01/08 to determine PCP and other phenol levels. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
21/12/2007	625431.4	Lake Mahinapua - Portage Landing, near Grebe Creek outlet	E2337900 N5820453	Sediment sample sent to Hills laboratories 07/01/08 to determine PCP and other phenol levels. The lower 100mm of a single sample core of approximately 200mm depth was sampled.
18/08/2008	654910.1	North Totara Lagoon - top sample. Water at this point within main lagoon channel flows slightly NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence.	E2335875 N5818347	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 1, bottom layers were mixed and comprise sample 2.

18/08/2008	654910.2	North Totara Lagoon - bottom sample. Water at this point within main lagoon channel flows slightly NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence.	E2335875 N5818347	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 1, bottom layers were mixed and comprise sample 2.
18/08/2008	654910.3	Rocky Creek confluence with main Totara Lagoon channel - top sample. Water at this point within main lagoon channel flows NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence.	NZMS 260 J33 E23349 N58167	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 3, bottom layers were mixed and comprise sample 4.
18/08/2008	654910.4	Rocky Creek confluence with main Totara Lagoon channel - bottom sample. Water at this point within main lagoon channel flows NE to SW at low tide and reverses as tide rises. Possibly some saltwater influence.	NZMS 260 J33 E23349 N58167	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 3, bottom layers were mixed and comprise sample 4.
18/08/2008	654910.5	Mirror Creek - top sample. Normally slow flows at this point upstream of entry into lake.	E2338110 N5820040	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 5, bottom layers were mixed and comprise sample 6.
18/08/2008	654910.6	Mirror Creek - bottom sample. Normally slow flows at this point upstream of entry into lake.	NZMS 260 J33 E23381 N58200	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 5, bottom layers were mixed and comprise sample 6.
20/08/2008	654910.7	Gows Creek - top sample. Slow flowing creek upstream of entry into main Totara Lagoon channel. Some tidal and possibly some saltwater influence.	E2333211 N5814186	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 7, bottom layers were mixed and comprise sample 8.
20/08/2008	654910.8	Gows Creek - bottom sample. Slow flowing creek upstream of entry into main Totara Lagoon channel. Some tidal and possibly some saltwater influence.	NZMS 260 J33 E2333211 N5814186	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 7, bottom layers were mixed and comprise sample 8.
20/08/2008	654910.9	Ruatapu drain - top sample. Drain containing black water, flowing from Ruatapu sawmill into wetland bordering Totara Lagoon. Sample taken from drain outlet into wetland.	E2336760 N5819305	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 9, bottom layers were mixed and comprise sample 10.
20/08/2008	654910.10	Ruatapu drain bottom. Drain containing black water, flowing from Ruatapu sawmill into wetland bordering Totara Lagoon. Sample taken from drain outlet into wetland.	E2336760 N5819305	Sediment sample sent to Hills laboratories 21/08/08 to determine PCP and other phenol levels. Three approx. 200mm depth cores were sampled per site, each core was divided into top and bottom layers, top layers were mixed and comprise sample 9, bottom layers were mixed and comprise sample 10.

7.5 Laboratory sample sheets for PCP testing of eel bile and aquatic sediment

AsureQuality

10 Quadrant Drive, Gracefield
P.O. Box 31 242, Lower Hutt
Wellington, New Zealand

T 64 4 5708600
F 64 4 5708176
W www.asurequality.com

Certificate of Analysis

Date Issued:	13 May 2009
Client:	West Coast Regional Council P O Box 66 Greymouth
Attention:	Jonny Horrox
Date Received:	29 Apr 2009
AsureQuality Lab. Reference:	55652
Sample Type(s):	Soil
Analysis:	**Chlorophenols (CPs)**
Method:	Based on USEPA Methodology (Isotope Dilution)

Results are reported in nanograms per gram (ng/g), equivalent to ppb, on an a dry weight basis to two significant figures. The DL value is reported to one significant figure. Results have been corrected for recoveries.

Unless requested, original samples will be disposed of eight weeks from the date of this report.

Comments:

Phil Bridgen
Team Leader - Dioxins
AsureQuality Limited

ilac-MRA

laboratory

Amended Report 358920
Cancels Report 358836

THIS REPORT MUST ONLY BE REPRODUCED IN ITS ENTIRETY

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ASUREQUALITY LIMITED. INDEPENDENT QUALITY ASSURANCE.

Results: Pentachlorophenol

Laboratory Reference: **55652-1**

Sample Identification: **Totara North Composite**

Date Received: 29 Apr 2009 Date Analysed: 07 May 2009

Date Extracted: 06 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.12					
PCP	0.56			111	25 - 150	

	Minimum	Maximum	Units
Total	0.685	0.685	ng/g

† = Results are reported on a dry weight basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CH Data Analyst: JM Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55652-2**

Sample Identification: **Totara Mid Composite**

Date Received: 29 Apr 2009 Date Analysed: 07 May 2009

Date Extracted: 06 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.17					
PCP	0.95			83	25 - 150	

	Minimum	Maximum	Units
Total	1.12	1.12	ng/g

† = Results are reported on a dry weight basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CH Data Analyst: JM Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: 55652-3

Sample Identification: Totara South Composite

Date Received: 29 Apr 2009 **Date Analysed:** 07 May 2009

Date Extracted: 06 May 2009

Analyte	†Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.15					
PCP	0.94			65	25 - 150	

	Minimum	Maximum	Units
Total	1.10	1.10	ng/g

† = Results are reported on a dry weight basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CH **Data Analyst:** JM **Authorised:** Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: 55652-4

Sample Identification: Bittern ck @ L Mahinapua

Date Received: 29 Apr 2009 **Date Analysed:** 07 May 2009

Date Extracted: 06 May 2009

Analyte	†Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.39					
PCP	2.5			94	25 - 150	

	Minimum	Maximum	Units
Total	2.90	2.90	ng/g

† = Results are reported on a dry weight basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CH **Data Analyst:** JM **Authorised:** Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55652/BLANK-A**

Sample Identification: **Laboratory Blank A - applies to samples 1 - 4**

Date Received: Not applicable
Date Extracted: 06 May 2009
Date Analysed: 07 May 2009

Analyte	Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.037					
PCP	0.16			111	25 - 150	

	Minimum	Maximum	Units
Total	0.192	0.192	ng/g

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CH Data Analyst: JM Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55652-5**

Sample Identification: **Ruatapu Dredge Pond**

Date Received: 29 Apr 2009
Date Extracted: 07 May 2009
Date Analysed: 12 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	160					
PCP	1300			95	25 - 150	

	Minimum	Maximum	Units
Total	1430	1430	ng/g

† = Results are reported on a dry weight basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: JM Data Analyst: JM Authorised: Phil Bridgen

13 May 2009

Results: Pentachlorophenol

Laboratory Reference: 55652/BLANK-C

Sample Identification: Laboratory Blank C - applies to sample 5

Date Received: Not applicable — Date Analysed: 12 May 2009

Date Extracted: 07 May 2009

Analyte	Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.059					
PCP	0.29			84	25 - 150	

	Minimum	Maximum	Units
Total	0.347	0.347	ng/g

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: JM Data Analyst: JM Authorised: Phil Bridgen

AsureQuality
1C Quadrant Drive, Gracefield
P.O. Box 31 242, Lower Hutt
Wellington, New Zealand
T 64 4 5708800
F 64 4 5708176
W www.asurequality.com

Certificate of Analysis

Date Issued:	12 May 2009
Client:	West Coast Regional Council P O Box 66 Greymouth
Attention:	Jonny Horrox
Date Received:	29 Apr 2009
AsureQuality Lab. Reference:	55648
Sample Type(s):	Eel Bile
Analysis:	**Chlorophenols (CPs)**
Method:	Based on USEPA Methodology (Isotope Dilution)

Results are reported in nanograms per gram (ng/g), equivalent to ppb, on an as received basis to two significant figures. The DL value is reported to one significant figure. Results have been corrected for recoveries.

Unless requested, original samples will be disposed of eight weeks from the date of this report.

Comments:

Phil Bridgen
Team Leader - Dioxins
AsureQuality Limited

Results: Pentachlorophenol

Laboratory Reference: **55648-1**

Sample Identification: **13/3/09 Totara Lagoon North (3 eels)**

Date Received: 29 Apr 2009 Date Analysed: 08 May 2009

Date Extracted: 07 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	1.00					
PCP	1.9			99	25 - 150	

	Minimum	Maximum	Units
Total	2.92	2.92	ng/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit

EMPC: Estimated Maximum Possible Concentration

%RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: TG Data Analyst: PB Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55648-2**

Sample Identification: **13/3/09 Totara Lagoon Middle (4 eels)**

Date Received: 29 Apr 2009 Date Analysed: 08 May 2009

Date Extracted: 07 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.66					
PCP	2.7			97	25 - 150	

	Minimum	Maximum	Units
Total	3.40	3.40	ng/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit

EMPC: Estimated Maximum Possible Concentration

%RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: TG Data Analyst: PB Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55648-3**

Sample Identification: **13/3/09 Totara Lagoon South (4 eels)**

Date Received: 29 Apr 2009 Date Analysed: 08 May 2009

Date Extracted: 07 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	0.72					
PCP	1.4			98	25 - 150	

	Minimum	Maximum	Units
Total	2.16	2.16	ng/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: TG Data Analyst: PB Authorised: Phil Bridgen

Results: Pentachlorophenol

Laboratory Reference: **55648 BLANK**

Sample Identification: **Laboratory Blank**

Date Received: Not applicable Date Analysed: 08 May 2009

Date Extracted: 07 May 2009

Analyte	Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	ND	0.01				
PCP	0.12			99	25 - 150	

	Minimum	Maximum	Units
Total	0.116	0.131	ng/g

ND = Not Detected

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
%RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: TG Data Analyst: PB Authorised: Phil Bridgen

13 May 2009

Results: Pentachlorophenol

Laboratory Reference: **55652-6**

Sample Identification: **Bittern ck @ L Mahinapua**

Date Received: 29 Apr 2009 Date Analysed: 08 May 2009

Date Extracted: 08 May 2009

Analyte	Conc.† (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	1.4					
PCP	12			97	25 - 150	

	Minimum	Maximum	Units
Total	13.2	13.2	ng/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit

EMPC: Estimated Maximum Possible Concentration

%RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CF Data Analyst: PB Authorised: Phil Bridgen

13 May 2009

Results: Pentachlorophenol

Laboratory Reference: **55652/BLANK-B**

Sample Identification: **Laboratory Blank B - applies to sample 6**

Date Received: Not applicable Date Analysed: 08 May 2009

Date Extracted: 08 May 2009

Analyte	Conc. (ng/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2346-TeCP	ND	0.01				
PCP	0.12			99	25 - 150	

	Minimum	Maximum	Units
Total	0.116	0.131	ng/g

ND = Not Detected

DL: Sample Specific Estimated Detection Limit

EMPC: Estimated Maximum Possible Concentration

%RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

Lab Analyst: CF Data Analyst: PB Authorised: Phil Bridgen

7.6 Laboratory sample sheets for Dioxin testing of eel flesh

AsureQuality
10 Quadrant Drive, Gracefield
P.O. Box 31 242, Lower Hutt
Wellington, New Zealand
T 64 4 5703000
F 64 4 5703176
W www.asurequality.com

Certificate of Analysis

Date Issued: 03 Jul 2009

Client: West Coast Regional Council
P O Box 66
Greymouth

Attention: Jonny Horrox

Date Received: 16 Jun 2009

AsureQuality Lab. Reference: 57612

Sample Type(s): Eel

Analysis: **Lipid determination**

Method:
The lipid content was determined by evaporating the sample extract to constant weight. The residue was determined gravimetrically on a calibrated balance. The lipid content is expressed as a percentage (% w/w) of the total sample to three significant figures.

Unless requested, original samples will be disposed of eight weeks from the date of this report.

Comments:

Phil Bridgen
Team Leader - Dioxins
AsureQuality Limited

03 July 2009

Results: Lipid determination

Date Received: 29 Apr 2009 Date Analysed: 01 Jul 2009

Laboratory Reference	Sample Identification	Lipid content (%) †
57612-1	Bittern ck @ L Mahinapua - Eel Flesh	7.49
57612-2	13/3/09 Totara Lagoon Middle (4 eels) - Eel Flesh	2.22
57612-3	13/3/09 Totara Lagoon South (4 eels) - Eel Flesh	2.79

† = Results are reported on a lipid weight basis

Lab Analyst: JZ Data Analyst: JZ Authorised: Phil Bridgen

AsureQuality
10 Quadrant Drive, Gracefield
P.O. Box 31 242, Lower Hutt
Wellington, New Zealand
T 64 4 5708300
F 64 4 5708176
W www.asurequality.com

Certificate of Analysis

Date Issued: 03 Jul 2009

Client: West Coast Regional Council
P O Box 66
Greymouth

Attention: Jonny Horrox

Date Received: 16 Jun 2009

AsureQuality Lab. Reference: 57612

Sample Type(s): Eel

Analysis: **Polychlorinated dibenzo-p-dioxins (PCDDs)**
Polychlorinated dibenzofurans (PCDFs)

Method: Based on USEPA Method 1613B (Isotope Dilution)

Results are reported in picograms per gram (pg/g), equivalent to ppt, on an as received basis to three significant figures. The DL value is reported to three significant figures. Results have been corrected for recoveries. The sum of PCDDs and PCDFs is calculated and reported to three significant figures as a lower, medium, and upper bound.

The total toxic equivalence (TEQ) was calculated for each sample using both WHO toxic equivalency factors (WHO-TEFs; Van den Berg et al., 2005) and international toxic equivalency factors (I-TEFs; Kutz et al., 1990). The total WHO-TEQ and I-TEQ level is reported as a lower, medium, and upper bound to three significant figures.

Unless requested, original samples will be disposed of eight weeks from the date of this report.

Comments:

Phil Bridgen
Team Leader - Dioxins
AsureQuality Limited

Results: USEPA Method 1613B

Laboratory Reference: 57612-1

Sample Identification: **Bittern ck @ L Mahinapua - Eel Flesh**

Date Received: 29 Apr 2009 Date Analysed U2: 01 Jul 2009
Date Extracted: 25 Jun 2009 Date Analysed SP2331: 02 Jul 2009

Analyte	Conc.+ (pg/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2378 TCDF	ND	0.0882		103	24 - 169	
Total TCDF	0.568					
2378 TCDD	ND	0.100		101	25 - 164	
Total TCDD	0.101					
37Cl4 TCDD				95	35 - 197	
12378 PeCDF	ND	0.0564		100	24 - 185	
23478 PeCDF			0.0573	102	21 - 178	
Total PeCDF			0.0573			
12378 PeCDD	ND	0.0654		99	25 - 181	
Total PeCDD	ND	0.0654				
123478 HxCDF	ND	0.0613		114	26 - 152	
123678 HxCDF	ND	0.0628		114	26 - 123	
234678 HxCDF	ND	0.0611		116	28 - 136	
123789 HxCDF	ND	0.0849		108	29 - 147	
Total HxCDF	ND	0.0849				
123478 HxCDD	ND	0.116		107	32 - 141	
123678 HxCDD	ND	0.123		110	28 - 130	
123789 HxCDD	ND	0.121				
Total HxCDD	ND	0.123				
1234678 HpCDF	ND	0.0662		110	28 - 143	
1234789 HpCDF	ND	0.110		90	26 - 138	
Total HpCDF	ND	0.110				
1234678 HpCDD	0.0677			108	23 - 140	
Total HpCDD	0.0677					
OCDF	ND	0.114				
OCDD	0.269			85	17 - 157	

	Lower Bound	Medium Bound	Upper Bound	Units
Sum of congeners:	1.06	1.31	1.56	pg/g
Total I-TEQ:	0.0295	0.134	0.239	pg/g
Total WHO-TEQ:	0.0179	0.138	0.259	pg/g

+ = Results are reported on an as received basis
ND = Not Detected
DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
^{13}C %RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit
$^{37}Cl_4$TCDD: Clean-up recovery spike

Lab Analyst: ML Data Analyst: JZ Authorised: Phil Bridgen

Results: USEPA Method 1613B

Laboratory Reference: 57612-2

Sample Identification: **13/3/09 Totara Lagoon Middle (4 eels) - Eel Flesh**

Date Received: 29 Apr 2009 Date Analysed U2: 01 Jul 2009

Date Extracted: 25 Jun 2009 Date Analysed SP2331: 02 Jul 2009

Analyte	Conc.† (pg/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2378 TCDF	ND	0.125		104	24 - 169	
Total TCDF	0.462					
2378 TCDD	ND	0.116		96	25 - 164	
Total TCDD	0.123					
37Cl4 TCDD				95	35 - 197	
12378 PeCDF	ND	0.0750		100	24 - 185	
23478 PeCDF	ND	0.0732		102	21 - 178	
Total PeCDF	ND	0.0750				
12378 PeCDD	ND	0.114		100	25 - 181	
Total PeCDD	ND	0.114				
123478 HxCDF	ND	0.0983		117	26 - 152	
123678 HxCDF	ND	0.0974		114	26 - 123	
234678 HxCDF	ND	0.0990		121	28 - 136	
123789 HxCDF	ND	0.137		108	29 - 147	
Total HxCDF	ND	0.137				
123478 HxCDD	ND	0.148		112	32 - 141	
123678 HxCDD	ND	0.152		107	28 - 130	
123789 HxCDD	ND	0.155				
Total HxCDD	ND	0.155				
1234678 HpCDF	ND	0.0878		110	28 - 143	
1234789 HpCDF	ND	0.153		86	26 - 138	
Total HpCDF	ND	0.153				
1234678 HpCDD			0.0817	109	23 - 140	
Total HpCDD			0.0817			
OCDF	ND	0.116				
OCDD			0.329	85	17 - 157	

	Lower Bound	Medium Bound	Upper Bound	Units
Sum of congeners:	0.996	1.37	1.75	pg/g
Total I-TEQ:	0.00115	0.160	0.318	pg/g
Total WHO-TEQ:	0.000916	0.180	0.359	pg/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit

ND = Not Detected

EMPC: Estimated Maximum Possible Concentration

^{13}C %RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

$^{37}Cl_4$TCDD: Clean-up recovery spike

Lab Analyst: ML Data Analyst: JZ Authorised: Phil Bridgen

Results: USEPA Method 1613B

Laboratory Reference: 57612-3

Sample Identification: **13/3/09 Totara Lagoon South (4 eels) - Eel Flesh**

Date Received: 29 Apr 2009 Date Analysed U2: 01 Jul 2009

Date Extracted: 25 Jun 2009 Date Analysed SP2331: 02 Jul 2009

Analyte	Conc.† (pg/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2378 TCDF	ND	0.119		121	24 - 169	
Total TCDF	0.153					
2378 TCDD	ND	0.147		111	25 - 164	
Total TCDD	ND	0.147				
37Cl4 TCDD				109	35 - 197	
12378 PeCDF	ND	0.0634		108	24 - 185	
23478 PeCDF	ND	0.0646		106	21 - 178	
Total PeCDF	0.0667					
12378 PeCDD	ND	0.0754		102	25 - 181	
Total PeCDD	ND	0.0754				
123478 HxCDF	ND	0.0606		120	26 - 152	
123678 HxCDF	ND	0.0634		115	26 - 123	
234678 HxCDF	ND	0.0625		121	28 - 136	
123789 HxCDF	ND	0.0853		109	29 - 147	
Total HxCDF	ND	0.0853				
123478 HxCDD	ND	0.149		112	32 - 141	
123678 HxCDD	ND	0.157		110	28 - 130	
123789 HxCDD	ND	0.156				
Total HxCDD	ND	0.157				
1234678 HpCDF	ND	0.0817		112	28 - 143	
1234789 HpCDF	ND	0.142		85	26 - 138	
Total HpCDF	ND	0.142				
1234678 HpCDD			0.0631	108	23 - 140	
Total HpCDD			0.0631			
OCDF	ND	0.104				
OCDD	0.251			84	17 - 157	

	Lower Bound	Medium Bound	Upper Bound	Units
Sum of congeners:	0.534	0.889	1.24	pg/g
Total I-TEQ:	0.000882	0.155	0.309	pg/g
Total WHO-TEQ:	0.000706	0.166	0.332	pg/g

† = Results are reported on an as received basis

DL: Sample Specific Estimated Detection Limit

ND = Not Detected

EMPC: Estimated Maximum Possible Concentration

^{13}C %RE: Labelled Compound Recovery

LCL-UCL: Lower Control Limit - Upper Control Limit

$^{37}Cl_4$TCDD: Clean-up recovery spike

Lab Analyst: ML Data Analyst: JZ Authorised: Phil Bridgen

Results: USEPA Method 1613B

Laboratory Reference: 57612 BLANK

Sample Identification: Laboratory Blank

Date Received: Not applicable
Date Extracted: 25 Jun 2009
Date Analysed U2: 01 Jul 2009
Date Analysed SP2331: 02 Jul 2009

Analyte	Conc.† (pg/g)	DL	EMPC	^{13}C%RE	LCL-UCL	Qualifiers
2378 TCDF	ND	0.160		111	24 - 169	
Total TCDF	0.993					
2378 TCDD	ND	0.155		100	25 - 164	
Total TCDD	ND	0.155				
37Cl4 TCDD				92	35 - 197	
12378 PeCDF	ND	0.0530		104	24 - 185	
23478 PeCDF	ND	0.0558		98	21 - 178	
Total PeCDF	0.135					
12378 PeCDD	ND	0.0707		96	25 - 181	
Total PeCDD	ND	0.0707				
123478 HxCDF	ND	0.0548		105	26 - 152	
123678 HxCDF	ND	0.0554		110	26 - 123	
234678 HxCDF	ND	0.0541		109	28 - 136	
123789 HxCDF	ND	0.0806		95	29 - 147	
Total HxCDF	ND	0.0806				
123478 HxCDD	ND	0.111		106	32 - 141	
123678 HxCDD	ND	0.115		111	28 - 130	
123789 HxCDD	ND	0.116				
Total HxCDD	ND	0.116				
1234678 HpCDF	ND	0.0954		101	28 - 143	
1234789 HpCDF	ND	0.155		80	26 - 138	
Total HpCDF	ND	0.155				
1234678 HpCDD			0.0516	105	23 - 140	
Total HpCDD			0.0516			
OCDF	ND	0.135				
OCDD	0.149			81	17 - 157	

	Lower Bound	Medium Bound	Upper Bound	Units
Sum of congeners:	1.33	1.68	2.04	pg/g
Total I-TEQ:	0.000665	0.150	0.299	pg/g
Total WHO-TEQ:	0.000561	0.161	0.322	pg/g

† = Results are calculated using the average weight of samples in this batch

ND = Not Detected

DL: Sample Specific Estimated Detection Limit
EMPC: Estimated Maximum Possible Concentration
^{13}C %RE: Labelled Compound Recovery
LCL-UCL: Lower Control Limit - Upper Control Limit
$^{37}Cl_4$TCDD: Clean-up recovery spike

Lab Analyst: ML Data Analyst: JZ Authorised: Phil Bridgen

7.7 Laboratory sample sheets: Sediment testing for other parameters

Client: Department of Conservation - Hokiti
Address: Private Bag, Sewell Street
HOKITIKA
Contact: Ron Van Mierlo

Laboratory No: 441737
Date Registered: 13/12/2006
Date Completed: 4/01/2007
Page Number: 1 of 3

Client's Reference: Coastal Lagoon

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Sediment

Sample Name	Rocky Creek 11/12/2006	Stonhouse Creek 11/12/2006
Lab No	441737/1	441737/2
Dry Matter (g/100g as rcvd)	61.1	62.5
Total Nitrogen (g/100g dry wt)	0.25	0.11
Total Recoverable Phosphorus (mg/kg dry wt)	703	811
Total Recoverable Boron (mg/kg dry wt)	< 20	< 20
Total Cyanide (mg/kg dry wt)	< 0.1	< 0.1
Total Recoverable Iron (mg/kg dry wt)	18900	30200
Total Recoverable Arsenic (mg/kg dry wt)	3.2	6.8
Total Recoverable Cadmium (mg/kg dry wt)	0.05	0.02
Total Recoverable Chromium (mg/kg dry wt)	14.7	21.3
Total Recoverable Copper (mg/kg dry wt)	8.6	16.2
Total Recoverable Mercury (mg/kg dry wt)	0.03	0.03
Total Recoverable Nickel (mg/kg dry wt)	10.8	18.1
Total Recoverable Lead (mg/kg dry wt)	8.85	14.2
Total Recoverable Zinc (mg/kg dry wt)	37.3	59.1

Pentachlorophenol in solids, screening by GC-ECD

Sample Name	Rocky Creek 11/12/2006	Stonhouse Creek 11/12/2006
Lab No	441737/1	441737/2
Units	(mg/kg dry wt)	(mg/kg dry wt)
Pentachlorophenol	0.97	0.09
Tetrachlorophenol	< 0.05	< 0.05

Organochlorine pesticides

Sample Name	Rocky Creek 11/12/2006	Stonhouse Creek 11/12/2006
Lab No	441737/1	441737/2
Units	(mg/kg dry wt)	(mg/kg dry wt)
Hexachlorobenzene	< 0.0005	< 0.0005
Alpha-BHC	< 0.0005	< 0.0005
Beta-BHC	< 0.0005	< 0.0005
Gamma-BHC (Lindane)	< 0.0005	< 0.0005
Delta-BHC	< 0.0005	< 0.0005
Heptachlor	< 0.0005	< 0.0005
Heptachlor epoxide	< 0.0005	< 0.0005
Aldrin	< 0.0005	< 0.0005
Dieldrin	< 0.0005	< 0.0005
Endrin	< 0.0005	< 0.0005
Endrin Aldehyde	< 0.0005	< 0.0005
Endosulfan I	< 0.0005	< 0.0005
Endosulfan II	< 0.0005	< 0.0005
Endosulfan sulphate	< 0.0005	< 0.0005
2,4'-DDE	< 0.0005	< 0.0005
2,4'-DDD	< 0.0005	< 0.0005
2,4'-DDT	< 0.0005	< 0.0005
4,4'-DDE	< 0.0005	< 0.0005
4,4'-DDD	< 0.0005	< 0.0005
4,4'-DDT	< 0.0005	< 0.0005
Total Chlordane ((cis+trans)*100/42)	< 0.002	< 0.002
cis-Chlordane	< 0.0005	< 0.0005
trans-Chlordane	< 0.0005	< 0.0005
Methoxychlor	< 0.0005	< 0.0005

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)	300	2
Plastic Jar (Soils)	400	2

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
Total Recoverable digest	Nitric / hydrochloric acid digestion. US EPA 200.2	N/A
Dry Matter	Dried at 103°C, gravimetric (removes 3-5% more water than air drying at 35°C)	0.1 g/100g as rcvd
Total Nitrogen	Catalytic Combustion (900°C, O_2), separation, Thermal Conductivity Detector [Elementar Analyser]	0.05 g/100g dry wt

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ANALYSIS REPORT

Client:	Department of Conservation	Lab No:	625431 SPv1
Contact:	Van Mierlo, Ron	Date Registered:	08-Jan-2008
	c/o Department of Conservation	Date Reported:	29-Jan-2008
	Private Bag 701	Quote No:	
	Hokitika	Order No:	
		Client Reference:	Coastal lagoon sediments
		Submitted By:	Van Mierlo, Ron

Sample Type: Sediment

Sample Name:		1 18-Dec-2007 10:00 am	2 18-Dec-2007 1:00 pm	3 18-Dec-2007 2:00 pm	4 21-Dec-2007 9:30 am	
Lab Number:		625431.1	625431.2	625431.3	625431.4	
Acetylated Phenols in Soil by GCMS						
Dry Matter	g/100g as rcvd	59	13	38	47	-
4-Chloro-3-methylphenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
2-Chlorophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
2,4-Dichlorophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
2,6-Dichlorophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
2,4-Dimethylphenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
3-Methylphenol (m-Cresol)	mg/kg dry wt	< 0.028	< 0.12	4.1	< 0.033	-
2-Methylphenol (o-Cresol)	mg/kg dry wt	< 0.028	< 0.12	0.29	< 0.033	-
4-Methylphenol (p-Cresol)	mg/kg dry wt	< 0.028	< 0.12	8.0	0.056	-
2-Nitrophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
Pentachlorophenol (PCP)	mg/kg dry wt	< 0.028	< 0.12	17	< 0.033	-
Phenol	mg/kg dry wt	0.042	0.26	1.0	0.12	-
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	< 0.028	< 0.12	4.8	< 0.033	-
2,4,5-Trichlorophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-
2,4,6-Trichlorophenol	mg/kg dry wt	< 0.028	< 0.12	< 0.042	< 0.033	-

SUMMARY OF METHODS

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

Sample Type: Sediment

Test	Method Description	Default Detection Limit	Samples
Acetylated Phenols in Soil by GCMS*	Sonication extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	-	1-4
Dry Matter (Org)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-4

ANALYSIS REPORT

Client:	Department of Conservation	Lab No:	654910 SPv1
Contact:	Van Mierlo, Ron	Date Registered:	22-Aug-2008
	C/- Department of Conservation	Date Reported:	01-Sep-2008
	Private Bag 701	Quote No:	33573
	Hokitika	Order No:	
		Client Reference:	Totara Lagoon
		Submitted By:	Van Mierlo, Ron

Sample Type: Sediment

Sample Name:		North Totara Top 18-Aug-2008 11:33 am	North Totara Bottom 18-Aug-2008 11:33 am	Rocky Creek Top 18-Aug-2008 12:30 pm	Rocky Creek Bottom 18-Aug-2008 12:30 pm	Mirror Creek Top 18-Aug-2008 3:00 pm
Lab Number:		654910.1	654910.2	654910.3	654910.4	654910.5
Individual Tests						
Dry Matter	g/100g as rcvd	34	35	44	52	22
Acetylated Phenols in Soil by GCMS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2-Chlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2,4-Dichlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2,6-Dichlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2,4-Dimethylphenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
3-Methylphenol (m-Cresol)	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2-Methylphenol (o-Cresol)	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
4-Methylphenol (p-Cresol)	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2-Nitrophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
Pentachlorophenol (PCP)	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
Phenol	mg/kg dry wt	0.058	< 0.046	< 0.036	< 0.031	< 0.066
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2,4,5-Trichlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066
2,4,6-Trichlorophenol	mg/kg dry wt	< 0.046	< 0.046	< 0.036	< 0.031	< 0.066

Sample Name:		Mirror Creek Bottom 18-Aug-2008 3:00 pm	Gows Creek Top 20-Aug-2008 12:00 pm	Gows Creek Bottom 20-Aug-2008 12:00 pm	Ruatapu Drain Top 20-Aug-2008 3:00 pm	Ruatapu Drain Bottom 20-Aug-2008 3:00 pm
Lab Number:		654910.6	654910.7	654910.8	654910.9	654910.10
Individual Tests						
Dry Matter	g/100g as rcvd	20	29	48	23	77
Acetylated Phenols in Soil by GCMS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2-Chlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2,4-Dichlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2,6-Dichlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2,4-Dimethylphenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
3-Methylphenol (m-Cresol)	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2-Methylphenol (o-Cresol)	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
4-Methylphenol (p-Cresol)	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2-Nitrophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
Pentachlorophenol (PCP)	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
Phenol	mg/kg dry wt	< 0.080	< 0.055	0.043	< 0.071	< 0.020
2,3,4,6-Tetrachlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020

Sample Type: Sediment						
Sample Name:		Mirror Creek Bottom 18-Aug-2008 3:00 pm	Gows Creek Top 20-Aug-2008 12:00 pm	Gows Creek Bottom 20-Aug-2008 12:00 pm	Ruatapu Drain Top 20-Aug-2008 3:00 pm	Ruatapu Drain Bottom 20-Aug-2008 3:00 pm
Lab Number:		654910.6	654910.7	654910.8	654910.9	654910.10
Acetylated Phenols in Soil by GCMS						
2,4,5-Trichlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020
2,4,6-Trichlorophenol	mg/kg dry wt	< 0.080	< 0.055	< 0.034	< 0.071	< 0.020

SUMMARY OF METHODS

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

Sample Type: Sediment			
Test	Method Description	Default Detection Limit	Samples
Acetylated Phenols in Soil by GCMS	Sonication extraction, GPC cleanup (if required), acetylation, GC-MS SIM analysis	-	1-10
Dry Matter (Env)	Dried at 103°C (removes 3-5% more water than air dry), gravimetry.	0.10 g/100g as rcvd	1-10

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

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

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

Client: West Coast Regional Council
Address: P O Box 66, GREYMOUTH
Contact: Jonny Horrox

Laboratory No: 462484
Date Registered: 31/08/2007
Date Completed: 10/09/2007
Page Number: 1 of 2

Client's Reference: Ruatapu Drain

The results for the analyses you requested are as follows:

Sample Type: Environmental Solids, Sediment

Pentachlorophenol in solids, screening by GC-ECD

Sample Name	Ruatapu Drain # 1 Lower 23/08/07 14:00	Ruatapu Drain # 1 u/s Top Rep 1 23/08/07 15:50
Lab No	462484/1	462484/2
Units	(mg/kg dry wt)	(mg/kg dry wt)
Pentachlorophenol	< 0.05	< 0.05
Tetrachlorophenol	< 0.05	< 0.05

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)	300	2

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
Pentachlorophenol in solids, screening by GC-ECD	Acetone/hexane extraction, GC-ECD analysis In-House	N/A